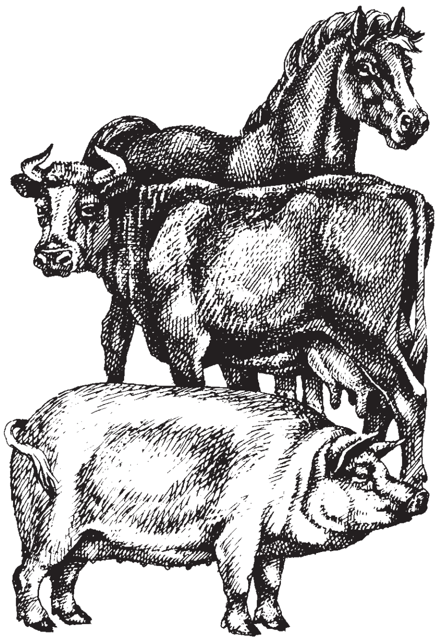
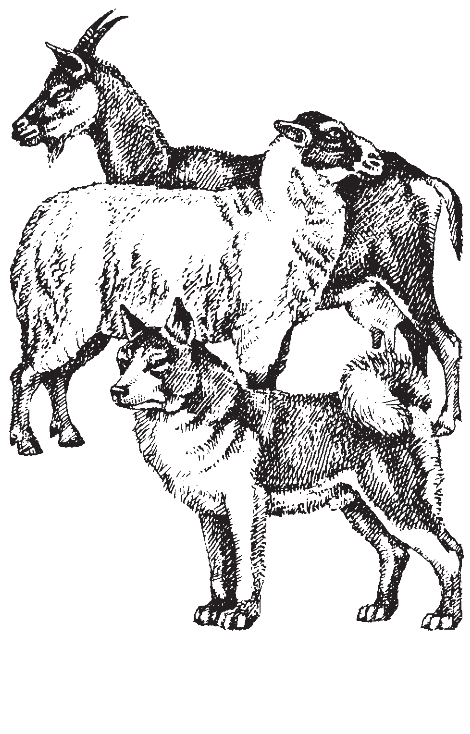
ARCHAEOLOGIA BALTICA 12

Edited by Algirdas Girininkas

Klaipėda University Press





ISSN 1392-5520

KLAIPĖDA UNIVERSITY

INSTITUTE OF BALTIC SEA REGION

HISTORY AND ARCHAEOLOGY

LITHUANIAN INSTITUTE OF HISTORY

ARCHAEOLOGIA BALTICA 12

Edited by Algirdas Girininkas

Klaipėda, 2009

UDK 902/904
Ar 46

Archaeologia Baltica is on EBSCO's Current Abstracts and TOC Premier Database Coverage List since 2007

Articles appearing in this journal are peer-reviewed by either internal or external reviewers.

Archaeologia Baltica volume 12 was prepared by Klaipėda University Institute of Baltic Sea Region History and Archaeology

Lithuanian language editor: Roma Nikžentaitienė
Design: Algis Kliševičius
Layout by: Lolita Zemlienė

Cover illustration: A brooch from Laiviai (Kretinga district)

ISSN 1392-5520

CONTENTS

Preface 6

FOOD AND AGRICULTURE

Indre Antanaitis-Jacobs, Mike Richards, Linas Daugnora, Rimantas Jankauskas, Nives Ogrinc.
Diet in early Lithuanian prehistory
and the new stable isotope evidence 12

Marie-Lorraine Pipes, Janusz Kruk, Danuta Makowicz-Poliszot, Šarunas Milisauskas.
Funnel Beaker animal husbandry at Bronocice 31

Linas Daugnora, Algirdas Girininkas
Butchery in the Early Bronze Age (Kretuonas 1C settlement data) 46

Anna Arnberg. To Make a Mark on Land. Fossil fields system
and the social implication of agriculture during
the Pre-Roman Iron Age on Gotland, Sweden 57

Vladas Žulkus, Linas Daugnora.
What did the Order's brothers eat in the Klaipėda castle?
(The Historical and zooarchaeological data) 74

Žydrūnė Miliauskienė, Rimantas Jankauskas. Dental wear patterns
in Lithuanian and Latvian paleoanthropological samples 88

Ieva Masiulienė.
16th–17th cen. Klaipėda town residents' lifestyle
(by archaeological, palaeobotanical, and
zooarchaeological data of Kurpių street plots) 95

Vita Rudovica, Arturs Viksna, Gunita Zariņa, Ilze Melne.
An insight into the bioarchaeology
of the medieval inhabitants of Veselava 112

NEW RESEARCH WORKS IN THE EAST BALTIC REGION

Florin Curta. A note on the "Slavic" bow fibulae of Werner's class I J 124

REVIEWS

Audronė Bliujienė. The Livs – neighbours of the northern Balts.
Notes on the margin of Roberts Spirĝis monograph
"*Bruņrupuču saktas ar krūšu važiņrotām un lībiešu kultūras attīstība Dauguvas lejtecē 10.–13. gadsimtā*", Rīga, 2008 137

Guidelines for Authors 141

Plates (I–IV)

PREFACE

This twelfth volume of Archaeologica Baltica is devote to an examines the role of food and diet in prehistory by examining the interrelationships of food, paleoanthropology, biology, archaeology and ecology. The production and consumption of food can tell us much about how different cultures constructed and perceived their environment. In this volume different authors analyzing how archaeological evidence can be used in reconstruction diet in prehistory and early history time.

In their article "Diet in early Lithuanian prehistory and the new stable isotope" Indre Antanaitis-Jacobs, Mike Richards, Linas Daugnora, Rimantas Jankauskas and Nives Ogrinc research food resources exploited in the Lithuanian Stone and Bronze Ages and presents the new direct, biochemical stable isotope evidence. Stable carbon and nitrogen isotope analyses were performed on 75 Stone and Bronze Age animal bone samples and 23 human bone samples. In this article authors discuss how the obtained values relate to diet and other evidence of diet, compare the obtained values with regional stable isotope data, and consider sociocultural implications.

In their article Marie-Lorraine Pipes, Janusz Kruk, Danuta Makowicz-Poliszot and Šarūnas Milišauskas describes the economic subsistence practices of the Funnel Beaker occupation at Bronocice, southeastern Poland (Małopolska) were examined through the analysis of a large faunal assemblage recovered from three distinct phases, 1, 3, and 4 (3800-3100 BC). The results of the analysis revealed several trends that reflected long-term cultural traditions. Even so, the analysis also found indications of modifications in livestock management practices over time that were probably influenced by increasing population density, social complexity and specialization both within the village as well as without, and by the physical requirements of increasing numbers of livestock. This article examines some of the broader observed trends and changes, and considers potential social and physical factors that might have been involved. It also compares the data with other faunal assemblages from sites in southeastern Poland and offers explanations for apparent differences.

The analysis also considered the overall range of body parts represented for domesticated species and observed a disparity with regard to pig remains. Whereas cattle and sheep were generally indicated by a wide range of skeletal elements and body parts, pig were not. The minimum number of pigs determined for each phase was great when compared to the actual number of skeletal elements recovered. Therefore it seems that pigs may have been butchered outside of the village and brought in as meat, especially during the first two phases. Age at death profiles support this conclusion as there are almost no juveniles represented overall. During Phase 4 there was a marked increase in the presence of juvenile pigs suggesting that by this time pigs were being reared in the settlement.

The interpretation of shifting trends and patterns over time focused on mainly on social explanations but also on the physical requirements of both animals and people. The two are linked and as such when considered together may in fact serve to expose necessary relationships between groups of people. Physical requirements such as pasturage, fodder, control over movement and breeding involve the cooperation and interaction of groups of people. Access and acquisition to animal resources may also have entailed interactions between groups. The data suggest that hunting may not be the only viable explanation for the presence of wild mammal remains at Bronocice.

Human food sources, the development of diet, butchery, the peculiarities of food preparation and its conservation still are little researched themes in East Baltic prehistory. In their article „Butchery in the Early Bronze Age (by Kretuonas 1C settlement data)" Linas Daugnora, Algirdas Girininkas analyse the butchering technology of the Early Bronze Age based on Kretuonas 1C's osteological material.

Analysis of the osteological and archaeological material discovered at the Early Bronze Age settlement of Kretuonas 1C suggests that the settlement's hunted game and reared animals were slaughtered within the settlement, not far from the dwellings. Butchering techniques and skeletal bone, antlers, bone fragments of both wild and domestic animals were found in this location showed that among the most hunted animals were elk, red deer, auroch, boar, marten, while pig, sheep, goat and cattle – among domestic animals. The tools used for butchering and the macroscopic analysis of the slaughtered artiodactyls' axial skeleton and long bones enabled an assessment of split bone in the butchering area, as well as of chop and cut marks acquired during the butchering process.

In her article "To Make a Mark on Land. Fossil fields systems and the social implication of agriculture during the Pre-Roman Iron Age on Gotland, Sweden" Anna Arnberg discusses in detail agriculture process in Gotland. The paper therefore starts with a presentation of the surveys and excavations carried out mainly by the Department of Human Geography at Stockholm University and Valter Lang and his colleagues in Estonia, and the results of these projects. As a complement to these research projects, A. Arnberg turns to questions regarding the social consequences of agriculture. She mainly interested in why people chose to maintain this kind of agricultural practice for a thousand years or more. Why did people continue to cultivate their fields in a manner which they knew from experience would deprive the fields of their fertility? What values, apart from the strictly nutritional, did cultivation and its material effects offer people in the pre-Roman Iron Age?

The field systems, as they are visible today in Gotland, according to the author, are the result of a process in time. The procedure stayed more or less the same for up to a thousand years or longer. As a consequence, cultivation was not the concern of one generation solely, but an act that linked generations together. The older members of society passed the tradition on to the younger members while working side by side with them. Hence, knowledge has in this context as much to do with conversations and with people's bodily engagements with the world, as with abstract thought. The knowledge, completed in the progression of agricultural techniques, acquired physical form by repeatedly being handed down to the next generation. In the field systems the acts carried out were materialized, acts that over the centuries involved a great number of people.

Because the ard depleted the soil of the plot, areas formerly used for cultivation were eventually transformed into infertile land. According to the A. Arnberg, this kind of agricultural technique could best be described as the deterioration of natural resources. But the question is: how did the cultivators perceive their depletion of fertile land? Presumably it was not in such negative terms. For though some steps were taken to prolong the fertility of the plot, which may mean that people found the depletion somewhat problematic, they nevertheless continued to treat the land as they always had done. According to the author, traditions like this one do last, not because people are unable to carry out tasks in other ways, but because traditions offer something to the people maintaining them. The values that agriculture offered people in the pre-Roman Iron Age, besides providing them with food, might partly be explained as involving them in a historically established process. It was a way of maintaining land that as a phenomenon and material expression reached beyond the individual and the individual's lifetime. In other words, this tradition did not just connect people in a contemporary perspective. In the landscape of conjoined plots, relations between people, between present and past, and between people and place attained physical form. Through the continuance of the agrarian techniques, the cultivators were literally woven into these materialized relations, at the same time as these cross-generational connections were preserved. What might be considered, as the deterioration of fertile land, might with these associations instead have been perceived as something attractive and desirable. Perhaps it was these associations that "justified" the waste of productive land.

In their article "What did the Order's brothers eat in the Klaipėda castle? (The historical and zooarchaeological data)" Vladas Žulkus and Linas Daugnora research historical data and zooarchaeological material about Klaipėda castle found during the 1997-1999 archaeological excavations and dated to the 14th-17th centuries.

According to the authors, the analysis of the historical data and zooarchaeological material showed that in the 14th-17th centuries, the inhabitants of the Klaipėda castle (the Order's brothers, their servants, the outwork's artisans, and the townspeople who hid in the outwork) reared and slaughtered domesticated animals, hunted large game and consumed its meat, processed cheese, ground grain, drank mead and ale. The bulk of the meat consisted of beef, mutton, and pork, as well as goats' meat starting 1434. An examination of the species and number of bones of domestic and wild animals in Klaipėda's castle shows that in all of the Klaipėda castle time periods analysed, differences were found between the historical source information and the zooarchaeological collection. Domestic animal bones dominated in the latter, especially that of ruminants (cattle, sheep, goats); pigs comprised the second group according to quantity. The growing quantity of small ruminants (sheep, goats) starting 1434 also is reflected in the zooarchaeological material; from the 16th to 17th centuries, the number of bones of these animals doubled. The amount of riding horses markedly grows in the inventory books starting the middle of the 15th century, and this also is confirmed by zooarchaeological material. When comparing the results of the zooarchaeological material's analysis with the known 14th-16th century inventories of Klaipėda's castle in which there are data regarding the domestic animals (cattle, sheep/ goats, horses, pigs) reared for the castle's needs and the food eaten by the castle's inhabitants, changes are observed in the faunal species and amounts of the zooarchaeological material that post-date 1521, when 31.25% consists of pig (*Sus suis*) bones, while the number of species and bone counts of large wild animals (aurochs/ European bison, elk, red deer) and fur-bearing animals (beaver, bear) grows significantly (from 5.5% to 22.92%). Various kinds of fish caught in the sea near Klaipėda and in the Curonian Lagoon held an important place in the diet of the castle's garrison. Fowl comprised only a small part of the food.

In their article "Dental wear patterns in Lithuanian and Latvian paleoanthropological samples" Žydrūnė Miliauskienė and Rimantas Jankauskas research evaluate dental occlusal wear in four samples, based on different chronology and subsistence: Stone Age, Iron Age, Medieval rural and Medieval nobility. The hypothesis tested was if transition from foraging subsistence to agriculture and later social stratification indeed was reflected by dental wear changes. According to results, the remarkable changes in nutrition patterns in the Baltic region occurred only in the Iron Age, which does not correspond with "classical" Neolithization model. The next substantial change in dental wear patterns, according to the authors, is connected with increased social stratification in Late Medieval period.

In her article „Few Aspects of burgesses nutrition in Klaipėda in 16th – 17th century" Ieva Masiulienė research questions associated with Klaipėda old townspeople food sources. On the basis of the archaeological excavation in the basement of the building at Kurpių street 3, osteological and palynological data author writes that in residential home lived traders – nobility city's residents. According to the author, the analysis of the archaeological data and zooarchaeological material showed that in the 16th-17th centuries, the nobility inhabitants of the Klaipėda reared and slaughtered domesticated animals, birds, drank ale in gardens grew vegetables. Various kinds of nuts, different brews held an important place in the diet of the city's residents.

In their article "An insight into the bioarchaeology of the medieval inhabitants of Veselava" Vita Rudovica, Arturs Viksna, Gunita Zariņa and Ilze Melne research osteological material permitted an insight into the palaeodemography and palaeodiet of the medieval inhabitants of Veselava (Cēsis District, Latvia). Soil samples should be taken from various positions around each skeleton during excavation. Palaeodietary analysis, utilising inductively coupled plasma atomic mass spectrometry (ICP-MS), was undertaken on 40 individuals, determining the concentration of seven elements in the bone. In order to assess the natural background level of these elements, 20 soil analyses were also undertaken.

According to the authors, the elemental content of male and female bone is similar, although the mean level of Zn and Cu in bone is slightly higher for males, which might indicate higher meat consumption. On the other hand, Sr and Mn values are higher for females, indicating a high proportion of plant foods in the diet.

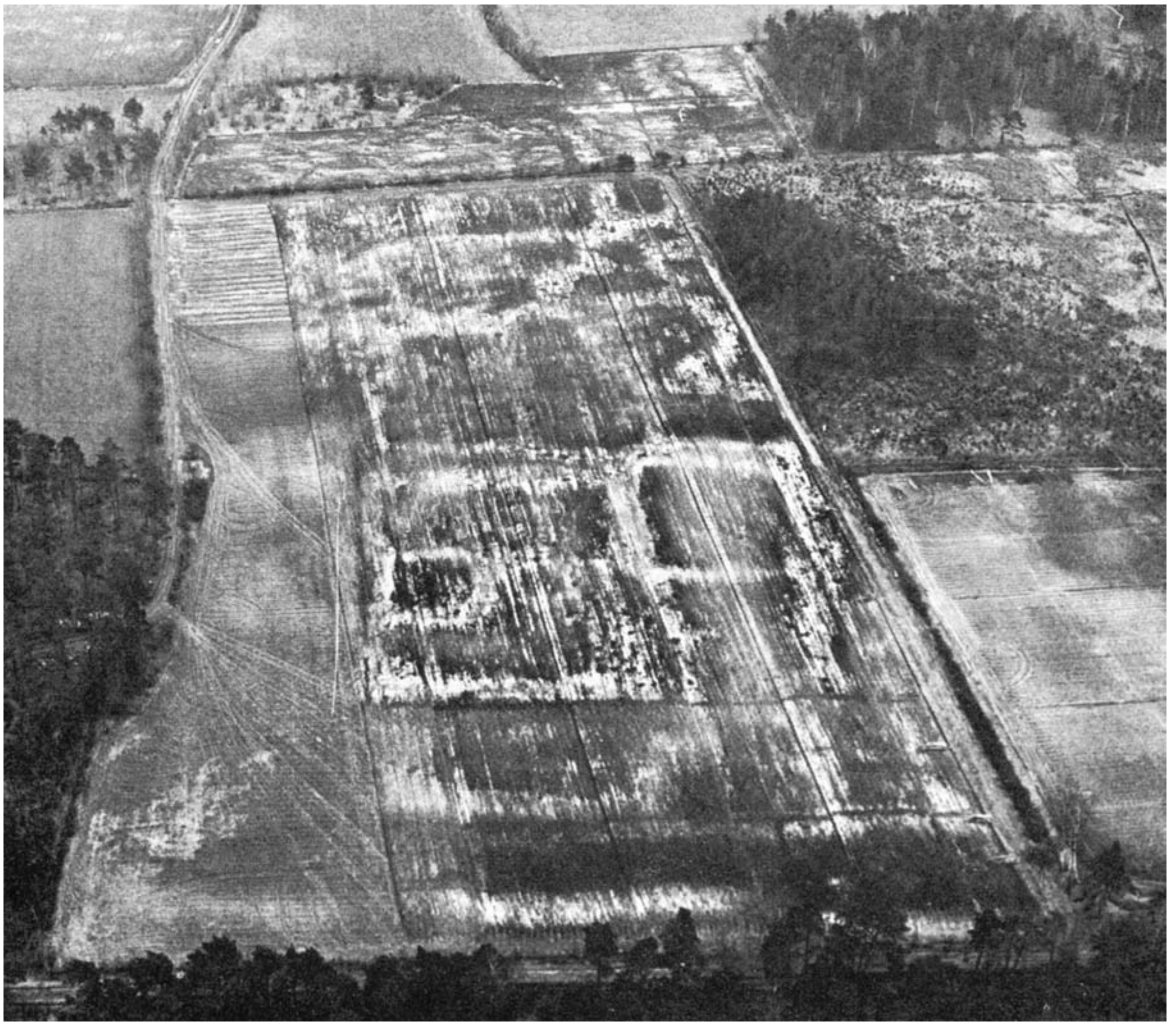
It is thought that the 13th–17th century inhabitants of Veselava often had a meagre diet, and that plant food consumption was higher among women.

In her article "A note on the "Slavic" bow fibulae of Werner's class I J " Florin Curta discusses in detail about bow fibula from Dailidės (Molėtai district in eastern Lithuania) cemetry that can result to the East Lithuanian Barrow Culture. The speciment of the author's classification belong to J. Werner's class I J. In addition to the Dailidės fibula, nine other fibulae are currently known for this class, four of which have been found in the Baltic region. J. Werner called this and other classes of bow fibulae "Slavic," but the evidence does not support his idea of explaining the distribution of such fibulae in Eastern Europe in terms of migration. Nonetheless, fibulae of Werner's class I J found at considerable distance from each other (e.g., Novi Banovci and Kielary) are very similar. However, the Dailidės fibula appears so far to be a unique piece within its own class, in terms of both size and ornamentation. According to author, using proportions and location of the ornament as criteria, fibulae of Werner's class I J do not differ much from brooches of Werner's class I F, for which clear links can be identified to the late fifth- or early sixth-century metalwork in the Lower and Middle Danube region. Given that the two classes have also similar distributions in Eastern Europe, it is quite possible that fibulae of Werner's class I J were imitations of I F fibulae, with a simple linear ornament replacing the scrollwork decoration. On the other hand, a very similar ornament may be found also on imitations of fibulae of the Csongrád class produced in the early sixth century in Mazuria.

According to the author, if Werner's class I J originated in Mazuria, then the Dailidės fibula, although of local production, may well have imitated a Mazurian original. Relations between the Olsztyn group in Mazuria and communities of the East Lithuanian Barrow Culture are poorly understood, although they must have been responsible for other similar phenomena, such as the silver belt buckle from Ziboliškė near Švenčionys, or the “Slavic“ bow fibula of Werner’s class I D found in Mikol’tsy near Myadel’. By contrast, no analogies exist in Mazuria for the fibulae from the neighboring regions in Belarus (Nikadzimava), Latvia (Boķi and Strīķi), Estonia (Jägala Jõessu), and the Kaliningrad *oblast’* of Russia (Linkuhnen and Schreitlauken). These investigations showed that Dailidės fibula may indicate gift-giving exchange between the elites in the region of the East Lithuanian Barrow Culture and in Mazuria, the latter also connected with the distant elites in the Carpathian Basin.

The review part of this volume presents reviews of Roberts Spirğis monograph “*Bruņrupuču saktas ar krūšu važiņrotām un lībiešu kultūras attīstība Daugavas lejtecē 10. – 13. gadsimtā*” (Rīga, 2008) reviewed by Audronė Bliujienė.

Algirdas Girininkas



Aerial photography showing parts of the fossil field systems at Uggårde-Vinarve, Rone parish, Gotland.
Photograph by Peter Manneke (Manneke 1974, p. 35).

FOOD AND AGRICULTURE

DIET IN EARLY LITHUANIAN PREHISTORY AND THE NEW STABLE ISOTOPE EVIDENCE

INDRE ANTANAITIS-JACOBS, MIKE RICHARDS, LINAS DAUGNORA, RIMANTAS JANKAUSKAS, NIVES OGRINC

Abstract

This article reviews current scientific evidence of food resources exploited in the Lithuanian Stone and Bronze Ages and presents the new direct, biochemical stable isotope evidence. Stable carbon and nitrogen isotope analyses were performed on 75 Stone and Bronze Age animal bone samples and 23 human bone samples. We discuss how the obtained values relate to diet and other evidence of diet, compare the obtained values with regional stable isotope data, and consider sociocultural implications.

Key words: stable isotopes, palaeodiet, Stone Age, Bronze Age, Lithuania, East Baltic, Corded Ware Culture

1. Introduction: The research question and the research material

The exploitation of food resources and its evolution in Lithuanian Stone and Bronze Age territory has been examined and/or discussed by means of archaeological (i.e., Rimantienė 1996; Girininkas 1994), zooarchaeological (Daugnora et al 2002; Duoba and Daugnora 1994; Daugnora and Girininkas 1995, 1996, 1998, 2004), and more recently chronological (Ramsey et al 2000), archaeobotanical (Stančikaitė 2000; Antanaitis et al 2000; Antanaitis-Jacobs et al 2001, 2004), palaeodental (Palubeckaitė and Jankauskas 2006), and combined bioarchaeological data (i.e., Zvelebil 1998; Antanaitis 2001). One Lithuanian stable isotope study of six Neolithic-Bronze Age humans and one millet sample has previously been published (Antanaitis and Ogrinc 2000). The 98 bone samples submitted for stable isotope analysis in this study include both human and animal bone from key Mesolithic, Neolithic, and a couple Bronze Age archaeological sites in Lithuanian territory (see Figure 1, Table 1).

Prehistoric faunal and floral data in archaeological contexts are in themselves significant in the determination of ancient inhabitants' diet. Palaeodental evidence such as tooth wear and changes in caries and calculus rates can suggest types of food consumed and changes in dietary patterns such as those that occurred during the transition to farming. Still, various factors such as the differential preservation of organic remains or the overrepresentation of seasonal hunting refuse in the material record can bias accurate interpretations interpretations and can be considered only as indirect evidence. Stable isotope analyses of human remains are especially valuable in dietary studies since they provide direct quantitative information on what the people ate specifically regarding the protein element of diet.

The particular ecology of sites can vary both geographically and chronologically. Locationally and temporally specific faunal stable isotope data illustrate the expected range of stable carbon and nitrogen isotope values in a particular place and time and are important for an accurate interpretation of the human data.

Human bone collagen is continuously resorbed and replenished, so that its isotopic composition reflects dietary averages over at least 10 to 20 years of an individual's life (Sealy 2001, Lee-Thorp 2008). Stable isotope data not only can suggest the importance of certain food sources in a population, but also intra-individual variation in diet (Eriksson 2003) and possible sociocultural or ideological implications (Antanaitis 2001, Eriksson 2003, Eriksson et al 2006, Fornander 2005/2006).

Stable isotopes are of great value as a tool in the interpretation of ancient diets. In this article, we focus mainly on the new stable isotope evidence related to diet on the direct quantitative information on what people in Lithuania in early prehistory ate. Just like other sources of paleodietary information, however, isotope measurements are subject to a number of significant uncertainties and potential biases (Milner et al 2004, but see Richards and Schulting 2006). Considering the potential biases to which every source of information is subjected, in the end, the best analytical strategy for scientifically establishing early prehistoric human diet includes a comparison of related cross-disciplinary data. We precede the presentation of our stable isotope study's results by a review of what other data suggest regarding human diet in early Lithuanian prehistory.

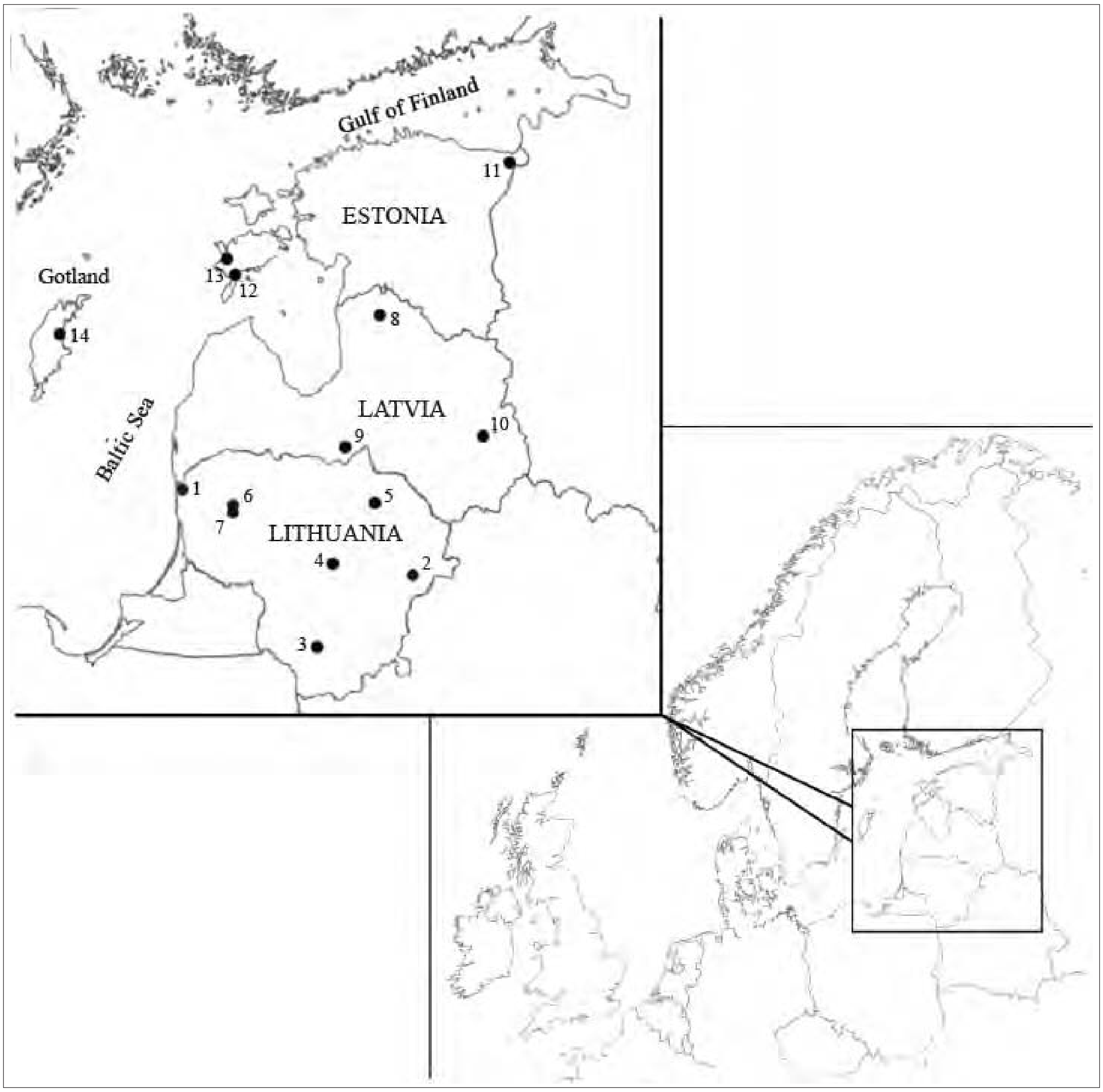


Figure 1. Location of Lithuanian and other East Baltic archaeological sites: 1. Šventoji, 2. Kretuonas/Žemaitiškė, 3. Turlojiškė/Kirsna, 4. Plinkaigalis, 5. Gyvakarai, 6. Donkalnis, 7. Spiginas; 8. Zvejnieki, 9. Selgas, 10. Sarkaņi, 11. Kudruküla, 12. Naakamäe, 13. Loona, 14. Västerbjers.

2. Other bioarchaeological evidence of diet in early Lithuanian prehistory

The Zooarchaeological evidence

Hunting and fishing tools in the East Baltic Stone Age included arrow points, spear points, bows, harpoons, fishhooks, nets, weirs, leisters, netfloats, boats, oars, dams, knives, scrapers, etc. (Daugnora and Girininkas 1995). During the entire Mesolithic, the animal that appeared to be most hunted in the entire East Baltic was the elk. Others hunted include red deer, aurochs, boar, marten, and beaver (Daugnora and Girininkas 2004, p.278). Seals were being hunted along the Baltic coast from the very beginning of the Mesolithic (Lõugas 1997, p.38; Storå 2000, 2001; Forsten and Alhonen 1975). The hunting of seals became especially widespread and reached its maximum in the Neolithic (Lepiksaar 1986, p.62). Faunal remains found within the Donkalnis graves include 183 animal tooth pendants, mostly of elk and red deer (93.44%), then aurochs (2.73%), boar (2.18%), bear (1.09%), and roe deer (0.53%) (Daugnora and Girininkas 1996, p.77).

Cumulatively, the boar (Sus scrofa), elk (Alces alces), and beaver (Castor fiber) very often dominate the faunal assemblages of Lithuania, Latvia, and Estonia during the Neolithic and Early Bronze Age. Other top five most popular mammals represented in Lithuanian territory in general is the red deer (Cervus elaphus). Seals (Phocaidae) were very important in sea coastal sites; geographic location is clearly an important variable.

Table 1. Lithuanian Stone and Bronze Age chronology

ARCHAEOLOGICAL PERIOD	DEFINING FEATURE OF ARCHAEOLOGICAL PERIOD	C14 bp	ENVIRONMENTAL PERIOD, bp
Late Mesolithic	Post-glacial and pre-Neolithic hunter-gatherers of Atlantic period; Kunda, Nemunas, Janislawice cultures	c. 8 000 – 6550/6300	Early Atlantic (8000 – 6700) and beginning of Late Atlantic (6700 – 5000); formation of Littorina Sea
Early Neolithic	Appearance of (Narva and Nemunas Culture) ceramics (Late Mesolithic in Scandinavia)	6550/6300 – 5600/5400	Late Atlantic
Middle Neolithic	Appearance of Comb-and-Pit Pottery culture	5600/5400 – 4400/4300	Late Atlantic - Early Subboreal (5000 – 4000)
Late Neolithic	Appearance of Corded Ware culture	4400/4300 – 3500	Middle/ Late Subboreal (4000 – 2500)
Early Bronze Age	First metal objects	3500 – 3100	Late Subboreal
Late Bronze Age	New kinds of bronze objects, cremations or earliest barrows with stone constructions, appearance of hillforts	3100 – 2500	Late Subboreal; at end of Subboreal, Littorina Sea changes into (salty) Limnea Sea

References

Antanaitis 2001; Antanaitis-Jacobs and Girininkas 2002; Juodagalvis 2005; Kabailienė 1990, 1998; Mangerund et al 1974.

The aurochs (Bos primigenius) begins to rise in popularity from the Middle Neolithic onward. Bird bones are poorly preserved in general, and often also unidentified, although the existing record clearly shows that in some sites there were significant numbers of bird bone remains (Daugnora et al 2002). Waterfowl (Anseriformes), especially mallards (Anas platyrhynchos), dominate bird bone assemblages. On the whole, pike (Esox lucius) is by far the best represented species of fish on the majority of the sites (Makowiecki 2003). Perch (Perca fluviatilis), pikeperch (Lucioperca lucioperca, Stizostedion lucioperca), and cyprinids followed pike as most popular fish species in investigated sites as a whole. (Daugnora 2000, 2000a; Antanaitis 2001).

The presence of domesticated animals–cattle (Bos bovis), sheep/goat (Ovis avies/Capra hircus), pig (Suis suis) – is apparent in the Middle Neolithic in Lithuania and Latvia, but not, by known data, in the best published archaeological sites of Estonia, where they begin to occur in the Late Neolithic. The Lithuanian sites appear to show the earliest and highest proportions of domesticated animals 6.15% at the Middle Neolithic Kretuonas 1B site and up to 18% at the Kretuonas 1D site by MNI (minimum number of individuals), for example, but the percentages need to be treated with caution due to small sample sizes. The Early Bronze Age in the East Baltic is still poorly researched. The second half of the Bronze Age suggests a marked change in the subsistence economy; domesticated animals in Late Bronze Age hillforts in Lithuania, Latvia, and Estonia constitute the majority of zooarchaeological remains (Daugnora and Girininkas 1998, Antanaitis 2001).

The Human palaeodental evidence

Comparatively very few early prehistoric human burials have been discovered in Lithuanian territory. The largest known concentration of interred Stone Age humans in the East Baltic area is the burial ground of Zvejnieki, in neighboring Latvia. Three hundred seventeen human burials have thus far been discovered (Zagorskis 1987, 1994). The analysis of dental pathologies of a sample of 118 individuals (2586 permanent teeth) from Zvejnieki was performed in order to test the "classic" Neolithization model which accentuates changes in dental health during the transition to agriculture (Palubeckaite and Jankauskas 2006). High dental wear, intensive teeth use, and low antemortem tooth loss (AMTL) together with a low incidence of caries is usually attributed to individuals in which subsistence is based on hunting and gathering. Subsistence based on agriculture generally is associated with lower tooth wear, increased caries rates, and AMTL due to changes in food preparation and increased reliance on agricultural products (Alexandersen 1988, p.15; Larsen 1997, p. 67; Mays 1998, p.153).

Dental wear at Zvejnieki was severe during the entire Stone Age. A high degree of attrition is typical of hunter-gatherers or populations with mixed economy (Alexandersen 2003, p.15; Bennike 1985, p.149). However, abrasiveness of food alone cannot explain asymmetry in dental wear and greater attrition of anterior teeth compared to molars. The same severe asymmetrical dental wear was found in the Mesolithic population of Skateholm (Alexandersen 1988, p. 157). The wear could be from activities other than eating. Ethnographic studies of Inuit populations had revealed a similar attrition pattern from the intensive use of teeth as tools, such as to soften hides or tighten fish lines (Merbs 1983, p. 154). An intensive use of teeth as tools could also result in broken or fractured teeth and unusual wear facets (Larsen et al 1998, p.142). This feature also was found in Zvejnieki. The biting and chewing of hard food products like bones, nuts, and roots also could have been responsible for the severe anterior dental attrition and chipping of posterior teeth in this population.

One of the most unexpected results of the dental study was the high caries rate at Zvejnieki, since a diet based on animal protein, fish, and vegetables with a low sugar content is not cariogenous (Mays 1998, p.149). According to the incidence of decay, Zvejnieki individuals were close to Stone Age foragers from southern Europe and the Mediterranean who had high caries rates, probably due to an access of fruits rich in carbohydrates (Meiklejohn and Zvelebil 1991, p.132). The highest number of affected teeth was found in the Mesolithic, with a substantial decline in the Neolithic, and a slight increase in the Bronze Age. Corrected caries rates, however, eliminated significant differences between these periods, suggesting the absence of dramatic change in diet during the transition to the Neolithic. A considerable amount of occlusal caries in the Mesolithic may suggest the existence of some sticky cariogenous food (e.g., honey) that could adhere to dental fissures long enough to cause decay. Most cavities in the Neolithic were localized on the cervical region of teeth. This is expected, taking into account high dental attrition, which leads to a compensatory over eruption of teeth and root exposure. Occlusal caries decreased almost twofold in the Neolithic. Such a shift in caries location could be due to changes in food preparation or due to the general increase of teeth use.

Extensive dental calculus (calcified dental plaque) is correlated with a diet based on proteins (meat, fish, nuts) (Hillson 1986, p.322). Mesolithic individuals had 55% of their teeth affected, a significantly lower incidence than the Neolithic (95.1%) and Bronze Age (100%) individuals. The dental calculus of the Mesolithic individuals, however, was mild, while 25.5% of the Neolithic and 14.3% of the Bronze Age individuals had teeth with moderate and severe calculus. The appearance of calculus together with caries could confirm diversity in diet, with a representation of both animal protein and carbohydrates (Palubeckaitė and Jankauskas 2006).

The analysis of dental pathologies at Zvejnieki suggests that caries rates did not change dramatically over time, while calculus rates showed a tendency to increase. Available data suggest slight and gradual changes in diet and food preparation, with, perhaps, a similar ratio of animal protein and plant food.

The Palaeobotanical evidence

While the lack of cereal pollen does not necessarily indicate a lack of cereals (Behre 1981, p.226-227; Poska et al 1999, p.307), the first pollen of cereals appeared in the East Baltic during the Late Atlantic: a single oat (Avena) pollen grain, Cerealia pollen, and hemp/hops (Cannabis/Humulus) in Lithuania, barley (Hordeum) in Latvia, Cerealia and Avena in Estonia. The most noteworthy and prolific finds of plant food on Mesolithic and Neolithic archaeological sites in all the Baltic States are hazelnut (Corylus avellana) and water chestnut (Trapa natans). Nuts, shells, and husks of these plants are found around hearths sometimes in large quantities together with wooden mallets as well as wooden and stone hoes in archaeological sites by the Middle Neolithic (Vankina 1970, Rimantienė 1996). The large number of remains of these nuts in macro form is typical not only of the East Baltic, but is widely documented throughout Europe during the Atlantic and Subboreal climatic periods.

West Lithuania's and East Latvia's Late Neolithic archaeological sites reveal a marked increase in hoes, grinding stones, and sickles (Butrimas 1996, Loze 1979, Rimantiene 1999). Pollen and seed analysis show cultivated plants were emmer wheat (Triticum dicoccon), barley, millet (Panicum), Italian millet (Setaria italica), and hemp (Rimantienė 1996). Palynological data suggest the intensification of cattle breeding and that agriculture became a common activity in the second half of the Early Subboreal or Late Neolithic (Stančikaitė 2000).

The least amount of information is available in regards to East Baltic Early Bronze Age farming. Late Bronze Age archaeological data show signs of intensive agriculture throughout the region, illustrated by the extent and intensity of cereal cultivation by palynological data, such finds as the stash of charred millet grains (Panicum miliaceum) at the Turloji kė site, radiocarbon dated to 2590+75 BP (Ua-16681) (Antanaitis and Ogrinc 2000, p.7), various grindstones, and even bronze sickles on archaeological sites in Lithuania by the end of the Late Bronze Age. Ardmarks found underneath fortified settlements, hundreds of stone shaft-hole axes (slashing tools) in fields, finds of cereal grains (including millet), seeds of perennial weeds, and cultivation tools, all suggest that slash and burn agriculture was dominant in Latvia by the beginning of the first mil. BC (Vasks et al 1999, p. 300-301, Graudonis 1989, p.73). The discovery of numerous fossil fields of so-called Celtic and Baltic types of the Late Bronze Age in Estonia suggest that farming was well established there by then (Lang 1992, 1994a, 1994b, 1994c, 1995).

3. The New Stable Isotope Evidence

Materials

Faunal samples in this study were taken from the most representative archaeological localities in Lithuania: the prominent Neolithic-Early Bronze Age ventoji site series in coastal Northwestern Lithuania (Rimantienė 1979, 1980, 1996; Juodagalvis and Simpson 2000), the Neolithic-Early Bronze Age inland, lacustrine site series of the well-known Kretuonas/ Žemaitiškė archaeological complex in Northeastern Lithuania (Girininkas 1990; Girininkas 1994; Daugnora and Girininkas 1996, 2004), and the Late Neolithic-Bronze Age Kirsna/ Turlojiškė archaeological complex near the Kirsna River in Southwestern Lithuania (Merkevičius 1998, 2000; Antanaitis et al 2000) (See Table 2).

The human bone collagen samples came from six different areas in Lithuania. The Donkalnis and Spiginas burial sites both occur in West Lithuania's Samogitian Highland, on separate islands in Biržulis Lake; 8 more-or-less intact and 6 derranged (from gravel pit digging) burials were found at Donkalnis, 4 burials – at Spiginas. The Donkalnis burial site was adjacent to a habitation site, as were the Kretuonas and Turlojiškė area burials. The Plinkaigalis individuals were buried in a cemetery in Central Lithuania's Kėdainiai district; most of the graves in the Plinkaigalis cemetery date from the 3rd to the 6th/7th C. AD, but this study's two individuals date to a different time, to the Late Neolithic's Boat Battle Axe Culture of the Corded Ware culture horizon (Butrimas et al 1985; Kazakevičius 1993, p. 160, 165). The Gyvakarai individual, from the Gyvakarai village in the Kupi kis district in northeastern Lithuania, also archaeologically is ascribed to the Late Neolithic Boat Battle Axe Culture (Tebel kis 2001, Tebel kis and Jankauskas 2006) (See Table 3).

Our study was limited in certain instances by the availability of materials. Unfortunately, little suitable Mesolithic bone other than human was available. As well, certain species of fauna are not represented equally throughout the Neolithic subperiods. The lack of chronologiclly or species-specific finds limits the data. Also not presented here are the data of 32 faunal samples and 5 human samples of the study, as the analyses did not yield valid results due to not enough collagen for measurement or a poor C:N ratio. These sorts of lacunae are, unfortunately, not atypical of the early prehistoric material record.

Methods

The chemical composition of an individual's bones contains information about what the individual ate (Lee-Thorp 2008, Sealy 2001). Since the stable isotope ratios of carbon (C) and nitrogen (N) occur in varying proportions in different foods and are passed on to the bones of the consumer, stable isotope ratios of bone collagen provide information about the consumer's diet. Stable isotope data of bone collagen are a direct biochemical means of ascertaining information about diet, specifically, the protein element of diet. Stable carbon isotope values, indicated as $\delta^{13}C$, have been used in two ways in palaeodietary reconstruction. The first and most popular way they are used is to determine the amount of marine protein in diet, compared to terrestrial protein (Schwarz and Schoeninger 1991; Tauber 1981, 1986).

The carbon isotopic value for an individual living entirely on a marine or a terrestrial diet, or its end-value, is slightly variable. The expected isotopic end-value for bone collagen of people in inland Scandinavia and northern lattitudes in general consuming only terrestrial (C_3) protein has an average $\delta^{13}C$ value of -20 to -21‰ (Lidén and Nelson 1994, p.18; Lovell et al 1986). The marine end-value, however, is correlated with salinity. The marine end-value of oceans is -11 to -12‰ whereas the Baltic Sea's is -14 to -15‰ because it is not as saline (Lidén 1995, p.16-17).

The second way that stable carbon isotope values also are used in palaeodietary reconstruction is to determine the amount of C4 plant protein such as maize (Bender 1968, Bender et al 1981) or millet (Murray and Schoeninger 1988) in diet. Most European palaeodietary reconstruction studies disregard C_4 plants in Stone Age diet since C_4 plants do not naturally occur in Europe. Palaeobotanical data from Lithuania and Latvia, how-

Table 2. Archaeological site summary

Site	Site type	Location	Climatic Period	Archaeological Period	Archaeological Culture	Available C14 bp dates
Spiginas	Burials	On island in lake	Atlantic–Subboreal	Late Mesolithic – Late Neolithic	Maglemose/ Kunda, Narva? Corded Ware	7780-4080
Donkalnis	Burials	On island in lake	Atlantic	Late Mesolithic – Early Neolithic	Maglemose/ Kunda, Narva?	7405-5785
Šventoji	Series: habitation	Coastal, lagoon	Late Atlantic–Subboreal	Middle Neolithic – Early Bronze Age	Narva, Globular Amphorae, Baltic Haff	5110-3490
Kretuonas/ Žemaitiškė	Series: habitation, burials	Inland, lake	Late Atlantic–Subboreal	Early Neolithic – Early Bronze Age	Narva, Comb and Pit Pottery, Funnelbeaker	5580-3340
Turlojiškė/ Kirsna	Series: habitation, burials	Inland, river	Subboreal	Late Neolithic – Late Bronze Age	Corded Ware, Stroked Pottery?	Br 2895-2590
Plinkaigalis	Burials	Inland, river	Middle Subboreal	Late Neolithic	Corded Ware	4280-4030
Gyvakarai	Burial	Inland, river	Late Subboreal	Late Neolithic	Corded Ware	3730
Zvejnieki	Burial ground, habitation	Inland, lake	Atlantic–Subatlantic	Mostly Mesolithic and Neolithic	Maglemose, Kunda, Narva?, Comb and Pit Pottery, Corded Ware,	8240-2370
Selgas	Burial	Inland, river	Middle Subboreal	Late Neolithic	Corded Ware	4165
Sarkaņi	Burial	Inland, lake	Middle Subboreal	Late Neolithic	Corded Ware	4285
Västerbjers	Habitation, burials	Coastal, island	Middle Subboreal	Middle Neolithic	Comb and Pit Pottery0	Mostly 4300-4100
Kudruküla	Habitation, burials	Near coast, river	Subboreal	Middle - Late Neolithic	Comb and Pit Pottery, Late Comb and Pit	4840-4770
Naakamäe	Habitation, burials	Coastal, island	Subboreal	Late Neolithic	Comb and Pit Pottery, Late Comb and Pit	4125
Loona	Habitation, burials	Coastal, island	Subboreal	Late Neolithic	Late Comb and Pit + Bronze Age	4270-4050, 2620

Table 2 References.

Antanaitis 1999, Antanaitis et al 2000; Antanaitis-Jacobs et al 2001; Butrimas et al 1985, 1994; Daugnora and Girininkas 1996; Erikkson 2003, 2004, Eriksson et al 2003; Girininkas 1990, 1994, 2002; Grasis 1996; Jaanits et al 1982; Juodagalvis and Simpson 2000; Kazakevičius 1993; Kriiska 1996; Kunskas et al 1985; Lõugas 1997, Lõugas et al 1996; Lõugas V. 1970; Merkevičius 1998, 2000; Rimantienė 1992, 1996, 2005; Tebelškis 2001; Tebelškis and Jankauskas 2006; Zagorska 1997, 2000; Zagorskis 1987; Žilinskas 1931, Žilinskas and Jurgutis 1939.

ever, confirm the presence of millet by the end of the Stone Age.

Stable nitrogen values, indicated as $\delta^{15}N$, are also used in two ways when reconstructing diet: 1) in determining how much plant food was consumed in diets and 2) in determining the trophic level of an organism in an ecosystem. Whether terrestrial or marine, nitrogen values are enriched up a food chain by 2-4‰ (Schoeninger and DeNiro 1984). Organisms belonging to the lowest level in a food chain are photosynthesizing plants and will have a $\delta^{15}N$ value of approximately 3‰ (air is used as the standard and is 0‰), organisms feeding entirely on plants will have a $\delta^{15}N$ value of approximately 6‰ or 3‰ higher than the previous level, and so on. Marine and freshwater food chains are longer than terrestrial, so the end value of marine food chains are higher than the corresponding terrestrial value; the top predator in a marine environment such as a seal may have a $\delta^{15}N$ value of 18‰, a Greenland Eskimo who eats the seal may have a $\delta^{15}N$ value of 20‰, while a top predator in a terrestrial environment like a bobcat will have an end value of approximately 10‰ (Lidén 1995, p.18; Schoeninger et al 1983; Schoeninger and Deniro 1984).

Methodology

Collagen was extracted from the bone samples following a modified Longin method (Richards and Hedges 1999) with the addition of an ultrafiltration step (Brown et al 1988). Sample preparation and isotope

Table 3. Burial summaries of study's human samples

Burial	C14 bp (Lab No.)	Archaeological culture	Gender	Age	Grave goods, Pathologies, Other
Spiginas 1	5020+200 (GIN-5569)	Kunda? Narva?	M	35-45	Traces of ocre, 2 rhomboid projectile points
Spiginas 2	4080+120 (GIN-5570)	Corded Ware	M	50-55	No grave goods, no pathologies, crouched burial
Spiginas 3	7780+65 (OxA-5925)	Kunda	F	?	No grave goods, unique body build; oldest known burial in Lithuania
Spiginas 4	7470+60 (GIN-5571)	Kunda	F	30-35	Lots of ocre, projectile point, 7 pendants of elk/red deer and boar teeth; Cervical and lumbar vertebra show osteochondrosis
Donkalnis 1	Mesolithic? Neolithic?		F	20-25	Patches of ocre; Harris lines (stress indicators) on distal ends of both radii and on first metatarsals
Donkalnis 2	7405+45 (CAMS-85221)	Kunda	M	20-25	Ocre, 57 animal tooth pendants; Harris line on right radius' distal end
Donkalnis 3	5785+40 (CAMS-85220)	Narva??	F	25-30	Ocre, 4 Harris lines on right tibia and on each radius; completely healed blunt injury to skull vault
Donkalnis 4	6995+65 (OxA-5924)	Kunda	M	50-55	Intensive ocre, 83 animal tooth pendants; scalping trauma (?), osteoarthritis of shoulder joints, possible posttraumatic arthritis of left wrist joint
Donkalnis 5	Mesolithic? Neolithic?	Kunda? Narva?	2 small children	~7 and younger	Ocre, lancet projectile point; scattered animal tooth pendants; bones of both youth scattered throughout the pit
Donkalnis 6	Mesolithic? Neolithic?	Kunda? Narva?	F	35-40	No grave goods; Healed parry fracture of left ulna; gave birth 4 or 5 times
Donkalnis 7	Mesolithic? Neolithic?	Kunda? Narva?	M	Over 45	Bear mandible and bear tooth pendant, triangular heart-shaped arrow point; Healed right clavicle fracture, distal end of right tibia shows signs of "squatting facet"
Donkalnis, derranged	Mesolithic?		?	?	[deranged as result of gravel pit excavation]
Kretuonas 1B, gr. 1	5350+130 (OxA-5935)	Narva?	F	20-25	~1/2 cm dark soil underneath upper body, broken bone dagger under right arm
Kretuonas 1B, gr. 3	5580+65 (OxA-5926)	Narva?	M	50-55	2 horse teeth
Plinkaigalis 241	4030+55 (OxA-5928)	Corded Ware	F	50-55	Buried with bent legs; Very worn teeth
Plinkaigalis 242	4280+75 (OxA-5936)	Corded Ware	F	Over 40	2 flint blades, 1 retouched flint knife, much charcoal in pit; Bent legs
Gyvakarai	3745+70 (Ki-9470) 3710+80 (Ki-9471)	Corded Ware	M	35-45	Boat-shaped polished stone axe, flint hafted axe, flint blade-knife, hammer-headed bone (antler?) pin
Turlojiškė 1 (1996), gr. 3 [Area 3, Plot 2]	3570+130 (Vs-1097)	Stroked Pottery??	M	25-30	2 wooden artefacts, copper pendant!, whetstone; skull trauma as probable cause of death; bog "sacrifice"?
Turlojiškė	2835+55 (OxA-5927)	Late Bronze Age	M	25-30	Previously regarded as Neolithic Nemunas Culture representative; brachychranic, protolaponoid elements
Turlojiškė 4 (1998) [Area 2, Plot 10]	Same cultural layer as millet dated 2590+75 (Ua-16681)	Late Bronze Age	M	20-25	Heavily patinated flint arrowpoint; skull trauma is probable cause of death; bog "sacrifice"?
Kirsna	2895+55 (OxA-5931)	Late Bronze Age	M	25-30	Individual's skull discovered in peatbog in association with bone artefacts, bone axes, daggers, harpoons, flint knives

References:

Antanaitis 1999; Butrimas et al 1985, 1992; Girininkas et al 1985; Kazakevičius 1993; Kunskas et al 1985; Merkevičius 1998, 2000; Tebelškis 2001, Tebelškis and Jankauskas 2006.

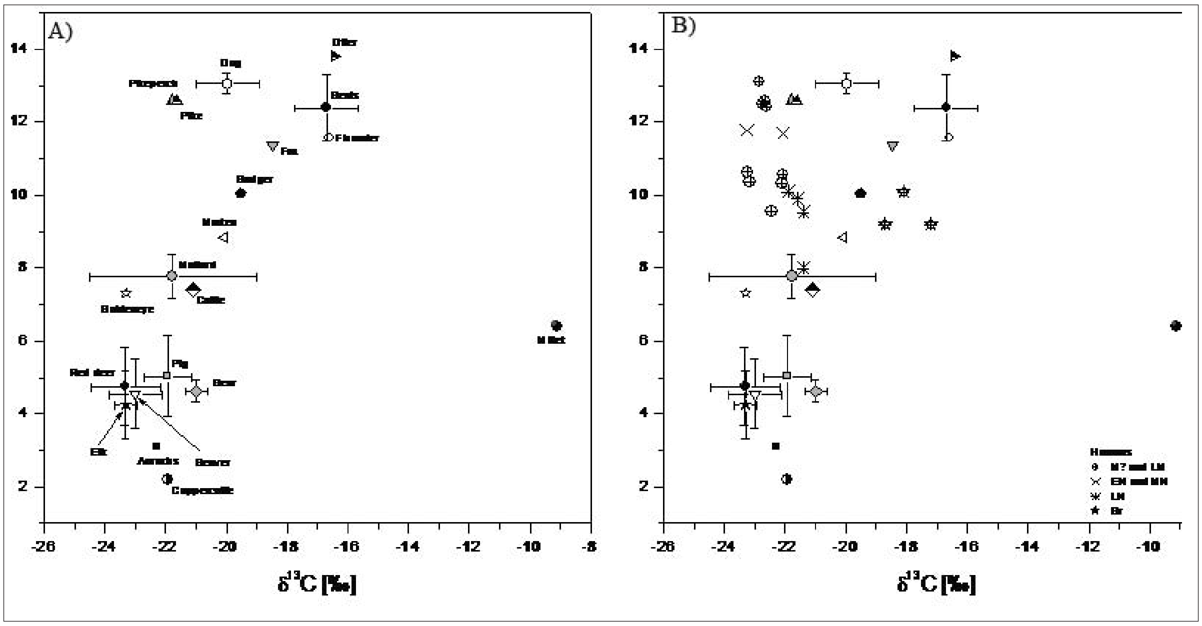


Figure 2. $\delta^{13}C$ and δ15N bone collagen values of A) averages and standard deviations for animals and millet and of B) averages and standard deviations for animals, millet, and all data for humans.

measurements were made at the Department of Human Evolution, Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany. Results presented here had collagen carbon to nitrogen ratios between 2.9 and 3.6 (DeNiro 1985).

Results

The results of the Lithuanian Stone-Bronze Age stable isotope analyses are presented in Table 4 and Figure 2. Of 75 faunal samples, 43 yielded valid stable isotope data; of 23 human samples, 18 yielded valid data. The stable carbon values of two Kretuonas 1B human samples (Ramsey et al 2000) and stable carbon and nitrogen data of one millet sample obtained elsewhere (Antanaitis and Ogrinc 2000) are included in this study.

4. Data Interpretation

Stable isotope ecology: the faunal and floral data

The faunal remains represent marine, terrestrial, and freshwater environments with both herbivores and carnivores for all three ecological systems. As seen in Figure 2A, isotopic analyses of the animals are relatively well clustered by species and trophic level.

Carbon isotope values from the six herbivores (red deer, elk, beaver, aucrochs, bear, and capercaille) range from -24,1 to -20.7‰. They are typical of animals feeding on C3 plants. The $\delta^{13}C$ values of the omnivore (Sus Scrofa – pig) also fall within this range. Among the carnivores (dog, fox, badger, and marten), the $\delta^{13}C$ values are higher, ranging between -20.7 and -18.5‰. The pike and pikeperch, highly carnivorous fish, have the average $\delta^{13}C$ value of -21.8 ± 0.1‰. As expected, the $\delta^{13}C$ values of marine animals are higher, ranging between -18.7 and -15.5‰.

The herbivores' $\delta^{15}N$ values in bone collagen are the lowest, ranging from 2.2 to 5.5‰ with an average $\delta^{15}N$ of 4.6 ± 0.8‰. $\delta^{15}N$ values ranged in carnivores from 8.8 to 13.3‰ and averaged $\delta^{15}N$ = 11.3 ± 1.9‰. The $\delta^{15}N$ of the pig ranged from 3.8 to 6.5‰ and lies within the range of the herbivores. On average, the increase from herbivores to carnivores is +3.0‰ for the $\delta^{13}C$ values and +6.7‰ for the $\delta^{15}N$. These differences are not what we could expect within a single food web, but indicate that some animals also consumed freshwater or marine food. The highest deviation in $\delta^{15}N$ values was observed in marine animals from 10.6 to 13.9‰, indicating the different feeding behavior of the species.

The Lithuanian territory's average $\delta^{13}C$ value for elk of 22.8 + 0.7‰ and corresponding $\delta^{15}N$ average value of 4.4 + 1.9‰ illustrate well the diet of herbivores. The $\delta^{13}C$ value of 6 bone samples of elk in Zvejnieki cemetery range from 22.0 to 22.8 with a corresponding $\delta^{15}N$ value range of 3.1 to 6.4 (Eriksson 2006, p. 190). An Early Subboreal Middle Neolithic elk value from the Estonian Kudruküla site had a $\delta^{13}C$ value of -22.6‰ (Lougas et al 1996, p. 405). It was found that Subboreal or Late Neolitic animals at Žemaitiškė have on average lower $\delta^{13}C$ values compared to other animals, suggesting a more forested environment. This interpretation coincides with palaeobotanical data at the adja-

Table 4. Lithuanian Stone And Bronze Age Stable Isotope Data

Lab Code	Site / Grave no.	Envir. chrono	Archy chrono	Species	Common name	d13C	d15N	C:N
J176A	Donkalnis 1	A?	M?	*Homo sapiens*	human	-23.2	10.6	3.2
J235G	Donkalnis 5	A?	M?	*Homo sapiens*	human	-22.1	10.6	3.4
J235F	Donkalnis 6	A? S?	M? N?	*Homo sapiens*	human	-22.1	10.3	3.2
J237B	Donkalnis 7	S?	N?	*Homo sapiens*	human	-22.4	9.6	3.3
J245D	Donkalnis, derranged	A?	M?	*Homo sapiens*	human	-23.2	10.4	3.3
102	Spiginas 3	EA	LM	*Homo sapiens*	human	-22.9	13.1	3.6
98	Spiginas 4	EA	LM	*Homo sapiens*	human	-22.7	12.6	3.5
J236A	Donkalnis 2	EA	LM	*Homo sapiens*	human	-22.6	12.4	3.3
103	Donkalnis 4	EA	LM	*Homo sapiens*	human	-22.8	12.5	3.6
J236B	Donkalnis 3	LA	EN	*Homo sapiens*	human	-22.1	11.7	3.3
J709B	Spiginas 1	LA/ES	MN	*Homo sapiens*	human	-23.3	11.8	3.6
J990A	Spiginas 2	MS	LN	*Homo sapiens*	human	-21.4	9.5	3.3
6927	Plinkaigalis 242	MS	LN	*Homo sapiens*	human	-21.6	9.9	3.3
101	Plinkaigalis 241	MS	LN	*Homo sapiens*	human	-21.4	8.0	3.3
69924	Gyvakarai	LS	LN	*Homo sapiens*	human	-21.9	10.1	3.3
6925	Turlojiškė 1 (1996), gr. 2	LS	EBr	*Homo sapiens*	human	-18.7	9.2	3.3
6928	Kirsna	LS	LBr	*Homo sapiens*	human	-18.1	10.1	3.2
6926	Turlojiškė 4 (1998)	LS	LBr	*Homo sapiens*	human	-17.2	9.2	3.3
43	Šventoji 2B	ES	MN	Alces alces	elk	-23.6	4.9	3.3
57	Šventoji 1B	S	MN or LN	*Alces alces*	elk	-23.1	3.6	3.4
36	Žemaitiškė 1	S	LN	*Cervus elaphus*	red deer	-24.1	4.0	3.5
6919	Turlojiškė	S	Br	*Cervus elaphus*	red deer	-22.5	5.5	3.4
86	Žemaitiškė 3B	LA	EN	**Ursus arctos**	brown bear	-20.7	5.0	3.3
48	Šventoji 3	ES	MLN	*Ursus arctos*	brown bear	-21.4	4.5	3.3
53	ventoji 6	S	LN	**Ursus arctos**	brown bear	-20.9	4.4	3.3
96	Kretuonas 1B	LA	MN	*Sus suis* or *Sus scrofa*	pig or boar	-23.6	6.4	3.5
58	Šventoji 1B	S	MN or LN	*Sus scrofa* (or *Sus suis*?)	boar (or pig?)	-21.8	4.1	3.4
45	Šventoji 3	ES	MLN	*Sus scrofa* or *Sus suis*	boar or pig	-21.3	3.8	3.3
46	Šventoji 3	ES	MLN	**Sus scrofa**	oar	-21.7	5.5	3.4
52	Šventoji 6	S	LN	*Sus scrofa*	boar	-21.6	5.3	3.4
38	Žemaitiškė 1	S	LN	*Sus scrofa*	boar	-23.3	6.5	3.5
89	Kretuonas 1D	S	LN	*Bos primigenius*	aurochs	-22.3	3.1	3.3
73	Šventoji 4B	LA or S	MN	*Anas platyrchynchos*	mallard	-24.8	7.2	3.3
75	Šventoji 23	S	LN	*Anas platyrchynchos*	mallard	-21.1	7.8	3.5
6918	Turlojiškė	S	LN	*Anas platyrchynchos*	mallard	-19.4	8.4	3.4
68	Žemaitiškė 2	S	LN	*Bucephala clangula*	common goldeneye	-23.3	7.3	3.4
74	Šventoji 23	S	LN	*Tetrao urugalus*	capercaille	-21.9	2.2	3.6
41	Šventoji 2B	ES	MN	*Esox lucius*	pike	-21.6	12.6	3.3
78	Šventoji 4	ES	MN	*Lucioperca lucioperca*	pikeperch	-21.8	12.6	3.5
81	Šventoji 4	ES	MN	*Pleuronectes platessa*	flounder	-16.6	11.6	3.3
49	Šventoji 3	ES	MLN	*Castor fiber*	beaver	-22.1	5.4	3.4
31	Žemaitiškė 2	S	LN	*Castor fiber*	beaver	-23.9	4.8	3.3
32	Žemaitiškė 2	S	LN	*Castor fiber*	beaver	-23.0	3.5	3.5
55	Šventoji 23	S	LN	*Lutra lutra*	otter	-16.5	13.8	3.4
40	Šventoji 2B	ES	MN	**Phocidae**	Seals	-17.7	10.6	3.4
44	Šventoji 2B	ES	MN	*Phocidae*	seals	-16.3	12.2	3.4
60	Šventoji 2B	S	MN	**Phoca vitulina**	harbour seal	-16.1	12.0	3.4
70	Šventoji 1	S	MN or LN	*Phoca vitulina*	harbour seal	-15.5	13.1	3.3
63	Šventoji 4	LA or S	MN or LN	*Pusa hispida*	ringed seal	-18.7	13.9	3.4
65	Šventoji 4	LA or S	MN or LN	**Pusa hispida**	ringed seal	-15.8	12.4	3.3
64	Šventoji 1	S	MN or LN	*Pusa hispida*	ringed seal	-16.5	11.1	3.4
71	ventoji 6	S	LN	*Phoca hispida*	ringed seal	-17.1	12.6	3.4

Lab Code	Site / Grave no.	Envir. chrono	Archy chrono	Species	Common name	d13C	d15N	C:N
61	Šventoji 6	S	LN	*Phoca grenlandica*	harp seal	-16.6	13.3	3.4
69	Šventoji 23	S	LN	*Halychoerus grypus*	grey seal	-16.5	12.7	3.5
51	Šventoji 6	S	LN	*Canis familiaris*	dog	-20.7	13.3	3.4
54	Šventoji 23	S	LN	*Canis familiaris*	dog	-19.2	12.8	3.6
47	Šventoji 3	ES	MLN	*Vulpes vulpes*	fox	-18.5	11.4	3.4
29	Žemaitiškė 2	S	LN	*Martes martes*	marten	-20.1	8.8	3.5
30	Žemaitiškė 2	S	LN	*Meles meles*	badger	-19.5	10.1	3.6
6917	Turlojiškė	LS	LBrA	*Bos taurus*	cattle	-21.1	7.4	3.2

Abbreviations

PB = Preboreal (c.10-9 000 BP)
A= Atlantic (c. 8000-5000 BP)
EA= Early Atlantic (8000-6700)
LA = Late Atlantic (6700-5000)
S = Subboreal (5000-2500)
ES = Early Subboreal (5000-4000)
LS = Late Subboreal (4000-2500)
E=Early
M=Middle
L=Late
M=Mesolithic
N=Neolithic
Br=Bronze

cent Žemaitiškė 2 site, which indicate that in the Late Neolithic the lake was drying up and trees were spreading (Antanaitis-Jacobs et al 2002).

Their higher $\delta^{13}C$ and $\delta^{15}N$ values suggest that the carnivores (fox, badger, and marten) also ate meat of herbivores living in open environments. It is interesting to note that fox have higher $\delta^{13}C$ and $\delta^{15}N$ values compared to red fox and arctic fox from the interglacial Upper Pleistocene period of Scladine Cave (Belgium) (Bocherens et al 1999). This would suggest a more carnivorous behavior as well as consumption of some marine animals. Also, the bears in our study have $\delta^{15}N$ values lower than Pleistocene brown bear populations (Bocherens et al 1995, 1997) indicating that the diet of bears in this study included more plants than during the colder climatic phases.

The highest $\delta^{15}N$ values among carnivores were observed in dog with the average $\delta^{15}N$ of 13.1 ± 0.3‰. The high isotopic value is most probably related to freshwater food consumption. The data are from the Late Neolithic and Subboreal lagoon archaeological sites of the ventoji series. The Zvejnieki cemetery's dog stable isotope data showed no patterns with human data, but rather three separate clusters of different diets. One represented a freshwater diet, the second marine, the third scavenger (Eriksson 2006, p. 197).

The boars' average $\delta^{13}C$ value of 21.9 + 0.8‰ and average $\delta^{15}N$ value 5.0 + 1.1 ‰ in Lithuanian territory also illustrate the diet of terrestrial ecosystem herbivores. The pooled $\delta^{13}C$ values of nine boar bones from the lakeside Zvejnieki burial ground averaged -23.3 + 1.0‰ while their corresponding $\delta^{15}N$ values averaged 6.4 + 2.0‰ (Eriksson et al 2003, p. 12). The $\delta^{15}N$ values of this latter boar are slightly higher than those of wild animals. Some of these wild pigs might have been slightly omnivorous, perhaps eating some food scraps of humans, or grazing on different plants. It is possible that the boar were tame scavengers, ingesting some human food refuse or cultivated plants. Nine boar samples from the mid-Subboreal pre-agricultural site of Västerbjers on the Gotland island coastal site had a $\delta^{13}C$ average value of -21.1 + 0.7‰ and $\delta^{15}N$ value of 5.5 + 1.3‰, interpreted as mainly feeding on plant material, perhaps supplemented by insects and worms (Eriksson 2004, p.142), are comparable with our data.

The three mallards and goldeneye have similar $\delta^{13}C$ and $\delta^{15}N$ values with an average of -22.2 ± 2.4 and 7.7 ± 0.5‰, respectively, which indicate omnivore feeding patterns based mainly on plants. The $\delta^{13}C$ value of the single mallard at Zvejnieki in Latvia was -17.6‰ and $\delta^{15}N$ was 6.0‰ (Eriksson 2006, p. 208).

The Lithuanian pike sample has a $\delta^{13}C$ value of 21.6‰ and $\delta^{15}N$ value of 12.6‰. The average $\delta^{13}C$ values of three pike from the inland lacustrine cemetery Zvejnieki were found to be -23.6 + 0.5‰ with a corresponding $\delta^{15}N$ average value of 12.5 + 0.7‰ (Eriksson et al 2003, p. 12). The $\delta^{13}C$ average value of five pike at Västerbjers was -12.0 + 1.5‰ while their $\delta^{15}N$ averaged 11.0 + 0.6‰ (Eriksson 2004, p.145). The difference in stable carbon isotope values of pike at the site compared to Lithuanian Žemaitiškė and Latvian Zvejnieki pike values could be due to the former's marine and latter's freshwater effect. The average of modern pike $\delta^{13}C$ values from Lake Baikal in Siberia and the Danube, Iron Gates region is -22.0‰ and their average $\delta^{15}N$ value is 12.0‰ (Richards et al 2001, p.15; Katzenberg and Weber 1999), similar to the data observed in our study. The highest $\delta^{15}N$ value of 12.6‰ was observed in another carnivorous fish, pikeperch. Unfortunately only one sample of each fish yielded valid results. In previous studies from the modern Lake Burtneiki and Canadian freshwater lake it was found that the trophic level within one species is correlated between size and δ^{15}N values and therefore high δ^{15}N variations could be expected in the same species as a result of changing diet with age (Olsson et al 2000; Hobson and Welch 1995).

This study's Šventoji sites' seal δ^{13}C values ranged from 18.7‰ to 15.5‰, while δ^{15}N values ranged between 10.6 and 13.9‰. The six pooled δ^{13}C values of seals from the Latvian Zvejnieki cemetery ranged from -18.2 to -15.4‰ and their δ^{15}N values ranged from 12.1 to 14.5‰ (Eriksson 2006:190). At the contemporary earlier Subboreal Estonian archaeological sites of Kudruküla, Naakamäe, and Loona, δ^{13}C values were from -17.1 to -14.9‰ (no δ^{15}N values) (Lõugas et al 1996). At the Swedish Gotland island Västerbjers site, the stable isotope ranges for seals were δ^{13}C -17.2 to -15.5‰ and δ^{15}N from 11.1 to 16.1‰ (Eriksson 2004, p.145).

Seals exhibit considerable isotope variability due not only to marine vs. freshwater habitats, but also and especially to their complex feeding strategy (seasonality, age, breeding are all factors, for example, as are some individuals feeding on more fresh and brackish water fish species in the Baltic, and other, more salt water species in the Atlantic), their migratory patterns, and their prey. Grey seals eat more fish than anything else, while harp and ringed seals also eat crustaceans (Eriksson 2004, p.145; Lawson et al 1995, Nilssen et al 1995, Tormosov and Rezvov 1978).

A single otter bone from Neolithic coastal lagoon site Šventoji 23 yielded a δ^{13}C value of -16.5‰ and a δ^{15}N value of 13.8‰. This carnivore would have fed on marine fish and shows a 2.2‰ enrichment in δ^{15}N over the marine fish such as flounder which is consistent with its higher trophic level. At lacustrine Zvejnieki, δ^{13}C values of -24.0‰ and -23.5‰ and δ^{15}N values of 12.4‰ and 13.0‰, respectively, were obtained from otter tooth pendants from Late Mesolithic child and adult grave no. 190 (Eriksson et al 2003, Eriksson 2006, p. 190).

The Late Bronze Age cattle in our study has a δ^{13}C value of -21.1 ‰ and δ^{15}N value of 7.4‰. Other Late Subboreal cattle dated to 3160+55 BP (Ua-19400) and 3095+65 BP (Ua-19407) at Västerbjers had δ^{13}C values of -21.4‰ and -20.8‰, respectively, and δ^{15}N values of 4.1‰ and 5.1‰, respectively (Eriksson 2004, p.141,143). The δ^{13}C values of cattle at the Neolithic of the Iron Gates region of the Danube valley were between -21.8 and -20.3‰ and their δ^{15}N value range was 4.5-7.7‰ (Bonsall et al 1997). The average δ^{13}C and δ^{15}N values of -20.7 ± 0.7‰ and 6.0 ± 0.4‰, respectively, were found in cattle in Neolithic Slovenia (Ogrinc and Budja 2005). Cattle δ^{13}C values from the Anglo-Saxon period at Berinsfield were between -21.8 and -21.4‰ and δ^{15}N values were between 5.3 and 6.3‰ (Privat et al 2002). Our cattle's δ^{15}N values were a little higher, suggesting different feeding patterns, perhaps ingestion of some cultivated plants (millet?) or human food refuse.

In a previous study (Antanaitis and Ogrinc 2000), the Late Bronze Age Turlojiškė's common or broomcorn millet (Panicum miliaceum L.) was found to have a δ^{13}C value of -9.1‰ and δ^{15}N value of 6.4‰. The mean δ^{13}C value of Bender's 1968 study of both Panicum and Setaria millet was -14.3‰ (Murray and Schoeninger 1988). Isotopic composition depends on several physical and/or biochemical properties and geoclimatic conditions, and the isotopic composition of a plant from different regions could have different stable isotopic signatures. Climate can cause ~3‰ variation in the δ^{13}C of a single species of plant (Cormie and Schwarz 1996, Smith et al 1976, Winter et al 1982). Our millet grains were charred. Carbonization was found not to alter carbon isotopic values, but rather to stabilize plant remains, protecting them from isotopic alteration after burial (Araus et al 2001, Tieszen and Fagre 1993).

The Human data

Within the whole data set there are no clear differences in diets related to sex or age.

As seen in Figure 2B, there does appear to be a chronological trend in human diet, noticeable especially when comparing Late Mesolithic, Late Neolithic, and Bronze Age individuals.

One set of data cluster at Donkalnis's grave nos. 1, "deranged", 5, 6, and 7. These burials have not been radiocarbon dated. Originally these burials were presumed "Late Neolithic Baltic Haff Culture" (Kunskas et al 1985), then possibly Mesolithic (Ramsey et al 2000), currently Mesolithic or Neolithic (Česnys and Butrimas, in press). The average δ13C values of -22.6 ± 0.6‰ and δ^{15}N of 10.3 ± 0.4‰ suggest relatively uniform diets between males and females with animal proteins coming from freshwater fish and other animal protein. It is interesting to note that the stable isotope signature of the child(ren) (Donkalnis 5) is similar to the adults, suggesting similar feeding habits. The δ^{15}N values are lower than those from the Danube Iron Gates sites studied by Bonsall et al 1997. The values are more indicative of diets in which the majority of proteins come from terrestrial-based resources with an addition of a significant amount of river fish.

A similar situation is suggested by the average δ^{13}C value of -22.7 ± 0.1‰ of the clustered individuals we know by radiocarbon dates to belong to the Late Mesolithic (Spiginas graves 3 and 4; Donkalnis graves 2 and 4), but the elevated average δ^{15}N value of 12.6 ± 0.3‰ indicates a higher input from freshwater fish. The majority of Ukrainian data from the Dnieper Rapids region that correspond chronologically with Lithuanian Late Mesolithic individuals show δ^{13}C values between -22‰ and -24‰, values indicative of the addition of aquatic resources, most likely river fish, to the diets of the individuals (Lillie and Richards 2000, p. 967).

The Late Atlantic Early Neolithic (Donkalnis 3) and Middle Neolithic (Spiginas 1) data suggest that freshwater fish was still the main source of protein in the human diet. However, only one human sample represents the entire Early Neolithic and one human sample the entire Middle Neolithic here! Stable carbon values obtained elsewhere for Middle Neolithic Kretuonas 1B individuals (graves 1 and 3) in Lithuanian territory were -24.4‰ and -23.1‰ (Ramsey et al 2000). A Late Atlantic Middle Neolithic individual's δ^{13}C value from a burial at the site of Tamula in Estonian territory was -23.9‰ (Lougas et al 1996, p. 405). At Latvia's Zvejnieki burial ground, with the exception of one δ^{13}C outlier of -18.8‰, 26 analysed human samples had carbon isotope values ranging between -24.1 and -21.3‰, indicating freshwater/ terrestrial protein input, while the high stable nitrogen values suggested a substantial contribution of protein likely from freshwater sources. In Zvejnieki, one group of human values clustered tightly with otters' values: approximately -23.2 to -23.9‰ δ^{13}C and approximately 12 to 13‰ δ^{15}N values, suggesting that these individuals had a diet similar to otters who eat mostly fish, but also crustaceans, amphibians, small mammals, and birds (Eriksson et al 2003, p.12). Middle Neolithic Early Subboreal human stable carbon values at the Estonian Kudruküla I and II were -21‰ and -20,4‰ (Lõugas et al 1996, p. 405). In general, concerning Stone Age human values at Zvejnieki, Eriksson et al point out (2003, p. 14) a pattern of higher variability in diet beginning from the Middle Neolithic.

All Lithuanian Late Neolithic Battle Axe and Corded Ware culture sample data (Gyvakarai, Plinkaigalis 242, Spiginas 2, and Plinkaigalis 241) have very similar isotopic signatures with δ^{13}C values ranging between -21.9 and -21,4‰, and δ^{15}N values ranging between 7.99 and 10.1‰. The δ^{15}N values are still high, suggesting a diet of mainly animal protein, either meat or milk. It is unlikely that freshwater fish were consumed in any significant quantities. These stable isotope data correspond well with human values obtained from Late Neolithic Corded Ware Culture individuals at three sites in Latvian territory Zvejnieki, Selgas, and Sarkaņi. The Corded Ware Culture individuals from Latvian territory had an average δ^{13}C value of -21.7‰ and a δ^{15}N value of 10.1‰, with standard deviations of 0.3‰ in both cases (Eriksson et al 2003, p.17). The low standard deviations indicate a completely uniform diet for the Corded Ware Culture group of individuals (Eriksson et al 2003, p.17: Lovell et al 1986) and this very likely is in the sense that they were practicing animal husbandry.

The coastal Neolithic Pitted Ware Culture of the Baltic region, which corresponds to the Middle Neolithic Comb-and-Pit Pottery Culture in Lithuania, was partly coeval with the Late Neolithic Battle Axe Culture. Current stable isotope research has suggested that the archaeological Pitted Ware Culture was represented by a distinct group of people, with a distinct diet. The stable isotope signatures suggest a massive intake of marine high trophic foods, most likely from seals. These people likely were seal hunters with a common cultural identity (Eriksson 2004, Erikkson et al 2006, Lidén and Eriksson 2007).

During the Bronze Age (Turlojiškė 1 of 1996 (Early Bronze Age); Turlojiškė 4 of 1998 and Kirsna (both Late Bronze Age)), similar δ^{15}N values were observed as with the Lithuanian Late Neolithic individuals, but with even higher δ^{13}C values, averaging -18.4 ± 0.9‰. Higher δ^{13}C values could indicate marine protein in the diet, but the δ^{15}N values are too low. The data rather suggest a diet based on domestic animals and the C4 plant millet. This possibility is further supported by stable isotope data determined in the cattle (Table 4) found at the same period and environment.

5. Discussion, conclusions, future research

Individuals such as Donkalnis 2, Donkalnis 4, and Spiginas 1 whose grave goods of various animal tooth pendants would suggest that game constituted an important part of their dietary input turn out to be individuals who, by stable isotope evidence, actually had a significant amount of fish in their diets. Whereas zooarchaeological data might suggest big game hunting as a prominent subsistence base, stable isotope data suggest that people in Lithuanian territory in the Mesolithic and earlier Neolithic had a diet that largely consisted of freshwater fish. This pattern corresponds in general with Mesolithic and earlier Neolithic human stable isotope data in Latvian territory, at the Zvejnieki cemetery (Eriksson et al 2003, p.14). Also, stable isotope data of later Mesolithic humans of the Dnieper Rapids region suggest a slightly higher input from freshwater fish when compared to the Epipalaeolithic period (Lillie and Jacobs 2006, p.883).

Available Late Neolithic zooarchaeological material generally is associated with archaeological cultures other than the Corded Ware Culture (especially with the Narva Culture). Stable isotope data suggest that "Late Neolithic" Corded Ware Culture bearers in the East Baltic actually were the first "Neolithic" inhabitants inasmuch as the term refers to food production. Stable isotope data from individuals who archaeologically belong to the Corded Ware Culture horizon have very uniform values that suggest little or no consumption of fish and a diet mostly of animal protein, very possibly of animals such as cattle. These Late Neolithic human stable isotope data correspond with extensive palynological data which suggest that farming was making a noticeable impact on the environment in the Late Neolithic (Stančikaitė 2000).

Available human palaeodental data from Zvejnieki suggest slight and gradual changes through early prehistory in diet with, perhaps, a similar ratio of animal protein and plant food. Both palynological and dental data suggest the importance of cultivated plants in diet. The combination of nitrogen stable isotope data with the carbon stable isotope data suggest that by the Bronze Age, at least in the southwestern (Turlojiškė) region of Lithuania, both domestic animals such as cattle and the C_4 plant millet were important food sources. While the archaeological materials both of cattle bone and of charred millet grains that date to the Late Bronze Age have previously been discovered in southwestern Lithuania (Antanaitis et al 2000; Antanaitis and Ogrinc 2000; Antanaitis-Jacobs et al 2001, 2002), this study suggests that an individual from the Early Bronze Age may have had a similar diet of cattle and millet.

From where did the millet come to Lithuanian territory? The Dnieper-Donets river basins in Ukraine currently are being investigated by archaeobotanical, genetic, and isotopic means as one possible gateway for the spread of millet into Eastern Europe (see "The East-West Millet Project" http://www.arch.cam.ac.uk/millet/).

Could Donkalnis 5 and 6, perhaps 7, actually be chronologically closer to the Late Neolithic, eating just a bit more freshwater fish than their later Late Neolithic inhabitant counterparts? Or were they earlier Mesolithic individuals who, like those at Ukraine's Epipalaeolithic Vasilyevka III cemetery, relied less on freshwater fish and more on terrestrial food resources (Lillie et al 2003; Lillie and Jacobs 2006)? Radiocarbon dating of these individuals would help to solve this question. Precise chronology has been an issue in Lithuanian Stone Age prehistory (Antanaitis 1999; Ramsey et al 2000; Česnys and Butrimas, in press). Recent zooarchaeological work in Latvia of the Zvejnieki cemetery material, specifically of bird bones associated with human burials indicates chronological misassociations; the bird bones chronologically, in fact, cannot be interpreted as grave goods (Mannermaa et al 2007). Estonian zooarchaeological and radiocarbon data suggest that the beginning of the Corded Ware Culture in the East Baltic was between 3000 and 2700 cal BC (Lougas et al 2007), 200 years earlier than previously supposed for Lithuania (Antanaitis and Girininkas 2002, p.11) and 300 years earlier than had been supposed for Latvia (Antanaitis 2001).

A uniform diet apparently was shared, however, by the Corded Ware Culture bearers in Lithuanian territory, as in Latvian territory (Eriksson et al 2003), something that is suggestive of a common cultural identity. Such has been the proposed scenario of the partly coeval Pitted Ware Culture bearers of the Baltic region (Eriksson et al 2006, Lidén and Eriksson 2007). Could subsistence have been a base for the development of separate sociocultural groups in the Late Neolithic, say those of Pitted Ware Culture seal hunters and Corded Ware Culture animal herders?

Corded Ware / Boat Axe Culture bearers often are associated with Indo-Europeans (Gimbutas 1997; Mallory 1989, p. 108). Also they are associated with a very specific phenotype: extreme hypermorphy, pronounced dolichocrany, a high, broad, and strongly profiled face, and a robust body build. This phenotype is characteristic of the Spiginas 2, Gyvakarai, as well as Plinkaigalis 241 and 242 individuals (Česnys 1985), i.e., all the Late Neolithic and Corded Ware Culture bearers in this study. The phenotype is similar to that found in Estonia (Mark 1956), Prussia (for summary, see Česnys 1991a, 1991b, 1991c), and the later Fatyanovo Culture bearers from the Central Russian plain. Such a type has no precedent in this area and its origins are still obscure (Jankauskas and Antanaitis 2000). That all the known Corded Ware Culture burials in Lithuanian territory are singular, contain adult individuals, are associated with a particular set of grave goods, and are characterised by a very specific phenotype would appear to support the hypothesis of immigration. Isotopic analysis of Linearbandkeramik people in Central Europe (5200-5000 BC) prove that quite a number of individuals even 2000 years earlier could migrate to different locations during their life (Price et al 2001). Unfortunately, no valid ancient DNA data have yet been obtained from Late Neolithic Corded Ware Culture bearers to support or negate the possibility of immigrants. Over 50 Corded Ware Culture burial sites are known in the East Baltic (see Žukauskaitė 2004, Fig.1). Precise radiocarbon, stable isotope, bioanthropological, and DNA data of these specific Corded Ware Culture bearers could answer such questions.

Acknowledgements

Indre Antanaitis-Jacobs gratefully acknowledges Ken Antanaitis-Jacobs for initiating the stable isotope research in Lithuania many many moons ago, as well as Gunilla Eriksson, Miglė Stančikaitė, Lembi Lõugas, Malcolm Lillie for various forms of collaboration. Thank you.

References

ALEXANDERSEN, V., 1988. Description of the human dentitions from the Late Mesolithic grave fields at Skateholm, southern Sweden. *In:* L. LARSSON, ed. *The Skateholm Project I. Man and Environment*. Stockholm, 106-163.

ALEXANDERSEN, V., 2003. Dental variation and change through time in Nordic populations. *In*: E. IREGREN, L. LARSSON, eds. *A tooth for a tooth: Seminar for odontologists, osteologists and archaeologists, May 28th 1998.* University of Lund, Institute of Archaeology Report Series No. 87, 9-36.

ANTANAITIS, I., 1999. Concerning the transition to farming in the East Baltic. *Documenta Praehistorica,* XXVI, 89-100.

ANTANAITIS, I., 2001a. *Rytų Baltijos regiono gyventojų ekonominė ir socialinė organizacija Vėlyvajame akmens ir Ankstyvajame bronzos amžiuje.* Thesis, (PhD). Vilnius University.

ANTANAITIS, I. 2001b. *East Baltic economic and social organization in the Late Stone and Early Bronze Ages.* Thesis summary, (PhD). Vilnius University.

ANTANAITIS, I., OGRINC, N., 2000. Chemical analysis of bone: Stable isotope evidence of the diet of Neolithic and Bronze Age people in Lithuania. *Istorija*, XLV, 3-12.

ANTANAITIS, I., RIEHL S., KISIELIENĖ, D., KELERTAS, K., 2000. The evolution of the subsistence economy and archaeobotanical research in Lithuania. *Lietuvos archeologija*, 19, 47-67.

ANTANAITIS-JACOBS, I., GIRININKAS A., 2002. Periodization and Chronology of the Neolithic in Lithuania. *Archaeologia Baltica*, 5, 9-39.

ANTANAITIS-JACOBS, I., KISIELIENĖ, D., STANČIKAITĖ, M. 2001. Macrobotanical and palynological research at two archaeological sites in Lithuania. *Archaeology and Environment,* 15. 5-21.

ANTANAITIS-JACOBS, I., KISIELIENĖ, D., STANČIKAITĖ, M., 2002. Archeobotanika Lietuvoje: Makrobotaniniai ir palinologiniai tyrinejimai. *Lietuvos archeologija*, 26, 77-98.

ARAUS, J.L., SLAFER, G.A., ROMAGOSA, I., MOLIST, M., 2001. FOCUS: Estimated wheat yields during the emergence of agriculture based on the carbon isotope discrimination of grains: Evidence from a 10th Millennium BP site on the Euphrates. *Journal of Archaeological Science*, 28, 341-350.

BEHRE, K.-E., 1981. The interpretation of anthropogenic indicators in pollen diagrams. *Pollen and Spores* 23(2), 225-245.

BENDER, M.M., 1968. Mass Spectrometric studies of carbon 13 variation in corn and other grasses. *Radiocarbon,* 10, 468-472.

BENDER, B., BAERRIS, M., STEVENTON, R.L., 1981. Further light on carbon isotopes and Hopewell agriculture. *American Antiquity* 46(2,) 346-353.

BENNIKE, P., 1985. *Palaeopathology of Danish Skeletons: A Comparative Study of Demography, Disease and Injury*. Akademisk Forlag.

BOCHERENS, H., FOGEL, M.L., TUROSS, N., ZEDER, M., 1995. Trophic structure and climatic information from isotopic signatures in a Pleistocene cave fauna of Southern England. *Journal of Archaeological Science* 22, 237-340.

BOCHERENS, H., BILLIOU, D., PATOU-MATHIS, M., BONJEAN, D., OTTE, M., MARIOTTI, A., 1997. Isotopic biogeochemistry (^{13}C, ^{15}N) of fossil mammal collagen from Scladina cave (Sclayn, Belgium). *Quaternary Research* 48, 370-380.

BOCHERENS, H., BILLIOU, D., MARIOTTI, A., PATOU-MATHIS, M., OTTE, M., BONJEAN, D., TOUSSAINT, M., 1999. Palaeoenvironmental and palaeodietary implications of isotopic biogeochemistry of last interglacial Neanderthal and mammal bones in Scladina cave (Belgium). *Journal of Archaeological Science* 26, 599-607.

BONSALL, C., LENNON, R., MCSWEENEY, K., STEWART, C., HARKNESS, D., BOROREANT, V., BARTOSIEWICZ, L., PAYTON, R., CHAPMAN, J., 1997. Mesolithic and Early Neolithic in Iron Gates: A Palaeodietary Perspective. *Journal of European Archaeology,* 5, 50-92.

BROWN, T.A., NELSON, D.E., VOGEL, J.S., SOUTHON, J.R., 1988. Improved collagen extraction by modified Longin method. *Radiocarbon*, 30, 171-177.

BUTRIMAS, A., 1996. Šarnelės neolito gyvenvietė. *Lietuvos archeologija*, 14, 174-191.

BUTRIMAS, A., ČESNYS, G., JANKAUSKAS, R. 1992. Spigino mezolito kapai. *Lietuvos archeologija*, 8, 4-15.

BUTRIMAS, A., KAZAKEVIČIUS, V., ČESNYS, G., BALČIŪNIENĖ, I., JANKAUSKAS, R., 1985. Ankstyvieji Virvelinės keramikos kultūros kapai Lietuvoje. *Lietuvos archeologija*, 4, 14-24.

CORMIE, A.B., SCHWARCZ, H.P., 1996. Effects of climate on deer bone $\delta^{15}N$ and $\delta^{13}C$: Lack of precipitation effects on $\delta^{15}N$ for animals consuming low amounts of C_4 plants. *Geochim. Cosmochim. Acta*, 60, 4161-4166.

ČESNYS, G., 1991a. The Neolithic and Bronze Age man in South-East Baltic Area. 1. An Inventory of recent and old craniological materials from univariate viewpoint. *Homo,* 42, 1-20.

ČESNYS, G., 1991b. The Neolithic and Bronze Age man in South-East Baltic Area. 2. Multivariate approach. *Homo,* 42, 130-149.

ČESNYS, G. 1991c. The Neolithic and Bronze Age man in South-East Baltic Area. 3. An essay on the genesis of craniological types. *Homo*, 42, 232-243.

ČESNYS, G., BUTRIMAS, A. In press. Reinventing Mesolithic Skulls in Lithuania: Donkalnis and Spiginas Sites. *Collegium Antropologicum*.

DAUGNORA, L., 2000. Fish and seal osteological data at Šventoji sites. *Lietuvos archeologija*, 19, 85-101.

DAUGNORA, L., 2000a. Šventosios gyvenvietėse iškastų žuvų kaulų analizė. *Archeologiniai tyrinėjimai Lietuvoje 1998 ir 1999 metais*, 580-599.

DAUGNORA, L., GIRININKAS, A., 1995. Analysis of faunal remains from the Kretuonas lake settlements. *International Journal of osteoarchaeology*, 5, 83-92.

DAUGNORA, L., BILSKIENĖ, R., HUFTHAMMER, A.K., 2002. Bird remains from Neolithic and Bronze Age settlements in Lithuania. *Acta zoologica cracoviensia*, 450, 233-238.

DAUGNORA, L., GIRININKAS, A., 1995. Neolithic and Bronze Age mixed farming and stock breeding in the traditional Baltic culture-area. *Archeologia Baltica*, 1, 43-51.

DAUGNORA, L., GIRININKAS, A., 1996. *Osteoarcheologija Lietuvoje: Vidurinysis ir vėlyvasis holocenas*. Vilnius: Kultūros paveldo centras.

DAUGNORA, L., GIRININKAS, A. 1998. Stock breeding in the Baltic Culture Area. *Archaeologia Baltica*, 3, 223-233.

DAUGNORA, L., GIRININKAS, A., 2004. *Rytų Pabaltijo bendruomenių gyvensena XI – II tūkst. Pr. Kr*. Kaunas: Lietuvos veterinarijos akademija ir Lietuvos istorijos institutas.

DUOBA, D., DAUGNORA, L., 1994. Osteologinės medžiagos, rastos Šventosios 6-oje gyvenvietėje, tyrimo rezultatai. *Lietuvos veterinarijos akademijos mokslo darbai* 22, 2428.

ERIKSSON, G., 2003. *Norm and difference. Stone Age dietary practice in the Baltic region*. Thesis, (PhD). Stockholm University.

ERIKSSON, G., 2004. Part-time farmers or hard-core sealers? Vasterbjers studied by means of stable isotope analysis. *Journal of Anthropological Archaeology*, 23, 135-162.

ERIKSSON, G., 2006. Stable isotope analysis of human and faunal remains from Zvejnieki. *In:* L. LARSSON, I. ZAGORSKA, eds. *Back to the Origins: New Research in the Mesolithic-Neolithic Zvejnieki Cemetery and Environment, Northern Latvia*. Almqvist & Wiksell International: Stockholm, 183-215.

ERIKSSON, G., LÕUGAS, L., ZAGORSKA, I., 2003. Stone Age hunter-fisher-gatherers at Zvejnieki, northern Latvia: radiocarbon, stable isotope and archaeozoology data. *Before Farming*, 1 (2),1-25. Available from http://www.waspjournals.

ERIKSSON, G., FORNANDER, E., LINDERHOLM, A., OLSSON, A., STORÅ, J., NÚÑEZ, M., LIDÉN, K., 2006. Distinguished by diet: The Neolithic Pitted Ware Culture in the Baltic Region. Poster presented at the Second International Symposium on Biomolecular Archaeology, Stockholm, 7-9 September 2006.

FORNANDER, E. 2005/2006. The Wild Side of the Neolithic. A study of Pitted Ware diet and ideology through analysis of stable carbon and nitrogen isotopes in skeletal material from Korsnäs, Grödinge parish, Södermanland. Thesis, (PhD). Stockholm University.

FORSTEN, A., ALHONEN, P., 1975. The subfossil seals of Finland and their relation to the history of the Baltic Sea. *BOREAS*, 4, 143-155.

GIMBUTAS, M., 1997. The Kurgan Culture and the Indo-Europeanization of Europe. *In*: M.ROBBINS DEXTER, K. JONES-BLEY (eds.). *Journal of Indo-European Studies Monograph No. 18*. Institute for the Study of Man: Washington D.C.

GIRININKAS, A., ČESNYS, G., BALČIŪNIENĖ, I., JANKAUSKAS, R., 1985. Kretuono 1-os gyvenvietes vidurinio neolito kapai. *Lietuvos archeologija*, 4, 5-14.

GIRININKAS, A., 1990. Kretuonas – srednii i pozdnii neolit. *Arkheologiia Litvy*, 7, Vilnius: Mokslas.

GIRININKAS, A., 1994. *Baltų kultūros ištakos*. Vilnius: Savastis.

GIRININKAS, A. 2002. Migraciniai procesai Rytų Pabaltijyje vėlyvajame neolite. Virvelinės keramikos kultūra. *Lietuvos archeologija*, 23, 73-92.

GRASIS, N., 1996. Auklas keramikas kultūras apbedījumi Sarkaņos un Selgās. *Zinātniskās ataskaites sesijas materiāli par arheologu 1994 un 1995 gada pētījumu rezultātiem*, 60-65.

GRAUDONIS, J., 1989. *Nocietinātās apmetnes Daugavas lejtecē*. Rīga: Zinātne.

GUMINSKI, W., 2005. Bird for dinner Stone age hunters of Dudka and Szczepanki, Masurian Lakeland, NE-Poland. *Acta archaeologica*, 76, 111-148.

HILLSON, S., 1986. *Teeth*. Cambridge: Cambridge University Press.

HOBSON, K.A., WELCH, H.E., 1995. Cannibalism and trophic structure in a high Arctic lake: Insights from stable isotope analysis. *Canadian Journal of Fisheries and Aquatic Sciences*, 52, 1195-1201.

JAANITS, L., LAUL, S., LÕUGAS, V., TÕNISSON, E., 1982. *Eesti esiajalugu*. Tallinn: Eesti Raamat.

JANKAUSKAS, R., ANTANAITIS, I., 2000. Indo-Europeans in the East Baltic: A Synthesis of Current Anthropological and Archaeological Theory and Data. *In:* A. KÜNNAP, ed. *Fenno-Ugristica* 23, *The Roots of Peoples and Languages of Northern Eurasia II and III.*. University of Tartu, Division of Uralic Languages, 115-124.

JUODAGALVIS, V., 2005. Mezolitas. Chronologines mezolito ribos. *In*: A. GIRININKAS, ed. *Lietuvos istoria. Akmens amzius ir ankstyvasis metalu laikotarpis*. Vilnius: Baltos lankos. 1, 54-55.

JUODAGALVIS, V., SIMPSON, D.N., 2000. Šventoji Revisited – the Joint Lithuanian-Norwegian Project. *Lietuvos archeologija*, 19, 139-152.

KABAILIENĖ, M. 1990. *Lietuvos holocenas (Tyrimo metodai, stratigrafija ir paleogeografija)*. Vilnius: Mokslas.

KABAILIENĖ, M., 1998. Vegetational History and Climate Changes in Lithuania during the Late Glacial and Holocene, according to Pollen and Diatom Data. In: M. KABAILIENĖ, D. KISIELIENĖ, D. MOE, U. MILLER, T. HACKENS, eds. *Environmental History and Quaternary Stratigraphy of Lithuania, PACT 54*. Belgium: Rixensart, 13-30.

KATZENBERG, M.A., WEBER, A., 1999. Stable Isotope Ecology and Palaeodiet in the Lake Baikal Region of Siberia. *Journal of Archaeological Science*, 26, 651-659.

KAZAKEVIČIUS, V., 1993. Plinkaigalio kapinynas. Monografija. *Lietuvos archeologija*, 10.

KRIISKA, A., 1996. Stone Age settlements in the lower ridges of the Narva River. *In:* T. HACKENS, S. HICKS, V. LANG, U. MILLER, L. SAARSE, eds. *Coastal Estonia: Recent Advances in Environmental and Cultural History. PACT 51*. Rixensart: Belgium, 359-372.

KUNSKAS, R., BUTRIMAS, A., ČESNYS, G., BALČIŪNIENĖ, I., JANKAUSKAS, R., 1985. Donkalnis: Velyvojo neolito gyvenvietė, alkas ir kapinynas. *Lietuvos archeologija*, 4, 25-66.

LANG, V., 1992. Eesti labidaspeaga luunõelte dateerimisest. *Stilus*, 1, 8-32.

LANG, V., 1994a. Fossil Fields at Saha-Loo. *TATÜ*, 1, 22-26.

LANG, V. 1994b. Celtic and Baltic Fields in North Estonia. Fossil field systems of the Late Bronze Age and Pre-Roman Iron Age at Saha-Loo and Proosa. *Acta Archaeologica*. Ilmumisel.

LANG, V., 1994c. Arheoloogilise materjali kõrvutusvõimalustest õietolmudiagrammiga (Maardu järve ja selle ümbruse põhjal). *TATÜ*, 1, 1-12.

LANG, V., 1995. Early Farming and Farming Society in Estonia: marginal notes to some tendencies of development (English summary). In: V. LANG, ed. *Eesti Arheologia Historiograafilisi, Teoreetilisi ja Kultuuriajaloolisi Aspekte. Muinaasaja Teadus.* Tallinn: Teaduste Akadeemia Kirjastus, 3, 176-181.

LARSEN, C.S., 1997. *Bioarchaeology: interpreting behavior from the human skeleton.* Cambridge.

LARSEN, C.S., TEAFORD, M.F., SANDFORD, M.K., 1997. Teeth as Tools at Tutu: Extramasticatory Behavior in Prehistoric St. Thomas, U.S. Virgin Islands. *In*: J.R. LUKACS, G.R. SCOTT, eds. *Albert Dahlberg Memorial Volume on Dental Morphology and Evolution*. Chicago: University of Oregon Press.

LAWSON, J.W., STENSON, G.B., MCKINNON, D.G., 1995. Diet of harp seals (*Phoca groenlandica*) in nearshore waters of the northwest Atlantic during 1990-1993. *Canadian Journal of Zoology*, 73, 1808-1818.

LEE-THORP, J.A., 2008. On isotopes and old bones. *Archaeometry*, 50, 925-950.

LEPIKSAAR, J., 1986. The Holocene History of Theriofauna in Fennoskandia and Baltic Countries. *Striae*, 24, 51-70.

LIDÈN, K., 1995. *Prehistoric Diet Transitions.* Thesis, (PhD). Stockholm University.

LIDÈN, K., NELSON, D.E., 1994. Stable carbon isotopes as dietary indicator, in the Baltic area. *Fornvannen*, 89, 13-21.

LIDÉN, K, ERIKSSON, G., 2007. Walking on the wild side: on cultural diversity and the Pitted Ware Culture along the Swedish east coast during the Middle Neolithic. *In*: M. LARSSON, M. PARKER PEARSON, eds. *From Stonehenge to the Baltic. Living with cultural diversity in the third millenium BC*. BAR International Series 1692, 1-9.

LILLIE, M.C., RICHARDS, M., 2000. Stable Isotope Analysis and Dental evidence of Diet at the Mesolithic-Neolithic Transition in Ukraine. *Journal of Archaeological Science*, 27, 965-972.

LILLIE, M., RICHARDS, M.P., JACOBS, K., 2003. Stable isotope analysis of 21 individuals from the Epipalaeolithic cemetery of Vasilyevka III, Dnieper Rapids region, Ukraine. *Journal of Archaeological Science*, 30, 743-752.

LILLIE, M., JACOBS, K., 2006. Stable isotope analysis of 14 individuals from the Mesolithic cemtery of Vasilyevka II, Dnieper Rapids region, Ukraine. *Journal of Archaeological Science*, 33, 880-886.

LÕUGAS, L., 1997. Post-glacial Development of Vertebra Fauna in Estonian Water Bodies. A palaeozoological study. Thesis, (PhD). Tartu University.

LÕUGAS, L., LIDÉN, K., NELSON, D.E., 1996. Resoure utilisation along the Estonian coast during the Stone Age. *In*: T. HACKENS, S. HICKS, V. LANG, U. MILLER, L. SAARSE, eds. *Coastal Estonia: Recent Advances in Environmental and Cultural History, PACT 51.* Rixensart: Belgium, 399-420.

LÕUGAS, L., KRIISKA, K., MALDRE, L., 2007. New dates for the Late Neolithic Corded Ware Culture and early husbandry in the East Baltic region. *Archaeofauna*, 16, 21-31.

LÕUGAS, V., 1970. *Eeati varane metalliaeg.* Thesis, (PhD). Estonian History Institute.

LOVELL, N., NELSON, D.E., SCHWARTZ, H.P., 1986. Carbon isotope ratios in palaeodiet: lack of sex or age effect. *Archaeometry*, 28, 51-65.

LOZE, I., 1979. Pozdnii neolit i rannia bronza Lubanskoi ravniny, Riga: Zinatne.

MAKOWIECKI, D., 2003. *Historia Ryb i Rybolowstwa w Holocenie na Nižu Polskim w swietle badan archeoichtiologicznych.* Poznan.

MALLORY, J.P., 1989. *In Search of the Indo-Europeans. Language, Archaeology and Myth.* London: Thames & Hudson.

MANNERMA, K., ZAGORSKA, I., JUNGER, H., ZARINA, G., 2007. New radiocarbon dates of human and bird bones from Zvejnieki burial ground in northern Latvia. *Before Farming*, 1(2),. Available from http://www.waspjournals.

MANGERUND, J., ANDERSEN, S.T., BEGLUND, B.E., DONNER, J.J., 1974. Quaternary stratigraphy of Norden, a proposal for terminology and classification. *Boreas*, 3, 109-128.

MARK, K.J., 1956. Paleoantropologija Estonskoj SSR. *Baltijskii etnograficheskii sbornik (Moskva)*, 170-228.

MAYS, S. 1998. *The Archaeology of Human Bones.* New York: Routledge.

MEIKLEJOHN, C., ZVELEBIL, M., 1991. Health status of European populations at the agricultural transition and the implications for the adoption of farming. *In:* H. BUSH, M. ZVELEBIL, eds. *Health in Past Societies: Biocultural interpretations of human skeletal remains in archaeological contexts.* British Archaeological Reports International Series 567, 129-145.

MERBS, C. F., 1983. Patterns of activity-induced pathology in a Canadian Inuit population. *Archaeological Survey of Canada, Paper No. 119*, Ottawa.

MERKEVIČIUS, A., 1998. Turlojiškės archeologinių objektų tyrinėjimai 1996 ir 1997 m. *Archeologiniai tyrinėjimai Lietuvoje 1996 ir 1997 m.* Vilnius: Lietuvos istorijos institutas, 26-29.

MERKEVIČIUS, A., 2000. Turlojiškės archeologinio komplekso tyrinėjimai. *Archeologiniai tyrinėjimai Lietuvoje 1998 ir 1999 metais*. Vilnius: Diemedžio leidykla, 44-46.

MILNER, N., CRAIG, O.E., BAILEY, G.N., PEDERSEN, K., ANDERSEN, S.H., 2004. Something fishy in the Neolithic? A re-evaluation of stable isotope analysis of Mesolithic and Neolithic coastal populations. *Antiquity*, 78 (299), 9-22.

MURRAY, M., SCHOENINGER, M.J., 1988. Diet, status, and complex social structure in Iron Age Central Europe: Some contributions of bone chemistry. *In*: B. GIBSON, M. GESELOWITZ, eds. *Tribe and Polity in Late Prehistoric Europe*. New York: Plenum Press, 157-178.

NILSSEN, K.T., HAUG, T., POTELOV, V., TIMOSHENKO, Y.K., 1995. Feeding habits of harp seals (*Phoca groenlandica*) during early summer and autumn in the northern Barents Sea. *Polar Biology*, 15, 485-493.

OGRINC, N., BUDJA, M. 2005. Paleodietary reconstruction of a Neolithic population in Slovenia: A stable isotope approach. *Chem Geol*., 218, 103-116.

OLSSON, A., VALTERS, K., BURREAU, S., 2000. Concentrations of organochlorine substances in relation to fish size and trophic position: A study on perch (*Perca fluviatilis* L.). *Environmental Science & Technology*, 34, 4878-4886.

PALUBECKAITĖ, Ž., JANKAUSKAS, R., 2006. Dental status of Zvejnieki sample as reflection of early ontogenesis and activities in adulthood. In: L. LARSSON,

I. ZAGORSKA, eds. *Back to the Origin: New Research in the Mesolithic-Neolithic Zvejnieki cemetery and environment, Northern Latvia / Acta Archaeologica Lundensia* 52, 163-180.

POSKA, A., SAARSE, L., VESKI, S., KIHNO, K., 1999. Farming from the Neolithic to the Pre-Roman Iron Age in Estonia, as Refleted in Pollen Diagrams. In: U. MILLER, T. HACKENS, V. LANG, A. RAUKAS, S. HICKS, eds. *Environmental and Cultural History of the Eastern Baltic Region, PACT 57*. Belgium: Rixensart, 305-317.

PRICE, T.D., BENTLEY, R.A., LÜNING, J., GRONENBORN, D., WAHL, J. 2001. Prehistoric human migration in the *Linearbandkeramik* of Central Europe. *Antiquity*, 75, 593-603.

PRIVAT, K.L., O'CONNELL, T., RICHARDS, M.P., 2002. Stable isotope analysis of human and faunal remains from the Anglo-Saxon cemetery at Berinsfield, Oxfordshire: dietary and social implications. *Journal of Archaeological Science*, 29, 779–790.

RAMSEY, C.B., PETTIT, P.B., HEDGES, R.E.M., HODGINS, G.W.L., OWEN, D.C., 2000. Radiocarbon dates from the Oxford AMS System: Archaeometry datelist 29. Commentary on Lithuanian graves by I. Antanaitis and K. Jacobs. *Archaeometry*, 42(1), 243-254.

RICHARDS, M.P., HEDGES, R.E.M., 1999. Stable isotope evidence for similarities in the types of marine fods used by Late Mesolithic humans at sites along the Atlantic coast of Europe. *Journal of Archaeological Science*, 26, 717-722.

RICHARDS, M.P., PETTIT, P.B., STINER, M.C., TRINKAUS, E., 2001. Stable isotope evidence for increasing dietary breadth in European mid-Upper Paleolithic. *Proceedings of the National Academy of Sciences of the United States of America*, 98 (11), 6528-6532.

RICHARDS, M.P., SCHULTING, R.J., 2006. Against the Grain? Response to Milner et al., (2004). *Antiquity*, 80, 444-456.

RIMANTIENĖ, R. 1979. *Šventoji I: Narvos kultūros gyvenvietės*. Vilnius: Mokslas.

RIMANTIENĖ, R., 1980. *Šventoji II: Pamarių kultūros gyvenvietės*. Vilnius: Mokslas.

RIMANTIENĖ, R., 1992. The Neolithic of the Eastern Baltic. *Journal of World Prehistory*, 6(1), 97-143.

RIMANTIENĖ, R., 1996. *Akmens amžius Lietuvoje*. Vilnius: „Žiburio" leidykla.

RIMANTIENĖ, R., 1999. Traces of Agricultural Activity in the Stone Age Settlements of Lithuania. In: U. MILLER, T. HACKENS, V. LANG, A. RAUKAS. S. HICKS, eds. *Environmental and Cultural History of the Eastern Baltic Region, PACT 57*. Belgium: Rixensart, 275-290.

RIMANTIENĖ, R., 2005. *Akmens amžiaus žvejai prie Pajūrio lagūnos*. Vilnius: Lietuvos nacionalinis muziejus.

SCHOENINGER, M.J., DENIRO, M.J., 1984. Nitrogen and Carbon Isotopic Composition of Bone Collagen from Marine and Terrestrial Animals. *Geochimica et Cosmochimica Acta*, 48, 625-639.

SCHOENINGER, M.J., DENIRO, M.J., TAUBER, H., 1983. Stable Nitrogen Ratios of Bone Collagen Reflect Marine and Terrestrial Components of Prehistoric Diet. *Science*, 220, 1381-1383.

SCHWARCZ, H.P., SCHOENINGER, M.J. 1991. Stable isotope analyses in human nutritional ecology. *Yearbook of Physical Anthropology*, 34, p. 283-321.

SEALY, J., 2001. Body tissue chemistry and Palaeodiet. *In*: D.R. BROTHWELL, A.M. POLLARD, eds. *Handbook of Archaeological Sciences*. Chichester, John Wiley and Sons, 269-279.

SMITH, B.N., OLIVER, J., MCMILLAN, C., 1976. Influence of carbon source, oxygen, concentration, light intensity and temperature on the $^{13}C/^{12}C$ ratio of plant tissues. *Bot. Gaz*., 137, 99-104.

STANČIKAITĖ, M., 2000. *Natural and Human Initiated Environmental Changes throughout the Late Glacial and Holocene in Lithuanian Territory*. Thesis, (PhD). Vilnius University.

STORÅ, J., 2000. Sealing and animal husbandry in the Ålandic Middle and Late Neolithic. *Fennoscandia archaeologica*, XVI, 57-81.

STORÅ, J., 2001. Stone age hunters and seals in the Baltic. *Stockholm Studies in Archaeology*, 21.

TAUBER, H., 1981. ^{13}C Evidence for Dietary Habits of Prehistoric Man in Denmark. *Nature*, 292, 332-333.

TAUBER, H., 1986. Analysis of Stable Isotopes in Prehistoric Populations. *Mitteilungen der Berliner Gesellschaft für Anthropologie, Ethnologie und Urgeschichte*, 7, 31-38.

TEBELŠKIS, P., 2001. Gyvakarų kaimo vėlyvojo neolito kapas. *Kultūros paminklai*, 8, 3-10.

TEBELŠKIS, P., JANKAUSKAS, R. 2006. Late Neolithic grave from Gyvakarai in the context of current archaeological and anthropological knowledge. *Archaeologia Baltica*, 6,

TIESZEN, L.L., FAGRE, T., 1993. Carbon isotopic variability in modern and archaeological maize. *Journal of Archaeological Science*, 20, 24-40.

TORMOSOV, D.D., REZVOV, G.V., 1978. Information on the distribution, number and feeding habits of ringed and grey seals in the Gulfs of Finland and Riga in the Baltic Sea. *Riistatieteellisiä Julkaisuja / Finnish Game Research*, 37, 14-17.

VANKINA, L.V., 1970. *Torfianikovaia stoianika Sarnate*. Riga: Zinatne.

VASKS, A., KALNINA, L., RITUMS, R., 1999. The Introduction and Pre-Christian History of Farming in Latvia. In: U. MILLER, T. HACKENS, V. LANG, A. RAUKAS, S. HICKS, eds. *Environmental and Cultural History of the Eastern Baltic Region, PACT 57*. Belgium: Rixensart, 291-304.

WINTER, K., HOLTUM, J.A., EDWARDS, G.E., O'LEARY, M.H. 1982. Effect of low relative humidity on $\delta^{13}C$ values in two C_3 grasses and in *Panicum milioides*, a C_3-C_4 intermediate species. *J. Exp. Bot*., 33, 88-91.

ZAGORSKA, I., 1997. The first radiocarbon datings from Zvejnieki Stone Age burial ground, Latvia. *ISKOS*, 11:42-46.

ZAGORSKA, I., 2000. The art from Zvejnieki burial ground, Latvia. In: A. BUTRIMAS, ed. *Prehistoric Art in the Baltic Region*. Vilnius: Academy of Fine Arts, 79-92.

ZAGORSKA, I., 2000. Sea mammal hunting strategy in eastern Baltic. *Lietuvos Archeologija*, 19, 275-285.

ZAGROSKIS, F., 2004. *Zvejnieki (Northern Latvia) Stone Age cemetery*. BAR International Series 1292.

ZAGORSKIS, F., 1987. *Zvejnieku akmens laikmeta kapulauks*. Rīga: Zinatne.

ZVELEBIL, M., 1998. Agricultural Frontiers, Neolithic Origins, and the Transition to Farming in the Baltic Basin. *In*: M. ZVELEBIL, L. DOMANSKA, R. DENNELL, eds. *Harvesting the Sea, Farming the Forest*. Sheffield Academic Press, 9-27.

ŽILINSKAS, J., 1931. *Akmens periodo (mesolithicum-neolithicum) žmogus Žemaitijoje ir Suvalkijoje – jo kilmė ir jojo ainiai*. Kaunas: Medicinos fakultetas.

ŽILINSKAS, J., JURGUTIS, A., 1939. Crania Lithuanica (XX amžiaus ir iškastinės lietuvių kaukolės). *Vytauto Didžiojo universiteto Medicinos fakulteto darbai*, 5 (3), 303-468.

ŽUKAUSKAITĖ, J., 2004. Rytų Baltijos regiono virvelinės keramikos kultūros atstovų kilmė. *Lietuvos archeologija*, 25, 109-134.

Received: 10 May 2008; Revised: 15 September 2008; Accepted: 10 April 2009

Dr Indre Antanaitis-Jacobs, corresponding author
Institute of Baltic Sea Region History and Archaeology
Klaipėda University
Tilžės St. 13, LT-91251 Klaipėda
Lithuania
E-mail: indreaj@hotmail.com (primary address)

Prof Dr Mike Richards
Department of Human Evolution
Max Planck Institute for Evolutionary Anthropology
Deutscher Platz 6
Leipzig D-04103, Germany
E-mail: richards@eva.mpg.de

Prof Dr Rimantas Jankauskas
Department of Anatomy, Histology, and Anthropology
Faculty of Medicine
Vilnius University
Čiurlionio 21, Vilnius LT 03101
LITHUANIA
E-mail: rimantas.jankauskas@mf.vu.lt

Dr Linas Daugnora
Institute of Baltic Sea Region History and Archaeology
Klaipėda University
H. Manto 84, LT-91251 Klaipėda
LITHUANIA

Dr Nives Ogrinc
"Jožef Stefan" Institute
Department of Environmental Sciences
Jamova 39
1000 Ljubljana
SLOVENIA
E-mail: nives.ogrinc@ijs.si

MITYBA LIETUVOS ANKSTYVOJOJE PRIEŠISTORĖJE IR NAUJI STABILIŲJŲ IZOTOPŲ DUOMENYS

Indre Antanaitis-Jacobs, Mike Richards, Linas Daugnora, Rimantas Jankauskas, Nives Ogrinc

Santrauka

Straipsnyje apžvelgiami turimi archeologiniai, zooarcheologiniai, paleobotaniniai, odontologiniai duomenys apie Lietuvos akmens ir bronzos amžiais naudotus maisto išteklius ir pristatomi bei detaliai analizuojami nauji stabiliųjų izotopų tyrimų rezultatai, teikiantys tiesioginę informaciją apie mitybą. Stabiliųjų anglies ir azoto izotopų tyrimams panaudoti 75 gyvulių ir 23 žmonių kaulų mėginiai, datuojami akmens ir bronzos amžiais. Straipsnyje aptariama, kaip izotopų vertės koreliuoja su mityba bei kitais mitybos rodikliais, gauti duomenys lyginami su kitų autorių tyrimų rezultatais iš Baltijos regiono, aptariamas socialinis ir kultūrinis kontekstas. 1 pav. pristatomas tiriamasis regionas, 1 lentelėje – chronologija, 2 lentelėje trumpai aprašomi straipsnyje paminėti archeologiniai paminklai, 3 lentelėje – pateikiama informacija apie žmonių kaulų mėginius.

Tiksliai bioarcheologinių duomenų interpretacijai įtakos gali turėti įvairiausi veiksniai. Tuo atžvilgiu žmonių palaikų stabiliųjų izotopų tyrimai mitybos atžvilgiu yra ypač vertingi, nes jie suteikia *tiesioginę* kiekybinę informaciją, ką žmonės valgė, ypač apie baltymų dalį dietoje.

Lietuvos akmens ir bronzos amžių stabiliųjų izotopų tyrimų rezultatai pateikti 4 lentelėje ir 2 pav. Kaip matyti 2 B pav., žmonių mityboje būta tam tikros chronologinės tendencijos, kas tampa ypač akivaizdu lyginant vėlyvojo mezolito, vėlyvojo neolito ir bronzos amžių žmonių tyrimų duomenis.

Donkalnio kapų Nr. 1, 5, 6, 7 ir suardytų kapų medžiagos sudaro vieną grupę. Šie kapai radiokarbono metodu nebuvo datuoti. Stabiliųjų izotopų duomenys liudija santykinai vienodą vyrų ir moterų dietą, kurioje gyvuliniai baltymai buvo gaunami iš gėlavandenių žuvų ir kitų gyvulinės kilmės produktų. Individai, kurie pagal radiokarbono datas priskiriami vėlyvajam mezolitui (Spigino kapai Nr. 3 ir 4; Donkalnio kapai Nr. 2 ir 4), taip pat sudaro vieną grupę, o jų aukštesnės δ^{15}N vertės (12,6±0,3‰) liudija didesnę gėlavandenių žuvų dalį mityboje.

Vėlyvojo Atlančio, ankstyvojo ir vidurinio neolito duomenys (Donkalnio kapas Nr. 3, Spigino kapas Nr. 1) yra negausūs, tačiau leidžia manyti, kad gėlavandenės žuvys tebebuvo pagrindinis baltymų šaltinis. To paties laikotarpio duomenys iš kaimyninio Zvejniekų kapinyno yra panašūs: anglies izotopo vertės rodo gėlavandenės ar sausumos kilmės baltymų, o aukštos stabiliojo azoto izotopo vertės – didelę dalį baltymų dietoje, greičiausiai gėlavandenės kilmės.

Visuose Lietuvos vėlyvojo neolito laivinių kovos kirvių ir virvelinės keramikos kultūros žmonių mėginiuose (Gyvakarai, Plinkaigalio kapai Nr. 241 ir 242, Spigino kapas Nr. 2) nustatytos labai panašios izotopų koncentracijos: $\delta^{13}C$ vertės svyruoja tarp -21,9 ir -21,4‰, o $\delta^{15}N$ vertės – tarp 7,99 ir 10,1‰. $\delta^{15}N$ reikšmės vis dar aukštos, o tai liudija dietą, susidedančią daugiausia iš gyvulinės kilmės baltymų – mėsos arba pieno. Dar daugiau – maži standartiniai nuokrypiai rodo visiškai vienodą virvelinės keramikos kultūros žmonių mitybą, o tai leidžia manyti, kad jie vertėsi gyvulininkyste. Stabiliųjų izotopų duomenys liudija ir tokią pačią Latvijos virvelininkų dietą, o tai leistų numanyti ir buvus bendrą kultūrinę tapatybę. Panašus scenarijus buvo pasiūlytas ir Baltijos regiono šukinės keramikos atstovams, kurių stabiliųjų izotopų duomenys liudija maitinimąsi ruonių mėsa. Gal gyvenimo būdas ir mityba buvo atskirų sociokultūrinių grupių vėlyvajame neolite – šukinės keramikos ruonių medžiotojų ir virvelinės keramikos gyvulių augintojų – atsiradimo pagrindas? Į tokius klausimus atsakyti padėtų tikslūs virvelininkų radiokarbono, stabiliųjų izotopų, bioantropologiniai ir DNR duomenys.

Aukštesnės bronzos amžiaus individų $\delta^{13}C$ vertės galėtų liudyti jūros kilmės baltymus jų mityboje, tačiau $\delta^{15}N$ vertės yra per žemos. Tiek ankstyvojo, tiek ir vėlyvojo bronzos amžiaus duomenys liudytų dietą, kurios pagrindą sudarė prijaukinti gyvuliai ir C_4 augalas soros.

FUNNEL BEAKER ANIMAL HUSBANDRY AT BRONOCICE

MARIE-LORRAINE PIPES, JANUSZ KRUK, DANUTA MAKOWICZ-POLISZOT, ŠARUNAS MILISAUSKAS

Abstract

The Funnel Beaker or *Tricterbecher* (TRB) occupation at Bronocice, southeastern Poland (Małopolska) was based on a mixed farming economy, the cultivation of cereals and the keeping of domesticated animals. A zooarchaeological analysis and interpretation of the faunal assemblage from three phases of Funnel Beaker occupation (3800-3100 BC) revealed significant trends and patterns in animal husbandry practices reflective of increasing social complexity and specialization. In comparison with other sites in southeastern Poland the faunal data from Bronocice stands out as unique among Funnel Beaker sites with the exception of Zawarża.

Introduction

This article presents the results of a zooarchaeological analysis and interpretation of the faunal assemblage from the Funnel Beaker or *Trichterbecher* (TRB) occupation at Bronocice, southeastern Poland (Małopolska). The Funnel Beaker people subsisted on a mixed farming economy, comprised of the cultivation of cereals and the keeping of domesticated animals. In this article we will concentrate primarily on the role of the domestic animals.

The large and complex faunal assemblage recovered from Bronocice spans six phases of occupation (3800-2700 BC). This discussion is limited to the data from the three Funnel Beaker phases, 1, 3, and 4 (3800-3100 BC). In an earlier study trends and patterns were recognized that merited further investigation. Various issues were identified through comparison of the ratios of wild mammal to domesticated mammal, the ratios of domesticated species over time, and the age at death profiles of domesticated mammals.

Using these standard tools we will consider the evidence for shifting animal exploitation over time and its significance in terms of animal husbandry practices, hunting and social relationships among residents at Bronocice and people living in other settlements. The results will be compared with available data from other Funnel Beaker sites with large samples of faunal remains in southeastern Poland: Ćmielów (Krysiak 1950, 1952), Gródek Nadbużny (Krysiak 1956, Guminski 1989), Kamień Łukawski (Krysiak and Lasota 1971), Niedżwiedż (Kruk 1980, Makowicz-Poliszot 1997), Zawarża (Makowicz-Poliszot 2002) and Zawichost-Podgórze (Krysiak 1966/1967)

Benecke (1994) and Döhle (1994) have surveyed the exploitation of domestic and wild animals by various Neolithic cultures in central Europe. Recently Steffens (2007) published an article about the role of hunting in the Funnel Beaker populations of Scandinavia and central Europe. Most Funnel Beaker faunal data has been recovered from sites in Denmark, eastern Germany and Poland (Midgley 1992). There are some general patterns among Funnel Beaker faunal assemblages. Two of the most commonly observed patterns are that sites in the north tend to have higher frequencies of wild mammals to domesticated mammals and that pigs are the second most frequent domesticated mammal species after cattle (Midgley 1992, Steffens 2007). Sites further south and west have noticeably smaller frequencies of wild mammals and a corresponding increase in domesticated mammals, though generally pig is found to be the second most frequent domesticated species after cattle. At Bronocice pig was always the third most frequent domesticated mammal species during all phases.

Bronocice excavations

The State University of New York at Buffalo and the Polish Academy of Sciences conducted a cooperative archaeological project at the Bronocice site, Świętokrzyskie province, 1974-78. The objectives of this archaeological project were twofold: 1) to investigate the prehistoric environment, chronology, economy, settlement system, and social organization of the Middle Neolithic (TRB or Funnel Beaker culture) and Late Neolithic (Funnel Beaker-Baden) communities and 2) to demonstrate the origin of complex societies in the Nidzica River basin, southeastern Poland.

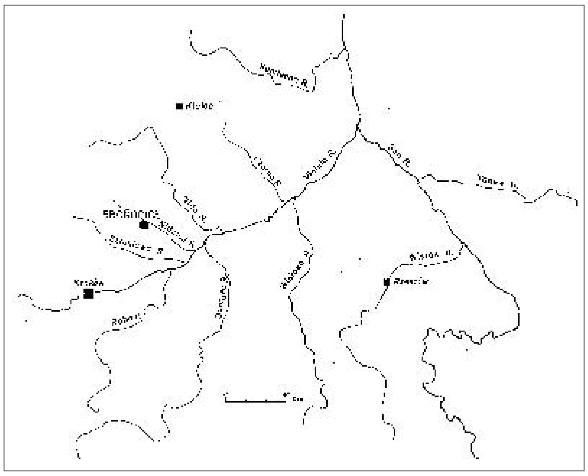


Fig. 1. Map showing the location of Bronocice in southeastern Poland.

Bronocice (50 21'00'' N latitude, 20 19'30'' E longitude) is located on the highest local elevation above the Nidzica River floodplain, near the small town of Działoszyce, Świętokryskie province (Fig. 1). The site has a total area of 52 ha; its length is about 1600 m and its width varies from 300 to 500 m.

Excavations were carried out in three natural topographic areas: A 18 ha, B 18 ha and C 16 ha. A total of 25 excavation units, encompassing approximately over 7300 square meters (0.73 ha) were uncovered (Fig. 2). Over 650 pits, 3 ditches, and 26 burials were excavated at Bronocice (Kruk and Milisauskas 1981; Milisauskas and Kruk 1984, 1989).

Chronology and cultural sequence in the Bronocice region

The Linear Pottery (*Linearbandkeramik*) culture, which was the earliest Neolithic occupation in the Bronocice region, is dated from 5400-4800 BC. With the disappearance of the Linear Pottery ceramics, Lengyel-Polgár ceramics began to dominate in the Bronocice region around 4700 BC. This stylistic change signified in the traditional nomenclature marks the beginnings of the Middle Neolithic in southeastern Poland. By 3800 BC the earliest Funnel Beaker material is found in the Bronocice region, disappearing around 3100 BC. The Funnel Beaker culture is found in Denmark, southern Norway, southern Sweden, the Netherlands, Germany, the Czech Republic, northeastern Austria, Slovakia, Poland and northwestern Ukraine. In Scandinavia it is the earliest Neolithic or farming culture (Midgley 1992). Funnel Beaker-Baden, Globular Amphora, and Corded Ware material are found during the Late Neolithic in the Bronocice region.

The location of all Funnel Beaker sites within Bronocice region was recorded by a systematic survey conducted in an area 314 km² centered on the site of Bronocice. This survey has located 106 Funnel Beaker settlements and they ranged from 1 ha to 21 ha in area at one time period.

The radiocarbon dates and typology of ceramics indicate that the Funnel Beaker occupation lasted for approximately 700 years at Bronocice and it is associated with three phases (Table 1).

Table 1. Chronological Sequence at Bronocice.

Phase	Culture	Dates BC cal.
1	Funnel Beaker	3800-3700
2	Lublin-Volhynian	3700-3650
3	Funnel Beaker	3650-3400
4	Funnel Beaker	3400-3100
5	Funnel Beaker-Baden	3100-2900
6	Funnel Beaker-Baden	2900-2700

Phase 1 represents Bronocice's earliest occupation of the Funnel Beaker culture on the loess uplands of southeastern Poland. It was a small settlement, approximately 2 ha, located principally in area C of Bronocice, whose duration was short, approximately 100 years (Milisauskas and Kruk 1984).

Following the disappearance of the early Funnel Beaker settlement in area C, a late Lublin-Volhynian (Phase 2) fortified settlement was established in its place. The Lublin-Volhynian settlement was of short duration, probably one or two generations. After the Lublin-Volhynian settlement period, a large Funnel Beaker settlement occurred in the eastern part of the elevation in area A, which consists of two Funnel Beaker occupation phases.

Phase 3 represents the "classic" Funnel Beaker phase on the loess uplands. This phase settlement occupied an 8 ha area. Phase 4 is associated with the later development of the classic phase. The Phase 4 settlement extended over 21 ha area. A Funnel Beaker cemetery located in area C is associated with either one or both of these phases. The cemetery is situated on the highest point of area C, where early Funnel Beaker (Phase 1) and Lublin-Volhynian settlements had been previously located. Thus they erased the memory of the Lublin-Volhynian presence in area C. Phase 4 is followed by Phases 5 and 6, which are associated with a local Funnel Beaker-Baden group (Kruk and Milisauskas 1983:272-276).

The faunal remains were identified by Danuta Makowicz-Poliszot during the 1980's and 1990's. The data were originally generated in Polish and have since been transcribed into English and entered into Micro-

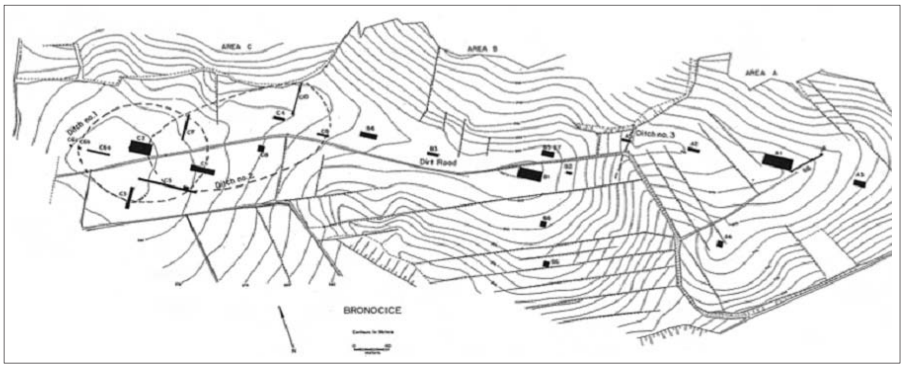


Fig. 2, Excavation units at Bronocice.

soft Office Access 2003. This program is a relational database that allows for easy manipulation of data. The coding system used for encoding the data was adapted by Marie-Lorraine Pipes based on the published version by Louis Berger & Associates, Inc. (Azizi et al. 1996). The Minimum Number of bone Units (MNU) is a reduction count similar to Number of Identified Specimens (NISP) but differing only slightly but in a significant way. The NISP count commonly used to quantify faunal remains is a cruder version of the MNU. NISP does not have the capacity to accommodate articulations often resulting in over-representation of taxa. The MNU count does so by being paired with a modifier that serves to indicate when multiple bones have been reduced to represent an articulation in the database. The MNU count describes what is being tabulated and in particular signals a reduction based on joints, or partial and whole skeletons, and on occasion loose teeth. Modifiers used in the database include Teeth (MNT or Minimum Number of Teeth), Elements (Minimum Number of skeletal Elements), Articulations (MNAE) and MNI (Minimum Number of Individuals). Age at death determinations were based on epiphyseal fusion and dental eruption indicators. Specific ages were not used. Instead four general age group designations were generated including of Juvenile, Subadult, Adult and Senile. Slaughter profiles and herd compositions were based upon these categories.

Faunal analysis concerns

Numerous authors have pointed out the difficulties in analyzing animal remains at archaeological sites and in accounting for taphonomic factors that potentially affect bone preservation (Meadow and Zeder 1978, Wilson, Grigson and Payne 1982, Grayson 1984, Klein and Cruz-Uribe 1984, Davis 1987, Daugnora and Girininkas 1996, Marciniak 1996, Lasota-Maskolewska 1997, Reitz and Wing 1999, O'Connor 2000). Observed differences in the relative abundance, and by default the assumed relative importance of animal species, may in fact, be due to differential preservation, chronological factors, excavation techniques, recovery methods, sampling errors, analytical methods, and taphonomic processes. However, observed patterning may also be the result of deliberate cultural practices which is a major reason why large samples recovered over long periods of time and from different contexts are critical in establishing whether or not patterns are valid.

There were a few other concerns worth mentioning. Archaeological remains are problematical in that depositional variability and collapsed time potentially skews the results of any analysis (Milner 2005). Constructing MNI counts was necessary for comparing the death profiles of livestock for each phase. This is problematical because of the temporal compression about which little can be done without refined C^{14} dates for every pit deposit. In an earlier publication we conducted an intensive pit by pit analysis in which we assumed that each one represented a short term deposit. The patterning discussed belowthat follows is in part supported by the results from that study. In this study many of the trends and patterns were similar which lends confidence to our findings in this article. The construction of MNIs presents some problems as well. They were generated by counting paired elements, stature, sex, and age groups within each pit. Entire carcasses were rarely present in pits. Instead they most often contained partial carcasses or single elements representing butcher waste, dietary refuse and craft manufacturing debris. Based on the disjointed remains most frequently encountered it is clear that meat was shared across households. So the method used to generate the MNI counts may possibly over-represent some of the animals. Another problem with MNIs is that several species are represented only by cranial bones. These generally consist of aurochs, wild pig and other ungulates. However, the same is true for domesticated pig. While domesticated pig is occasionally represented by meat cuts, most of the time cranial elements predominated. The end result is that the MNI counts are over-represented in these instances.

Faunal data summary: Bronocice

The animal bones from the Funnel Beaker occupation at Bronocice were derived from 119 pits. The Funnel Beaker faunal assemblage consisted of 6047 bone fragments of which 2510 were identified. The entire analyzed faunal assemblage comprises 15,553 bone fragments of which 6,110 were identified. The rate of identified bones ranged from 34 percent to 49 percent. (Table 2). Sample sizes for each phase varied, increasing from Phase 1 up to Phase 4. It will be seen that within each phase pit bone volume varied considerably, as did range species, skeletal elements and age compositions. The faunal data are summarized in Table 2 that presents overall counts of bone, identified bone and the relative percentage of bone identified within each phase.

Table 2. Bone Assemblage Summary by Phase, Total Number of bone Fragments (TNF) and Minimum Number of bone Units (MNU).

Phase	Time Period	TNF	MNU	Relative % of Identified Bone
1	3800-3700 BC	1185	400	.34
3	3650-3400 BC	1456	715	.49
4	3400-3100 BC	3406	1395	.41
	Total Funnel Beaker	6047	2510	.42

The Phase 1, 3, and 4 bone data come from single component pits. The number of pits containing faunal remains grew three fold from the first to last Funnel Beaker phase corresponding with the increase in settlement size. The size of phase assemblages grew greater over time. During the earliest phase the ratio of identified bone to unidentified bone was higher than in Phases 3 and 4. The Phase 3 bone had a much higher rate of identifiable bone. The jump in the rate of identifiable bone from Phase 1 to Phase 3 may potentially indicate a change in the processing of the bone between phases. While Outram (2005) offers a cautionary note about interpreting high frequency bone breakage without careful examination it should be noted the Bronocice assemblage was recovered from several pit contexts and not middens. A high frequency of bone breaking can indicate extreme processing of bone for marrow and grease. It may be that during the initial settlement of Bronocice Funnel Beaker people may have been stressed for resources and so made greater use of bone grease and marrow. At this time the settlement may not have had well established support lines in which case it would have been far more dependent on itself for survival. When an animal was slaughtered it may have been processed intensively. During Phase 3 the rate of identified bone increased to its greatest point indicating less intensive reduction of the carcass. Between Phases 1 and 2 there was a brief interlude, possibly one generation, by a group of Lublin-Volhynian people. By Phase 3 the settlement was reestablished. Perhaps this was a time of reduced social stress, increased social stability and therefore integrated support so that the need for intensive exploitation of carcasses was not as great. The rate of identifiable bone decreased during Phase 4 though it remained higher than during Phase 1.

Table 3 summarizes the range and relative frequencies of mammal species from Bronocice based on combined sample pit totals by phase while Table 4 presents similar site totals for the other sites in southeastern Poland. The tables separate domesticated species from non-domesticated species. Non-domesticated mammals increased to five percent over time remaining at this level during Phases 3 and 4. In most cases these species were identified only by cranial elements. The tables further divide non-domesticated species into three categories. Possible breed stock species included wild progenitors of cattle and pig. Game animals comprised a range of ungulates that were exploited for several potential reasons including meat, hides, antler and bone for tools. Hamster is listed as an intrusive species, mainly because none of the recovered samples showed signs of having been processed by tools. Grouping species in this way provides a different angle of consideration concerning their role within the assemblages. Several DNA studies have revealed that the genetic composition of modern cattle is the result of cross-breeding with aurochs in the distant past (Götherström et al. 2005, Beja-Pereira et al. 2006). In fact, the modern European pig is descended from the European wild boar and not the domesticated pig first introduced by the earliest Neolithic people (Larson et al 2007, and Larson et al 2005). In an ethnographic study done by Ekvall (1968) he observed the offspring from crossings between wild yak and domesticated yak as well as wild yak and domesticated cattle. The results in either crossing were offspring significantly larger in size than either parent. The problem with current methods of faunal identifications is that aurochs and wild pig are identified solely based on size. Without DNA testing it is impossible to know if the aurochs or wild pigs identified at Bronocice are crossings or the actual species. Even if they are actual aurochs and wild remains they may represent deliberate back-breeding attempts to invigorate the herds.

It is also worth noting that fur bearers commonly present on Funnel Beaker sites are completely absent. Though the other phases and cultures from Bronocice are not discussed here it should be mentioned that fur bearers were almost completely missing from those deposits as well. Wild mammals were virtually absent from Phase 1 but increased in frequency over time. During phase 4 the range of wild species broadened

Table 3. Summary List of Phase 1, 3, and 4 Pits, Minimum Number of bone Units (MNU).

Phase 1 Pits	MNU	Phase 3 Pits	MNU	Phase 4 Pits	MNU
C6	5	1-A1	103	2-B1	36
2-C7	1	1-AD	1	2-B7	263
5-B6	32	3-A2	4	3-B1	16
9-C6	1	6-A1	7	4-A1	2
12-C2	69	6-A4	9	4-A2	31
17-C2	21	7-A3	8	5-A2	7
20-C2	42	8-AD	5	5-A4	20
21-C2	25	9-C7	2	5-B5	160
24-C2	1	15-A1	3	7-A1	22
32-C2	9	20-B1	6	7-B5	4
33-C2	3	21-A1	38	8-A1	2
35-C2	1	26-A1	105	9-A1	4
36-C2	28	28-A1	9	9-A3	1
40-C2	35	33-A1	32	9-B1	19
42-C2	3	37-A1	2	10-A1	13
45-C2	1	38-A1	46	13-A1	2
46-C2	14	42-A1	6	16-A1	18
49-C2	69	44-A1	3	16-A3	2
59-C2	2	49-A1	5	17-A1	23
61-C2	8	51-A1	13	20-A1	2
76-C1	23	64-A1	73	21-B1	11
80-C1	8	66-A1	1	23-A1	7
		67-A1	1	23-B1	187
		75-A1	2	24-B1	56
		76-A1	27	27-A1	24
		78-A1	20	29-A1	10
		89-A1	10	30-A1	42
		98-A1	31	32-A1	13
		100-A1	11	34-A1	1
		101-A1	67	35-A1	7
		102-A1	11	39-A1	17
		110-A1	9	42-B1	16
		111-A1	11	46-A1	5
		117-A1	6	50-A1	2
		120-A1	4	53-A1	5
		124-A1	7	55-A1	2
		126-A1	17	57-B1	13
				58-A1	9
				58-B1	25
				59-A1	3
				63-A1	1
				68-A1	113
				74-A1	3
				80-B1	5
				82-A1	6
				83-A1	1
				85-A1	1
				90-A1	5
				92-A1	9
				94-A1	3
				95-A1	4
				96-A1	8
				98-B1	12
				99-A1	3
				103-A1	45
				105-A1	1
				115-A1	33
				118-A1	19
				119-A1	10
				123-A1	11
TOTAL MNU	400		715		1395

from four species to six and included roe deer and elk. However, in both cases these species were represented only by antler remains suggesting that these two species do not in fact represent live animals but instead material resources for the manufacture of objects. In none of the phases were concentrations of antler remains found within pits. Instead they were occasional elements found along with dietary remains and other refuse types.

During Phase 1 nearly all of the non-domesticated mammal skeletal elements consisted of cranial bone. The only species indicated by other body parts was red deer for which a foreshank was present. During Phase 3 the range of body parts expanded slightly for wild pig, cattle, horse and red deer. The increased range of body parts however generally consisted of lower leg and foot bones except in the case of wild pig for which the lower forearm, neck and rib were present, horse for which the upper arm, butt and thigh were present, and red deer for which the thorax was present. This type of information argues for the presence of skins or hides but not for meat. Perhaps these were obtained through exchange with people living outside of the settlement. By Phase 4 there was a noticeable increase in the range of body parts represented for most species so that in addition to cranial and lower limb elements there were also meat bearing parts. This changed may signal actual consumption of wild mammals on a regular basis and may be indicative of actual hunting. During all phases body parts were found distributed throughout several pits instead of being deposited in a single or even a couple of pits.

Large domesticated mammals form the great majority of all deposits and included cattle, pig, sheep, goat and dog. Dog are rare during Phase 1 but increase during later phases. One of the most notable patterns from Bronocice was the constant rank order of cattle, sheep/goat and pig regardless of phase or associated culture. This pattern is unusual for Funnel Beaker sites where pig is normally second after cattle in relative abundance. An earlier study had already indicated that there was a considerable drop in cattle between Phase 1 and Phase 3 and a subsequent rebound during Phase 4 (Milisauskas et al. in press). Though the percentages are slightly different this pattern is evident when looking at the entire Funnel Beaker faunal assemblage. The drop in cattle frequencies during Phase 3 is of particular interest. It suggests that something happened during this time that impacted cattle in a negative way. During all three phases sheep were the second most abundant species. Table 3 lists goat, sheep and sheep/goat separately because of the difficulty in distinguishing between the two species. However, on the rare occasion when goat was identified it was always present in much lower frequencies than sheep. Therefore it seems likely that the majority of the sheep/goat category represents sheep. During Phase 3 when cattle are less frequent than at any other time sheep and pig increased in frequencies considerably. Whatever impacted the cattle herd during Phase 3 it seems to have been compensated for by more intensive exploitation of pig and sheep/goat.

Age at death profiles provide one of the best sources of information concerning the management of livestock. Large domesticated mammal age at death profiles were generated for each phase as well as for the sites of Zawarża and Niedźwiedź. During Phase 1 over half of the cattle were adults with an almost equal number of juveniles and subadults being represented. Most of the cattle were of medium size, while an equal number of small and large cattle were also present. Phase 3 was marked by a very high percentage of adults, 74 percent and correspondingly low percentages of juveniles and subadults. In addition there was a senile individual.

The predominance of adult cattle at Bronocice is consistent during all three phases. The classic model put forth by Payne and reinforced by many others whereby the primary use of animals used for meat results in high frequency kill-off patterns of younger animals does not work at Bronocice or the other two sites (Payne 1973, Greenfield 2005). Instead the high frequencies of adults must be considered first terms of the need to build the herds and possibly as evidence for dairying. It has been suggested by Bogucki and others that dairying was already being practiced during the Early and Middle Neolithic (Bogucki 1984, 1986, Copley et al. 2003, Miracle 2006, Mulville and Outram 2005, Bartosiewicz 2005). The high numbers of adults in this case would appear to be due to efforts at building up the herd and not to dairying. Medium size cattle were most common though there were large and very large individuals indicated as well. At Zawarża adults also predominated. No senile cattle were observed there. So this outlying settlement was similar in cattle profile to Bronocice but not as extreme. During Phase 4 adults were still well represented at 66 percent however juveniles were now more abundant while subadults remained at the same level. There was one senile individual represented. Medium size cattle were the most frequent in stature but there was an increased in the number of large and very large cattle. This may be due to a rise in the use of oxen, the ard and wheeled vehicles.

At Niedźwiedź cattle were also represented by a high percentage of adults and almost equal numbers of subadults and juveniles, the former being slightly more common. While the numbers were different between the two sites they were not pronounced. It should be noted however that at Niedźwiedź the rank order was

Table 4. Bronocice Range of Mammal Species and Relative Frequencies by Phase and Minimum Number of bone Units (MNU).

Class/Species	Phase 1 3800-3700 BC		Phase 3 3650-3400 BC		Phase 4 3400-3100 BC	
	MNU	Rel%	MNU	Rel%	MNU	Rel%
Domesticated Mammals						
Cattle *(Bos taurus)*	238	.60	284	.40	809	.60
Dog *(Canis familiaris)*	8	.02	56	.08	82	.06
Goat *(Capra hircus)*	1	<.01	2	<.01	4	<.01
Pig, Domesticated *(Sus domesticus)*	46	.115	131	.18	145	.10
Sheep *(Ovis aries)*	7	.02	84	.12	104	.075
Sheep/Goat *(Ovis/Capra)*	88	.22	124	.17	179	.13
Domesticated Mammals Subtotal	388	.97	681	.95	1323	.95
Non-domesticated Mammals						
Possible Breed Stock						
Aurochs *(Bos primigenius)*	1	<.01	3	<.01	25	.02
Pig, Wild *(Sus scrofa)*	3	.01	8	.01	6	<.01
Possible Breed Stock Subtotal	*4*	*.01*	*11*	*.015*	*31*	*.02*
Game, Meat and Hides						
Elk *(Alces alces)*	-	-	-	-	1	<.01
Horse *(Equus caballus)*	1	<.01	7	.01	14	.01
Red Deer *(Cervus elaphus)*	4	.01	14	.02	24	.02
Roe Deer (*Capreolus capreolus)*	-	-	-	-	1	<.01
Game, Meat and Hides Subtotal	*5*	*.01*	*21*	*.03*	*40*	*.03*
Intrusive Species						
Hamster *(Cricetus cricetus)*	3	.01	2	<.01	1	<.01
Intrusive Species Subtotal	*3*	*.01*	*2*	*<.01*	*1*	*<.01*
Non-domesticated mammals Subtotal	12	.03	34	.05	72	.05
Total TNF/MNU	400	1.00	715	1.00	1395	1.00

cattle, pig and sheep/goat. So there was a different economic emphasis in place at that site.

Sheep/goat age at death profiles changed over time. During Phase 1 there was a predominance of adults but there were also a high percentage of juveniles and few subadults. This may be the result of building the herd during a period of time when the area was not as conducive to the rearing of sheep/goat. During Phase 3 there was a drop in juveniles and an increase in adults. This takes on a new significance when considered along with the increase in sheep/goat relative to cattle. During this period it seems there was a shift in economic emphasis on the rearing of sheep specifically. The increase in adults suggests a new role for these animals may have begun. That new role may have been the use of their wool perhaps for small scale purposes such as felting but not necessarily for textiles. During Phase 4 there was a slight increase juveniles and a drop in subadults. This pattern suggests an increased reliance on sheep/goat for meat. If cattle became increasingly tied to dairying and traction it may be that sheep/goat meat was more in demand.

Pig age death profiles change significantly over time. During Phase 1 and 3 there were high frequencies decreasing during Phase 4. However, from the earliest to the latest phase there were increasing numbers of juvenile pigs. During this last phase Payne's model succeeds in pointing to a population reared primarily for meat. There also seems to be an increase in size though without sexing data it may simply be reflection of a greater number of males. During an ethnographic study done by Pipes (Pipes 2006) it was revealed that in England butchers most frequently slaughter female pigs for their customers because their meat has a better flavor. The flesh of male pig has a strong odor. Therefore most males are slaughtered much earlier before

Table 5. Range of Mammal Species and Relative Frequencies from Funnel Beaker Sites in Southeastern Poland, based on Number of Identified Specimens (NISP).

Site	Gródek Nadbużny		Zawichost-Podgórze		Kamień Łukawski		Zawarża		Niedźwiedź		Ćmielów	
Associated Bronocice Phases	Phase 1,3		Phase 3		Phase 3		Phase 3		Phase 4		Phase 4	
Distance from Bronocice	260 km		120 km		120 km		12 km		25 km		100 km	
Class/Species	NISP	%	NISP	%	NISP	%	NISP	%	NISP	%	NISP	%
Domesticated Mammals												
Cattle (*Bos Taurus*)	1265	.59	1017	.57	1676	.59	1193	.64	777	.58	1578	.58
Sheep/Goat (*Ovis/ Capra*)	252	.12	251	.14	403	.14	406	.22	194	.15	276	.10
Pig (*Sus domesticus*)	453	.21	323	.18	582	.21	194	.10	278	.21	566	.21
Dog (*Canis familiaris*)	41	.02	94	.05	66	.02	13	.05	18	.01	111	.04
Horse (*Equus caballus*)	16	.01	40	.02	8	<.01	13	.05	21	.02	58	.02
Domesticated Mammals Subtotal	*2027*	*.95*	*1725*	*.96*	*2735*	*.96*	*1819*	*.97*	*1288*	*.97*	*2589*	*.95*
Wild Mammals												
Cross Breed Stock												
Aurochs (*Bos primigenius*)	-	-	-	-	12	<.01	-	-	-	-	-	-
Wild Pig (*Sus scrofa*)	59	.03	16	.01	12	<.01	2	<.01	17	.01	43	.02
Cross Breed Stock Subtotal	*59*	*.03*	*16*	*<.01*	*24*	*.01*	*2*	*<.01*	*17*	*.01*	*43*	*.02*
Non-domesticated Mammals												
Game, Meat and Hides												
Elk (*Alces alces*)	6	<01	-	-	2	<.01	2	<.01	-	-	4	<.01
Red Deer (*Cervus elaphus*)	20	.01	32	.02	27	.01	40	.02	11	.01	36	.01
Roe Deer (*Capreolus capreolus*)	11	<.01	10	.01	29	.01	1	<.01	8	.01	45	.02
Hare (*Lepus sp.*)	-	-	1	<.01	2	<.01	2	<.01	-	-	-	-
Brown Bear (*Ursus arctos*)	3	<.01	3	<.01	2	<.01	-	-	-	-	4	<.01
Game, Meat and Hides Subtotal	*40*	*.02*	*36*	*.03*	*62*	*.02*	*45*	*.02*	*19*	*.02*	*89*	*.03*
Game, Fur-bearers												
Wolf (*Canis lupus*)	-	-	-	-	-	-	1	<.01	-	-	2	<.01
Fox (*Vulpes vulpes*)	3	<.01	-	-	-	-	-	-	-	-	3	<.01
Lynx (*Lynx lynx*)	-	-	2	<.01	1	<.01	-	-	-	-	-	-
Badger (*Meles meles*)	1	<.01	3	<.01	3	<.01	-	-	-	-	5	<.01
Beaver (*Castor fiber*)	-	-	4	<.01	24	.01	-	-	-	-	5	<.01
Wild Cat (*Felis silvestris*)	-	-	-	-	-	-	1	<.01	-	-	-	-
Otter (*Lutra lutra*)	1	<.01	-	-	-	-	-	-	-	-	-	-
Game, Fur-bearers Subtotal	*5*	*<.01*	*9*	*.01*	*28*	*.01*	*2*	*.005*	*-*	*.02*	*15*	*<.01*
Other												
Other wild animals	-	-	4	<.01	-	-	-	-	-	-	-	-
Other Subtotal	-	-	4	<.01	-	-	-	-	-	-	-	-
Non-domesticated Mammals Subtotal	*104*	*.05*	*75*	*.04*	*114*	*.04*	*49*	*.03*	*36*	*.03*	*147*	*.05*
Total NISP	2131	1.00	1861		2849	1.00	1333	1.00	1867	1.00	1800	1.00

they become sexually active. While that may not have been a concern among Funnel Beaker people most pigs were of medium size suggesting a predominance of females.

Discussion

The analysis of the Bronocice faunal data serves as a basis for considering some of the social and behavioral aspects of the Funnel Beaker people who lived there. Livestock rearing was one of the foundation stones upon which their economy was built. So controlling factors that potentially affected the health and stability of their livestock was critical. The ability to feed and water animals as well as to protect them were vital concerns. Control over the breeding and the movement of livestock must have been achieved through the erection of barriers and penning.

Comparing Bronocice with six other sites in southeastern Poland reveals that there are some significant differences between them. Though overall ratios of wild mammals are similar, the range of species among these sites was distinct from Bronocice. Only six species overlap between Bronocice and the other sites. Aurochs remains were recovered only from Kamień Łukawski.

Table 6. Bronocice large domesticate mammal age at death profiles by phase based on MNI.

Species	Age Group	Stature	Phase 1 MNI	Phase 1 Rel.%	Phase 3 MNI	Phase 3 Rel.%	Phase 4 MNI	Phase 4 Rel.%
Cattle	Juvenile		12	.23	9	.11	24	.17
	Subadult		11	.21	12	.16	22	.16
	Adult	*Unknown*	*8*	*.15*	*11*	*.14*	*18*	.13
		Small	*6*	*.11*	*12*	*.16*	*18*	*.13*
		Medium	*10*	*.19*	*17*	*.22*	*30*	*.22*
		Large	*6*	*.11*	*14*	*.18*	*20*	*.15*
		Very Large	-	-	*1*	*.01*	*4*	*.03*
		Total Adult MNI	30	.56	55	.74	90	.66
	Senile		-	-	1	.01	1	.01
		Total Cattle	53	1.00	77	1.00	137	1.00
Sheep/Goat	Juvenile		8	.30	11	.24	19	.26
	Subadult		6	.22	10	.22	12	.16
	Adult		13	.48	25	.54	43	.58
		Total Sheep/Goat	27	1.00	46	1.00	74	1.00
Pig	Juvenile		4	.17	9	.27	17	.33
	Subadult		5	.20	5	.15	7	.14
	Adult	*Unknown*	*5*	*.20*	*11*	*.32*	*15*	*.29*
		Small	*1*	*.04*	*3*	*.09*	*1*	*.02*
		Medium	*4*	*.17*	*5*	*.15*	*4*	*.08*
		Large	*4*	*.17*	*1*	*.03*	*6*	*.11*
		Total Adult MNI	14	.58	20	.59	26	.50
	Senile		1	.04	-	-	2	.03
		Total Pig	24	1.00	34	1.00	52	1.00
Total MNI by Phase			104		157		263	

Table 7. Large domesticated mammal age at death profiles from Zawarża and Niedźwiedź based on MNI.

Species	Age Group	Zawarża Phase 3 Rel.%	Niedźwiedź Phase 4 Rel.%
Cattle	Juvenile	.22	.19
	Subadult	.18	.21
	Adult	.60	.59
	Senile	-	.01
		1.00	1.00
Sheep/Goat	Juvenile	.33	.34
	Subadult	.23	.20
	Adult	.44	.45
	Senile	.01	.01
		1.00	1.00
Pig	Juvenile	.18	.22
	Subadult	.29	.24
	Adult	.52	48
	Senile	.01	.06
		1.00	1.00

The rank order pattern of domesticated mammals seen during the Funnel Beaker phases is quite different from other Funnel Beaker sites in the area because of the prominence of sheep/goat and the decline in pigs over time. Sheep/goat are grazers and browsers that do best in open areas while pigs on the other hand can inhabit forested and marshy areas (Bartosiewicz 2005, 2007). The area was initially heavily forested but when the forest canopy was opened up it most likely never closed again but instead grew in size. The increasing numbers of sheep/goat over time suggests the area was increasingly opened up and that the forest was pushed back. The dramatic increase in the size of the settlement of Bronocice is an indication of this process of landscape modification. So while the area may not have been initially well suited to sheep/goat it was altered. The people at Bronocice were clearly intent on raising sheep/goat and this may reflect continued social relations with people on the other side of the Carpathian Mountains. It may also be that the similar rank order seen at the site of Zawarża represents a strong tie to the

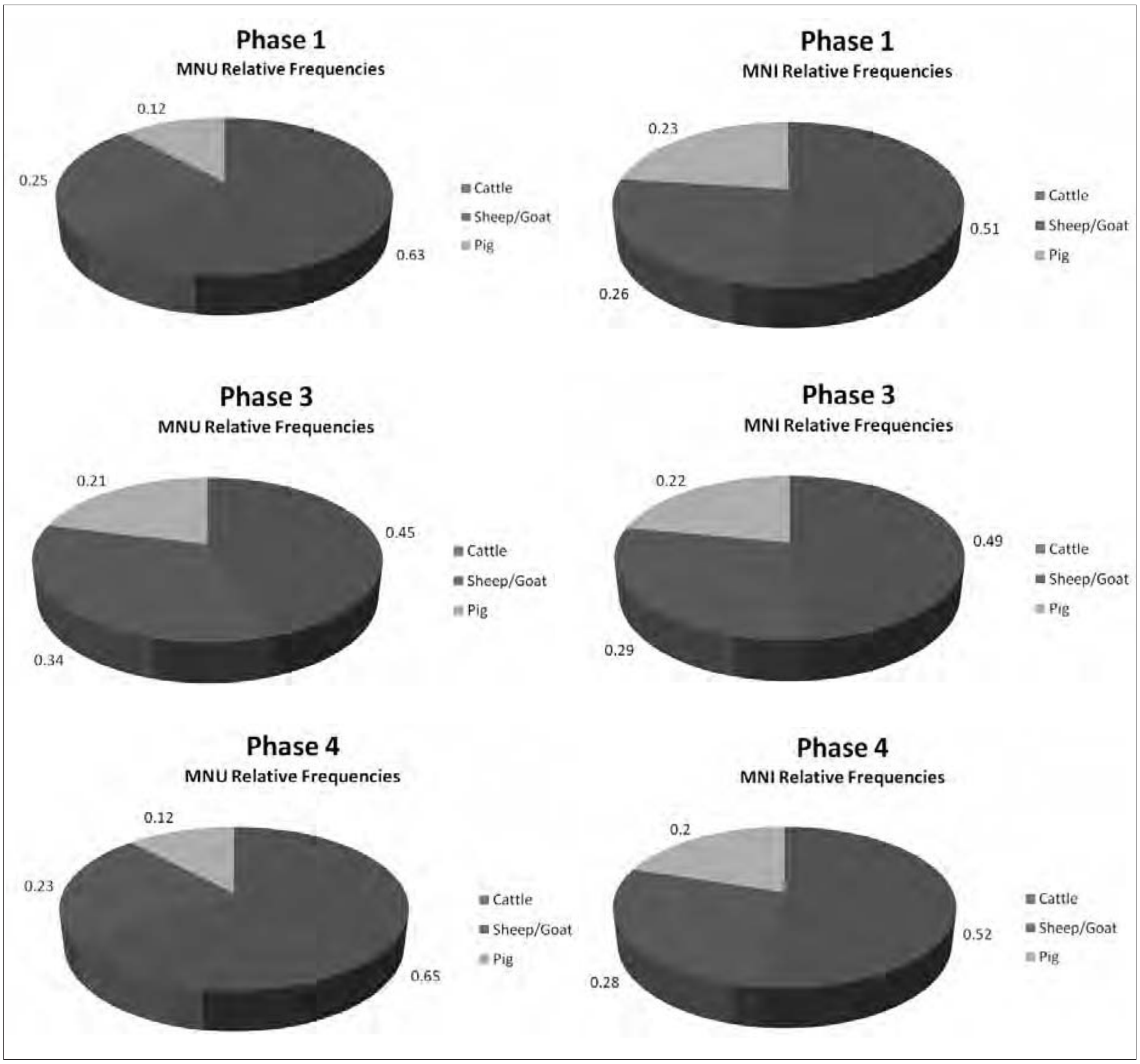


Fig. 3. A Comparison of MNU and MNI Relative Frequencies for Cattle, Sheep/Goat and Pig by Phase.

residents of Bronocice. The two lie in close proximity to each other so allowing for relatively easy movement of livestock. Perhaps they traded livestock for breeding purposes. At any rate both settlements shared the same animal husbandry practices. It should be noted that Kulczycka-Leciejewiczowa (2002) speculated that Zawarża was occupied for a single generation.

The role of sheep/goat shifted and changed economically over time. Relative frequencies of sheep/goat to cattle and shifting ages at death highlight difference in when they were slaughtered and potentially the purposes they served. Initially the large number of adults seems to have been tied to increasing the size of the herd. Then during Phase 3 they increased in number relative to cattle and in age. Much has been written about sheep and the relatively late development of their fleece into wool (Ryder 1983). Perhaps there has been an overemphasis concerning the role of wool as a basic commodity in textile manufacturing. Fibers had long played an important in societies and it seems incredible that people would not have plucked the wool off of animals much earlier and used them to create string, thread long before they wove the fibers into cloth. At Bronocice the increase in herd size and in the age at death profile for Phases 3 and 4 strongly suggest these animals served a secondary purpose in addition to being meat. The increased consumption of juveniles during Phase 4 may correlate with the shift in use of cattle for traction and possibly dairying.

The shifts seen in cattle frequencies from Phase 1 to Phase 3 indicate something impacted the herd in a negative way. The decline in cattle is best seen when considering the frequencies of bones (MNU) as opposed to minimum number of individuals (MNI), and is supported by a pronounced shift in age at death profiles. Figure 3 presents relative frequencies based on MNU and MNI. The drop in cattle is evidence in both MNU and MNI frequencies. There are many factors that influence the health and reproductive survival of domesticated livestock (Gregg 1988, Bogaard 2004. In this case it might be suggested that social reasons were responsible for the drop in cattle and the subsequent need to rebuild the herd. Healthy reproduction of livestock requires herds to consist of a fairly large number of animals as well as the constant introduction of new genetic material (Siracusano 2002, Fernández et al 2006). Inbreeding leads to poor reproductive health. This introduction by default implies the existence of outside social relationships between social groups and the exchange of livestock for breeding purposes (Fernández et al 2006). For a short of time there was conflict in the region during Phase 2 as seen by occupation of Bronocice by Lublin-Volhynian people and the construction of a fortification at the site. It may be that during that time social relations were disrupted and breeding of livestock impacted in a negative way. We simply do not know what happened. But the fairly large decrease in cattle and the increase in slaughter of adults during the subsequent Phase 3 Funnel Beaker period is strong evidence of the rebuilding of the cattle herd (Greenfield 2005). The high frequency adult cattle continued to a lesser degree during Phase 4 and correlates with greater numbers of larger individuals. The now famous Funnel Beaker pot bearing a decoration probably depicting wheeled vehicles, plowed fields bounded by forest and the river further reveals the presence of oxen or draft animals (Kruk and Milisauskas 1999, Milisauskas and Kruk 1991). Bogucki and others have made persuasive arguments concerning the social and economic impacts oxen, plows and wheeled vehicles had during this period of time and suggest they were responsible for setting into motion increasing social differentiation (Anthony 2007, Bogucki 1993, Johannsen 2002). Further evidence of draft animals may be seen in skeletal pathologies which will be summarized in the future (Fabiś 2002, Johannsen 2002).

Livestock requirements include protection and containment. Control over cattle reproduction was an important element in the survival of cows and their offspring (Siracusano 2002, Ryan 2005). Cattle have no breeding season but ideally they should not deliver in the fall as the chances of dietary stress increase. Pasturage and foddering are necessarily important elements in feeding animals. An inability to control reproduction would potentially result in livestock dying due to malnutrition or starvation, or being slaughtered instead. The Lublin-Volhynian ditch constructed during Phase 2 may well have served as an animal enclosure even before the group had left the area or died out. No other earthwork was created until Phase 5.

The age at death profiles signaled big changes in the management of pigs over time. They became increasingly used for meat. However, pigs are problematic because they are over-represented. There are simply not enough skeletal elements nor a sufficient range of body parts indicated to account for the high number of minimum number of individuals for any phase. Their frequencies drop over time relative to sheep/goat even though the actual estimates of individuals rise. Perhaps the changing environment impacted their survival in the immediate area. The real question is whether or not they were actually raised in the settlement or if they were brought into the settlement as processed carcasses. In a previous study it was found that cranial bone were the most frequent skeletal elements though various meat bearing elements were just as common. This pattern was observed by Marciania k (2005) from other Funnel Beaker faunal assemblages, which leaves open the possibility that the rank order pattern reported at other sites may be incorrectly tabulated. Pigs differ from cattle and sheep/goat in their behaviors. It has been suggested that pigs may have had symbolic meaning and have been treated ritually by Funnel Beaker people (Midgley 1992).

Conclusion

It is evident that there is a large amount of data on the animal husbandry at Bronocice. The overall characteristics of the faunal assemblage from Bronocice exhibit similarities and differences with those from other Funnel Beaker sites in southeastern Poland. Cattle and sheep were clearly prominent on the Bronocice landscape and their economic importance increased through time. Sheep significance may reflect the importance of the secondary products such as wool production. Furthermore, cattle and sheep played a role in social and symbolic life of people at Bronocice.

References

ANTHONY, D., 2007. *The Horse, The Wheel, and Language*. Princeton: Princeton University Press.

AZIZI, S.C., DALLAL D., GORDON M.A., JANOWTIZ M.F., MACZAJ N.N.S., AND PIPES M.-L. 1996. *Analytical Coding System for Historic Period Artifacts*. South Orange, New Jersey: The Cultural Resource Group, Louis Berger & Associates, Inc.,

BARTOSIEWICZ, L., 2005. Plain Talk: Animals, Environment and Culture in the Neolithic of the Carpathian Basin and Adjacent Areas. In: *(Un)settling the Neolithic*. D. BAILEY, A. WHITTLE, V. CUMMINGS, eds. Oxford: Oxbow Books, 51- 63.

BARTOSIEWICZ, L., 2007. Mammalian Bone. In: A. WHITTLE, ed., *The Early Neolithic on the Great Hungarian Plain. Investigations of the Körös Culture Site of Ecsegfalva 23, County Békés, Vol. 1.* Budapest: Publicationes Instituti Archaeologici Academiae Scientiarum Hungaricae, 287-311.

BEJA-PEREIRA, A., CARAMELLI, D., LALUEZA-FOX, C., VERNESI, C., FERRAND, M., CASOLI, A, GOYACHE, F, ROYO, L.J., CONTI, S., LARI, M, MARTINI, A., OURAGH, L., MAGID, A., ATASH, A., ZSOLNAI, A., BOSCATO P., TRAINTAPHYLIDIS, C., PLOUMI, K., SINEO, L., MALLEGNI, F., TANBERLET, P., ERHARDT, G., SAMPIETRO, L., BERTRANPETIT, I., BARBUJANI, G., LUIKAT, G., AND BERTORELLE, G., 2006. The Origin of European Cattle: Evidence from Modern and Ancient DNA. *Proceedings of the National Academy of Sciences,* 103-21, 8113-8118.

BENECKE, N., 1994. *Archäozoologische Studien zur Entwicklung der Haustierhaltung in Mitteleuropa und Südskandinavien von den Anfangen bis zum ausgehenden Mittelalter*. Berlin: Akademie Verlag.

BOGAARD, A., 2004. *Neolithic Farming in Central Europe, An Archaeobotanical Study of Crop Husbandry Practices*. London: Routledge.

BOGUCKI, P., 1984. Patterns of Animal Exploitation in the Early Neolithic of the Polish Lowlands. In: C. GRIGSON AND J. CLUTTON-BROCK, eds. *Animals and Archaeology: 4. Husbandry in Europe*. Oxford: BAR International Series 227, 35-44.

BOGUCKI, P., 1986. The antiquity of dairying in temperate Europe. *Expedition,* 28(2), 51-58.

BOGUCKI, P., 1993. Animal traction and household economies in Neolithic Europe. *Antiquity*, 67(256), 492-503.

COPLEY, M.S., BERSTAN, R, DUDD, S.N., DOCHERTY, G, MUKHERJEE, A.J, STRAKER, V, PAYNE, S, AND EVERSHED, R.P., 2003. Direct Chemical Evidence for Widespread Dairying in Prehistoric Britain. *Proceedings of the National Academy of Sciences,* 100(4), 1524-1529.

CRAIG, O.E., CHAPMAN, J., HERON, C., WILLIS, L.H., BARTOSIEWICZ, L., TAYLOR, G., WHITTLE, A. AND COLLINS, M., 2005. Did the first farmers of central and eastern Europe produce dairy foods? *Antiquity,* 79, 882-894.

DAVIS, S.J.M., 1987. *Archaeology of Animals.* New Haven: Yale University Press.

DAUGNORA, L. and GIRININKAS, A., 1996. *Osteoarcheologija Lietuvoje: vidurinysis ir vėlyvasis holocenas.* Vilnius: Savastis.

DÖHLE, H.-J., 1994. Betrachtungen zum Haustier-Wildtier-Verhältnis in neolithischen Tierknochenkomplexen. In: M. KOKABI AND J. WAHL, eds., *Beiträge zur Archäologie und prähistorischen Anthropologie*. Forschungen und Berichte zur Vor-und Frühgeschichte in Baden-Württemberg, 53, 223-230.

EDWARDS, C. J. and BRADLEY, D.G., 2007. Ancient DNA Analysis of Aurochsen. In: A. WHITTLE, ed. *The Early Neolithic on the Great Hungarian Plain. Investigations of the Körös Culture Site of Ecsegfalva 23, County Békés. Vol. 1*. Budapest: Publicationes Instituti Archaeologici Academiae Scientiarum Hungaricae, 327-329.

EKVALL, R. B., 1968. *Fields on the Hoof. Nexus of Tibetan Nomadic Pastoralism.* New York: Holt Rhinehart and Winston.

FABI, M., 2002. Pathological alteration of cattle skeletons – evidence for the draught exploitation of animals? In: J. DAVIES, M. FABI , I. MAINLAND, M. RICHARDS AND R. THOMAS. *Diet and Health in Past Animal Populations, Current Research and Future Directions. Proceedings of the 9th ICAZ Conference, Durham 2002*. Oxford, Oxbow Books, 58-62.

FERNÁNDEZ, H., HUGHES, S., VIGNE, J-D., HELMER, D., HODGINS, G., MIQUEL, C., HÄNNI, C., LUIKART, G., and TABERLET, P., 2006. Divergent mtDNA lineages of goats in an Early Neolithic site, far from the initial domestication areas. *Proceedings of the National Academy of Sciences,* 103-42, 15375-15379.

GRAYSON, D.K., 1984. *Quantitative Zooarchaeology: Topics in the Analysis of Archaeological Fauna.* Orlando: Academic Press.

GREENFIELD, H.J., 2005. A Reconsideration of the Secondary Products Revolution in South-eastern Europe: on the Origins and Use of Domesticated Animals for Milk, Wool, and Traction in the Central Balkans. In: J. MULVILLE AND A. OUTRAM, eds. *Zooarchaeology of Fats, oils, Milk and Dairying.* Oxford: Oxbow Books, 14-31.

GREGG, S.A., 1988. Neolithic subsistence II: Livestock. In: *Foragers and Farmers, Population Interaction and Agricultural Expansion in Prehistoric Europe*. Chicago: University of Chicago Press, 99-124.

GÖTHERSTRÖM, A., ANDERUNG, C., HELLBORG, L., ELBURG, R., SMITH, C., BRADLEY, D., and ELLEGREN, H., 2005. Cattle domestication in the Near East was followed by hybridization with aurochs bulls in Europe. *Proceedings of the Royal Society: Biological Sciences,* 272(1579), 2345-2350.

GUMINSKI, W., 1989. *Gródek Nadbużny, osada kultury pucharów lejkowatych.* Wrocław: Ossolineum.

JOHANNSEN, N. N., 2002. Paleopathology and Neolithic cattle traction: methodological issues and archaeological perspectives. In: J. DAVIES, M. FABIŠ, I. MAINLAND, M. RICHARDS and R. THOMAS. *Diet and Health in Past Animal Populations, Current Research and Future Directions. Proceedings of the 9th ICAZ Conference, Durham 2002*. Oxford, Oxbow Books, 39-51.

KLEIN, R.G. and CRUZ-URIBE, K., 1984. *The Analysis of Animal Bones from Archaeological Sites.* Chicago: The University of Chicago Press.

KRUK, J., 1980. *Gospodarka w Polsce południowo-wschodniej w V-III tysiącleciu p.n.e*. Wrocław: Ossolineum.

KRUK, J. and MILISAUSKAS, S., 1981. Wyżynne osiedle neolityczne w Bronocicach, woj. Kieleckie. *Archeologia Polski,* 26(1): 65-113.

KRUK, J.and MILISAUSKAS, S. 1983. Chronologia absolutna osadnictwa neolitycznego z Bronocic, woj. kieleckie, *Archeologia Polski,* 28(2): 257-320.

KRUK, J. and MILISAUSKAS, S., 1999. *Rozkwit i upadek społeczeństw rolniczych neolitu.* Kraków: Instytut Archeologii i Etnologii Polskiej Akademii Nauk.

KRYSIAK, K., 1950. Szczątki zwierzęce z osady neolitycznej w Ćmielowie. *Wiadomości Archeologiczne,* 17, 165-228.

KRYSIAK, K., 1952. Szczątki zwierzęce z osady neolitycznej w Ćmielowie, cz. II. *Wiadomości Archeologiczne,* 18 (3-4), 251-290.

KRYSIAK, K., 1956. Materiał zwierzęcy z osady neolitycznej w Gródku Nadbużnym, pow. Hrubieszów. *Wiadomości Archeologiczne,* 23 (1), 49-58.

KRYSIAK, K., 1957 Material zwierzęcy z osady neolitycznej w Klementowicach, pow. Puławy. *Materiały Starożytne,* 2, 203-206.

KRYSIAK, K., 1966-1967. Szczątki zwierzęce z osady neolitycznej w Zawichost-Podgórzu, pow. Sa ndomierz. *Wiadomości Archeologiczne,* 32, 376-384.

KRYSIAK, K. AND LASOTA, A., 1971. Zwierzęce materiały kostne z osady Kamień Łukawski, pow. Sandomierz, *Wiadomości Archeologiczne,* 36 (2), 187-200.

KULCZYCKA-LECIEJEWICZOWA, A., 2002. *Zawarża, osiedle neolityczne w południowopolskiej strefie lessowj.* Wrocław: Instytut Archeologii i Etnologii PAN, Oddział we Wrocławiu.
LARSON, G., ALBARELL, U., DOBNEY, K., ROWLEY-CONWY, P., SCHIBLER, J.,, TRESSET, A., VIGNE, J-D., EDWARDS, C.J., SCHLUMBAUM, A., DINU, A., BĂLĂÇSESCU, A., DOLMAN, G., TAGLIACOZZO, A., MANASERYAN, N., MIRACLE, P., VAN WIJNGAARDEN-BAKKER, L., MASSETI, M., BRADLEY, D.G., and COOPER, A., 2007. Ancient DNA, pig domestication, and the spread of the Neolithic into Europe. *Proceedings of the National Academy of Sciences,* 104-39, 15276-15281.
LARSON, G., DOBNEY, K., ALBARELLA, U., FANG, M., MATISOO-SMITH, E., ROBINS, J., LOWDEN, S., FINLAYSON, H., BRAND, T., WILLERSLEV, E., ROWLEY-CONWY, P., ANDERSSON, L., and COOPER, A., 2005. Worldwide Phylogeography of Wild Boar Reveals Multiple Centers of Pig Domestication. *Science,* 307:11, 1618-1821.
LASOTA-MOSKALEWSKA, A., 1997. *Podstawy archeozoologii. Szczątki ssaków.* Warszawa: Wydawnictwo Naukowe PWN.
MAKOWICZ-POLISZOT, D., 2002. Zwierzęce szczątki kostne ze stanowiska kultury pucharów lejkowatych z Zawarży. In: A. KULCZYCKA-LECIEJEWICZOWA, *Zawarża, osiedle neolityczne w południowopolskiej strefie lessowej*. Wrocław: Instytut Archeologii i Etnologii Polskiej Akademii Nauk, 135-160.
MAKOWICZ-POLISZOT, D., 1997. Hodowla i łowiectwo w czasach pra – i wczesnohistorycznych. In: K. TUNIA, *Zarcheologii Małopolski: Historia i stan badań zachodniomałopolskiej wyżyny lessowej,*. Kraków: Instytut Archeologii i Etnologii PAN, Oddział w Krakowie, 483-507.
MARCINIAK, A., 2005. *Placing Animals in the Neolithic: Social Zooarchaeology of Prehistoric Farming Communities.* London: UCL Press.
MARCINIAK, A., 1996. *Archeologia i jej źródła: Materiały faunistyczne w praktyce badawczej archeologii.* Warszawa -Poznań: Wydawnictwo Naukowe PWN.
MEADOW, R.H. and ZEDER M.A., eds., 1978. *Approaches to Faunal Analysis in the Middle East.* Cambridge, MA: Peabody Museum Press, Harvard University.
MIDGLEY, M., 1992. *TRB Culture: The First Farmers of the North European Plain.* Edinburgh: Edinburgh University Press.
MILISAUSKAS, S. and KRUK, J.,1984. Settlement organization and the appearance of low level hierarchical societies during the Neolithic in the Bronocice microregion, Southeastern Poland. *Germania* 61(1), 1-30.
MILISAUSKAS, S. and KRUK, J. 1989. Economy, migration, settlement organization, and warfare during the late Neolithic in Southeastern Poland. *Germania* 67 (1), 77-96.
MILISAUSKAS, S. and KRUK, J., 1991. Utilization of cattle for traction during the later Neolithic in Southeastern Poland. *Antiquity* 65 (248), 561-566.
MILISAUSKAS, S., KRUK, J., MAKOWICZ-POLISZOT, D., AND PIPES, M-L., in press. *Neolithic Animal Husbandry at Bronocice.* Kraków: Instytut Archeologii i Etnologii, PAN.
MILNER, N., 2005. Can seasonality studies be used to identify sedentism in the past? In: *(Un)settling the Neolithic,* D. BAILEY, A. WHITTLE AND V. CUMMINGS (eds). Oxbow Books, Oxford> 32-37.
MIRACLE, P., 2006. Neolithic Shepherds and their Herds in the Northern Adriatic Basin. In: *Animals in the Neolithic of Britain and Europe*, D. SERJEANTSON and D. FIELD, eds. London: Oxbow Books, 63-93.
MULVILLE, J. and OUTRAM, A. K. 2005. *The Zooarchaeology of Fats, oils, Milk and Dairying. Proceedings of the 9th Conference of the International Council of Archaeozoology, Durham, August 2002*. Oxford: Oxbow Books.
MULVILLE, J., BOND, J. and CRAIG, O., 2005. The white stuff, milking in the outer Scottish Isles. In: *Zooarchaeology of Fats, oils, Milk and Dairying. Proceedings of the 9th Conference of the International Council of Archaeozoology, Durham, August 2002*. Oxford: Oxbow Books, 167-182.
O'CONNOR, T., 2000. *The archaeology of animal bones,* College Station: Texas A & M University Press.
OUTRAM, A. K., 2005. Distinguishing bone fat exploitation from other taphonomic processes: what caused the high level of bone fragmentation at the Middle Neolithic Site of Ajvide, Gotland? In: *Zooarchaeology of Fats, oils, Milk and Dairying. Proceedings of the 9th Conference of the International Council of Archaeozoology, Durham, August 2002*. Oxford: Oxbow Books, 32-43.
PAYNE, S., 1973. Kill-off Patterns in Sheep and Goats: The Mandibles from Asvan Kale. *Anatolian Studies, 23, Asvan 1968-1972: An Interim Report*, 281-303.
PIPES, M.-L., 2006. Good to Sell, to Buy, to Eat? Social Discourse between Meat Vendors and Consumers. East Anglia Research Station Report. Stalham, England. University at Buffalo, State University of New York.
REITZ, E. and WING, E., 1999. *Zooarchaeology,* Cambridge: Cambridge University Press.
RYDER, M.L., 1983. *Sheep and Man.* London: Duckworth.
SIRACUSANO, G., 2002. Archaeozoo-ecological footprints: how sustainable was cattle raising and breeding. *In:* M. MALTY, ed., *Integrating Zooarchaeology, Proceedings of the 9th ICAZ Conference, Durham 2002*. Oxford: Oxbow Books, 41-50.
STEFFENS, J., 2007. Die Bedeutung der Jagd in der Trichterbecherkultur. *Archäologisches Korrespondenzblatt,* 37:471-487.

Received: 15 February 2008; Revised: 10 May 2008;
Accepted: 10 January 2009.

Marie-Lorraine Pipes
Department of Anthropology
State University of New York at Buffalo
Buffalo, NY 14261-0026
USA
E-mail: Pipesml@aol.com

Janusz Kruk
Instytut Archeologii i Etnologii PAN
Oddział w Krakowie
ul. Sławkowska 17
31-016 Kraków
Poland
E-mail: kruk@archeo.pan.krakow.pl

Danuta Makowicz-Poliszot
Instytut Archeologii i Etnologii PAN
Oddział w Krakowie
ul. Sławkowska 17
31-016 Kraków
Poland

Šarunas Milisauskas
Department of Anthropology
State University of New York at Buffalo
Buffalo, NY 14261-0026
USA
E-mail: smilis@buffalo.edu

GYVULININKYSTĖ PILTUVĖLINIŲ TAURIŲ KULTŪROS BRONOCICE GYVENVIETĖJE

Marie-Lorraine Pipes, Janusz Kruk, Danuta Makowicz-Poliszot, Šarunas Milisauskas

Santrauka

Pragyvenimo ekonomikos tyrimai piltuvėlinių taurių kultūros (toliau – PTK) Bronocice gyvenvietėje (Pietryčių Lenkija, Mažoji Lenkija) yra susiję su didelės apimties faunos liekanų tyrimais šios kultūros 1, 3 ir 4 fazių (3800–3100 BC) laikotarpiu. Gauti duomenys atskleidė kelias tyrimų kryptis, kurios atsispindi ilgalaikėse PTK tradicijose. Tyrimų metu aptikta požymių, rodančių, kad laikui bėgant kito naminių gyvulių priežiūra, padidėjo jų kiekis, o tai tikriausiai buvo susiję su žmonių populiacijos augimu, socialiniais pokyčiais bendruomenėje ir ūkio specializacija tiek bendruomenės mastu, tiek už jos ribų. Šiame straipsnyje plačiai apžvelgiamos gyvulininkystės kryptys ir pokyčiai, susiję su socialiniais ir fiziniais veiksniais. Gauti duomenys lyginami su kitose Pietryčių Lenkijos gyvenvietėse aptikta gyvulininkystės medžiaga, pateikiami aiškinimai dėl esamų akivaizdžių skirtumų.

Bronocice gyvenvietė yra didžiausia ir ilgiausiai egzistavusi minėtame regione tarp kitų PTK gyvenviečių. Tuo tarpu PTK išskirtose fazėse yra pastebėta dviejų Liublino-Volynės ir piltuvėlinių taurių-Badeno kultūrų invazija. Faunos pokyčiai išryškėja atskirais PTK periodais ir minėtų kultūrų invazijų metu. PTK faunos tyrimų duomenys rodo, kad naminiai gyvuliai sudarė daugumą, o galvijai tarp jų vyravo (dar iš naminių gyvulių buvo auginamos avys ir kiaulės). Laukinių žinduolių aptikta labai nedaug, tarp jų vyravo kanopiniai, o ne kailiniai gyvūnai.

Naminių gyvulių dominavimas pietinėse PTK gyvenvietėse yra tipiškas reiškinys, nes gyventojai augino daugiausia naminius gyvulius, laukinių gyvūnų medžiojo nedaug, kailinių žvėrių trūkumo nejautė.

Ketvirtosios PTK fazės metu pagausėjo kanopinių žvėrių, kas matyti iš osteologinės medžiagos. Tai buvo susiję su ragų, o ne mėsos poreikiu. Dažniausiai aptinkama stirnų. Bronocice gyvenvietėje tik ketvirtosios PTK fazės metu aptinkama ragų. Tačiau Liublino-Volynės kultūros gyvavimo metu ir dar vėliau, PTK Badeno kultūros pasirodymo metu, stirnų kiekis padidėja. Tai susiję su mėsos ir kailių poreikiu, ir tik viename to meto palaidojime aptinkama šių ragų.

Naminių žinduolių kiekis kiekvienos PTK fazės metu skirtingas. Pirmosios fazės metu tarp naminių žinduolių daugiausia buvo veisiami galvijai. Po trumpo laikotarpio, kai pasirodė Liublino-Volynės kultūrinė grupė, jau PTK trečiosios fazės metu, sumažėja galvijų ir atitinkamai pagausėja avių ir kiaulių. Ketvirtosios fazės metu vėl pagausėja galvijų. Šis galvijų mažėjimo procesas iki galo dar nėra aiškus. Tai galėjo būti susiję su PTK Liublino-Volynės kultūrinės grupės gyventojų pasirodymu, ligomis ar dar dėl iki šiol neištirtų veiksnių.

Naminių gyvulių kiekis, kuris pasiskirstęs tokia tvarka: galvijai, avys, kiaulės, yra netipiškas PTK. Dažniausiai publikacijose apie PTK gyvulininkystės tyrimus nurodoma kita naminių gyvulių kiekio pasiskirstymo tvarka: galvijai, kiaulės, avys. Tik vienoje Pietvakarių Lenkijos teritorijos Zawarża gyvenvietėje aptiktas panašus galvijų kiekio pasiskirstymas. Pastaroji gyvenvietė yra tik 12 km nutolusi nuo Bronocice gyvenvietės. Kitos šio regiono gyvenvietės buvo mažesnės, jose gyveno tik viena ar dvi žmonių kartos. Manoma, kad Bronocice gyvenvietė PTK trečiosios fazės metu dominavo, o panašumas tarp Zawarża ir Bronocice gyvenvietėse egzistavusios gyvulininkystės yra tose gyvenvietėse gyvenusių bendruomenių glaudžių ryšių rezultatas ar net žmonių maišymosi tarp minėtų bendruomenių pasekmė.

Tyrimų duomenys įgalina teigti, kad kiekvienos PTK fazės metu pastebimi skirtumai tarp naminių gyvulių kiekio pasiskirstymo, ypač kiaulių, rodytų, kad jos galėjo būti auginamos ir skerdžiamos ne gyvenvietės teritorijoje, ypač PTK pirmosios ir antrosios fazių metu. Kiaulių skerdimo amžius rodo, kad nebuvo skerdžiami jauni paršiukai. Tik PTK ketvirtosios fazės metu, kai kiaulės buvo pradėtos auginti gyvenvietėje, padidėja ir jauno amžiaus paskerstų kiaulių kiekis.

Kintanti gyvulininkystės kryptis ir struktūra yra susijusi ne tik su socialine žmonių struktūtos kaita, bet ir su fiziniais žmonių ir gyvūnų poreikiais. Šios dvi sąsajos – tai apgalvoti veiksniai, rodantys būtinybę bendrauti tarp atskirų žmonių grupių. Tarp fizinių poreikių buvo ganyklų priežiūra, pašaro ruošimas, gyvulių ganymo kryptis ir jų auginimas, kas skatino bendrauti ir kooperuotis atskiras žmonių grupes. Gyvulių įsigijimas taip pat vertė sąveikauti atskiras žmonių grupes. Tyrimų duomenys rodo, kad medžioklė nebuvo perspektyvi ūkio šaka, nors laukinių gyvulių Bronocice gyvenvietėje ir aptinkama.

Vertė Algirdas Girininkas

BUTCHERY IN THE EARLY BRONZE AGE (BY KRETUONAS 1C SETTLEMENT DATA)

LINAS DAUGNORA, ALGIRDAS GIRININKAS

Abstract

Analysis of the osteological and archaeological material discovered at the Early Bronze Age settlement of Kretuonas 1C suggests that the settlement's hunted game and reared animals were slaughtered within the settlement, not far from the dwellings. We analyse the butchering technology of the Early Bronze Age based on Kretuonas 1C's osteological material. The tools used for butchering and the macroscopic analysis of the slaughtered artiodactyls' axial skeleton and long bones enabled an assessment of split bone in the butchering area, as well as of chop and cut marks acquired during the butchering process.

Key words: butchering technology, Kretuonas 1C, Early Bronze Age, East Lithuania.

Introduction

Human food sources, the development of diet, butchery, the peculiarities of food preparation and its conservation still are little researched themes in East Baltic prehistory. The peculiarities of diet in prehistoric East Baltic settlements and cemeteries have been researched via stable isotope data by G. Eriksson (Eriksson 2006, pp.183-215) (human data from the Zvejnieki burial ground, faunal data from the Zvejnieki I and II habitation sites (in Latvja)); I. Antanaitis, N. Ogrinc (2000, pp. 3-12); I. Antanaitis-Jacobs, M. Richards, L. Daugnora, R. Jankauskas, N. Ogrinc (2009, pp.12-30) (Kretuonas 1B, Plinkaigalis, Gyvakarai, Kirsna, Turlojiškė burial grounds; Lithuania); L. Lõugas, K. Lidén, D. E. Nelson (1996, pp. 399-420) (Narva, Tamula, Kudruküla, Naakamäe, Loona burial grounds, Estonia). These human data suggest that the people's physical environment and particular locations of food resources were very important factors in their diet.

The aim of this article is to evaluate the methods of butchery used by the Early Bronze Age people of the Kretuonas 1C settlement by means of macroscopic analysis of the skeletal material.

Man and the environment around Lake Kretuonas in the Early Bronze Age

Multidisciplinary research data (zooarchaeological, archaeological, palynological) illustrate that environmental conditions around Lake Kretuonas in East Lithuania in the Stone and Bronze Ages (Figs. 1A, B) were sufficiently good for habitation; the people could subsist from the resources in their environment – the fish in Lake Kretuonas and other water bodies in its basin, the heterogeneous vegetation and fauna that lived in the mixed forests, and, starting the end of the Neolithic – from animal husbandry as well, as indicated by the fields-pastures surrounding the settlements and the osteological material found within the settlements (Daugnora, Girininkas 2004, Girininkas 2008 pp.15-32). The determination of the natural environment enables a rather detailed reconstruction of human diet from both foraging and farming at Kretuonas 1C during the Early Bronze Age.

The various postglacial sediments that formed around Lake Kretuonas later conditioned the heterogeneous formation of the soil. In the larger part of the basin where morainic clayey loam hills dominate, turfy-ashen grey weakly podsolized soils had already formed in the Neolithic. In the southwestern part of the lake and basin where sandy parent material dominates, there are ashen grey- ilainiai soils. The depressions contain marshy, ashen-grey-marshy soils (Garunk tis *et al* 1974, pp.18-19; Seibutis 1974, pp.41-51). Different vegetation grew in the corresponding, different soils and different species of animals propagated. Dry pine forests were widespread in the basin's western part, which transformed into deciduous trees-hazel, birch, and alder covering the low-lying marshland-around Lake Kretuonas in the southwest. Juniper groves grew in the basin's eastern part, especially on the morainic hills, while pine forests grew inbetween them in the sandy tracts (Girininkas 2008, pp. 22-23).

The Early Bronze Age is associated with the Late Subboreal. Birch and pine forests spread around Lake Kretuonas and peat formation continued in the bog zone although it became drier, while alder dominated and spruce groves increased in the depressions of the lake basin. The linden and elm groves that flourished in the Neolithic yielded the drier soils to birch and pine groves, while oak groves changed little. The largest

Fig. 1. A Location of Kretuonas 1C settlement in Lithuania, B Location of the settlement around Lake Kretuonas.

amount of grass pollen of the entire prehistoric period in the Kretuonas basin is observed in the sediments of this period (Kabailienė, Grigienė 1997, pp. 44-52). This fact is undoubtedly associated with the increased plots of cultivated land and pastures. Zooarchaeological data also confirm this. At Kretuonas 1C, which is the most distinctive Early Bronze Age site in the area, the amount of domesticated animal bone increased up to 18% (MNI) (Daugnora, Girininkas 2004, pp.155, 165) and the amount of pollen of cultivated cereals increased (Girininkas 2008, pp. 22-23). The inhabitants still had populated the lakeshores where Neolithic habitation sites also are found. This is very clear from the topography of Kretuonas 1C and other Early Bronze Age settlements.

The settlement was established on the eastern shore of Lake Kretuonas right next to the mouth of the Žaugėda rivulet. It was a pile dwelling site, on the sand bar of the flooded rivulet and lake. Birch groves grew around the settlement, pine groves – in the higher places, alder, hazel, and much oak – alongside the lake, with the addition of fir trees on the slopes of the morainic hills. Abundant ash groves (*Fraxinus excelsior* L.) grew on the first terrace; they flourished in hewed out, burnt out, and abandoned plots. Meadows with fences could be found east of the settlement, with a hoed up field nearby. An agrarian type of landscape extended around the settlement. This is confirmed by zooarchaeological (Daugnora, Girininkas 2004, pp.233-250) and palynological data (Kabailienė, Grigienė 1997, pp.44-52).

At that time approximately one-fifth of meat products were obtained from the animals reared by the settlers. Cultured cereal plant pollen is found in the sediments of the settlement's cultural layer. In addition to growing cereal grains and raising animals, the people intensively hunted and fished. A five meter long creel was found right next to the settlement in the channel of a rivulet, while the largest amount of hunted game was comprised of elk, red deer, and furbearing animals which were needed for trade in order to get metal products, amber.

In living here approximately 300 years, the people of the Early Bronze Age Kretuonas 1C settlement left a rather impressive cultural layer, already very similar to the agrarian type of settlements of Central Europe; it was from 5-10 cm to 120 cm thick with many and various artefacts (Girininkas 1988, 1990, 1992; Daugnora, Girininkas 2004, pp.233-250). Large rubbish heaps were found near the settlement in which were found many broken pottery sherds, along with items made from bone, horn, stone, wood, and flint.

According to the archaeological research data of Kretuonas 1C, it can be said that this was a settlement base near which there were animal enclosures and winter dwellings for the animals that protected them from wild beasts and other hostile tribes. With its surrounding fields, enclosures, metal recasting and fishing loci, we can call this settlement a large and unified economic unit. Research conducted in the surrounding areas suggests that an entire line of economic products existed not in the settlement itself, but rather in this tribal community's controlled territory. Thus the Kretuonas 1C community can be considered a local territorial community with a strictly defined and owned territory for the acquisition of raw material and land suitable for farming, in which existed a clear division of labor and social differentiation.

The butchering locus, the blows, and the animal bone analysis

A very interesting and significant feature for research into Early Bronze Age people's diet is an area of very large accumulation of zooarchaeological material found in the eastern part of the Kretuonas 1C settlement during excavations in 1987 and 1988, a place which we named "the slaughterhouse" (Fig. 2). The accumulation locus was approximately 180 m^2 large. Skeletal bone, antlers, bone fragments of both wild and domestic animals were found in this location. By both the preserved skeletal freagments of separate fauna and by the settlement's inventory, this butchering locus is dated to the Early Bronze Age - 2000-1700/1650 BC (Table 1).

Analysis of the identified bones from the "slaughterhouse" showed that single teeth dominated (28.33% of the identifed bones) because the majority of skulls and large part of the mandibles (11.74%) were split in separating the body from the *ramus mandibula* (Fig. 3) (Daugnora, Girininkas 1996, p.89) and removing the canine teeth that were used to make amulet pendants (Daugnora ir Girininkas 1995, p.88, Fig. 3). Single chop marks were observed on the joints of the analysed bones, either at the surface or where the muscles had been attached (Plate I:2), but healthy long bones or skulls virtually were not found in the butchery locus; what dominated there were rib and skull fragments, wrist and heel bones, metacarpal/ metarsal bones, phalanges, and sesamoid bones. The large amount of proximal and distal parts of long bones and fragments of these bones show some butchering and bone splitting methods that traditionally were used by Mesolithic and Neolithic hunters (Daugnora, Girininkas, 2004, pp.114-115; 139; Daugnora, Girininkas, 1996, pp.29-30). Also found were antlers, which in most instances still had parts of the frontal bone (*os frontale*) attached.

Analysis of the axial skeleton shows that the elk's first and second neck vertebrae were chopped though (Figs. 4-5). This not only means that the neck was separated from the head, but also that this area was separated into the left and right sides. Many rib bodies (*corpus costae*), without their heads (*caput costae*) were found in the butchering area. On the exterior posterior surface below the *procesus/facies articularis caudalis* of an excavated horse's cervical vertebra, two long cuts were found (Plate I:1). Three cuts were found on the front surface of a thoracic vertebra of an elk near the connection with the *discus intervertebralis*. Chop marks also were observed on the side of a bovine tail vertebra (*vertebrae caudales* Ca IV or Ca V).

While analyzing 40 front leg scapula fragments, we determined that 20 of them are distal fragments and belong to artiodactyls (aurochs, elk, red deer, roe deer, boar, cattle, sheep/ goat, pig). Single chops were found in the neck area of a pig's scapula or near the beginning of the *spina scapula*, along the sides. Twaddlers and small spades were made from the proximal part of the mentioned fauna (Daugnora, Girininkas, 1995; 1996).

Analysis of 56 humeri of elk, red deer, and boar (excluding those of beaver (*Castor fiber*)) revealed 27 proximal fragments and 29 distal fragments (Figs. 6 and 7). The body of the humerus was struck while splitting it or separating the distal end (*Trochlea humeri*), while in seven instances the established blow separated the

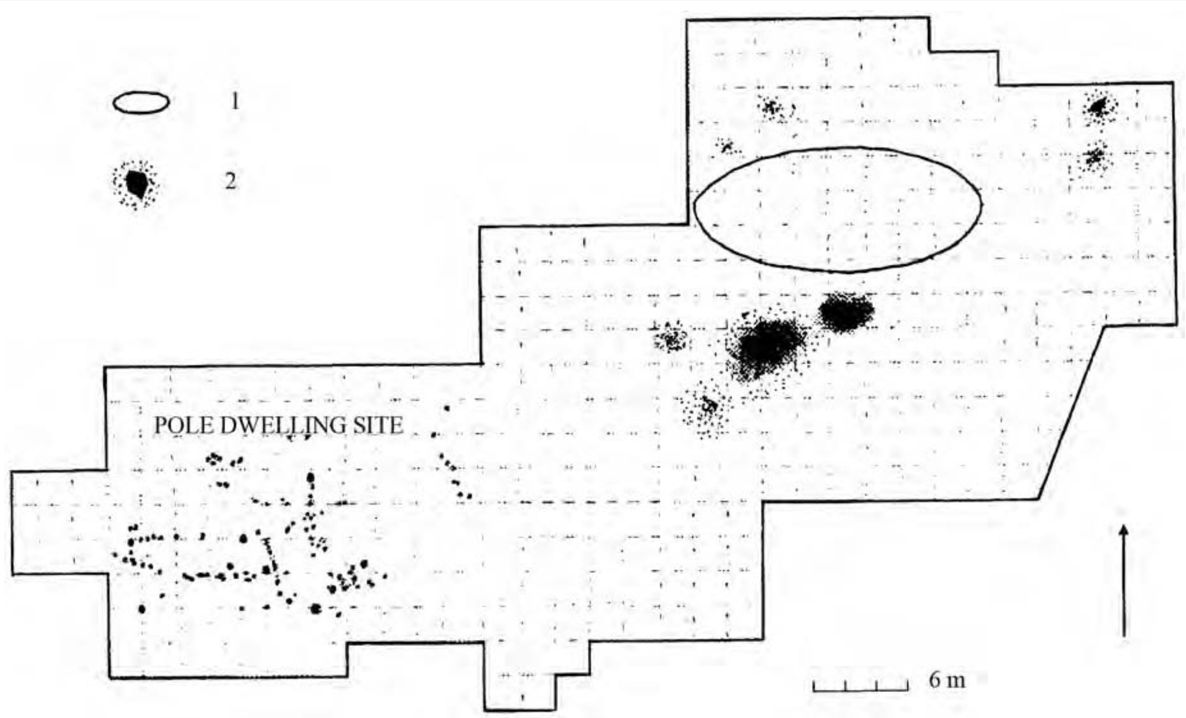


Fig. 2. Kretuonas 1 C settlement's excavation area: 1- buthcering locus, 2 - ceramic concentration.

Table 1. Radiocarbon dates of bones found in Kretuonas 1 C's butchering locus

Bone sample	**Lab. Nr.**	**^{14}C data (BP)**	**Uncalibrated**	**Calibrated (BC) 2σ Max.-min.**	**Calibrated 1 σ range**
Equus Caballus	Ki-10102	3460±70	1510±70	1879–1839; 1829–1791 1785–1729; 1725–1689	1945–1603 1553–1537
Capra Hircus	Ki-101030	3520±70	1570±70	1935–1933; 1921–1745	2031–1989 1985–1685 1667–1663
Bos bovis	Ki-11043	3610±70	1860±70	2193–2179; 2141–1855 1847–1769; 1757–1749	2119–2097 2087–2085 2039–1881
Bos bovis	Ki-11084	3580±50	1630±50	2115–2099; 2037–1855 1847–1769; 1757–1749	2015–1997 1979–1879 1839–1829 1789–1787
Bos bovis	Ki-11085	3620±50	1670±50	2137–2077; 2069–1879 1841–1829; 1793–1785	2107–2105 2033–1915 1903–1889
Bos bovis	Ki-11086	3600±50	1650±50	2135–2081; 2045–1873 1843–1809; 1801–1775	2025–1995 1981–1885
Bos bovis	Ki-11087	3600±37	1650±37	2113–2101; 2035–1879 1839–1829; 1791–1785	2013–1999 1979–1915 1905–1887
Martes Martes	Ki-10101	3590±70	1640±70	2109–2105; 2033–1877 1841–1827; 1795–1779	2137–2079 2067–1747
Esox lucius	Ki-11042	3550±70	1600±70	2123–2097; 2089–2085 2039–1733; 1717–1689	2009–2001 1975–1967 1959–1859 1845–1771

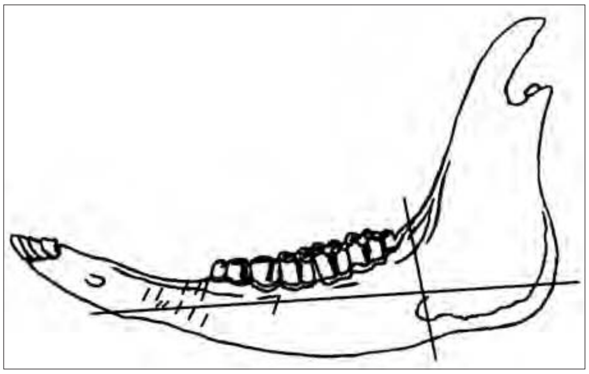


Fig. 3. Mandible-splitting diagram.

Fig. 4. Top cervical vertebrae (a*tlas*): modern elk's (in center) and chopped first cervical vertebrae fragments found at Kretuonas 1C.

Fig. 5. Second cervical vertrebrae (a*xis*). Kretuonas 1C.

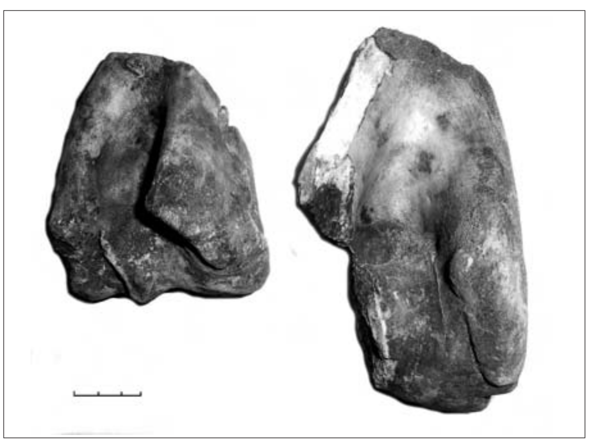


Fig. 6. Distal parts of elk and red deer humeri, chopped transversely and longitudinally. Kretuonas 1C.

humerus's distal disk transversely (Plate I:3). Cuts also were found on the edges of a pig's/ boar's and elk's humeri's *fossa olecranii* (Plate I:4).

Analysis of the 107 fragments of artiodactyl foreleg (*ossa antebrachii*) bones showed that the body of the foreleg bone also was split with an axe. A fair amount of proximal (16) and distal (11) parts of radii and chopped through ulna proximal tuberosity (6) would confirm this thought (Fig. 8).

Metacarpal and metatarsal bones (*ossa metacarpalia et metatarsalia*) were used in the production of tools (tool sheaths, chisels). Of the 151 metacarpal/ metatarsal bone fragments found in the butchering locus, 46 proximal and distal parts (Fig. 9) were found with single blows.

Split pelvic bone fragments in which *acetabula* dominated were found upon analysis of rear leg bones.

The splitting of femurs, as one of the largest accumulations of bone marrow, was similar to humeri splitting technology, i.e., both the proximal part of the bone (the head of the femur – *caput femoris* – and the greater trochanter – *trochanter major*, together or separate) and the distal end of the femur were found (Fig.10). Single cut marks were found on the distal part of the femur near the *tuberositas supracondylaris lateralis et medialis*, to which attach the *caput medialis musculi gastrocnemii et caput lateralis musculi gastrocnemii*.

Analysis of the second rear leg's long bone, the tibia, showed no difference from the splitting of other long bones. The proximal and distal parts of the tibiae were picked out from the butchering locus's accumulation of bones (Fig. 11). The body of the bone usually was chopped up into small fragments or used for tool manufacture.

We believe that the heel bones were split for other reasons. This probably was done wanting to disarticulate the feet from the top end of the bone that has more meat. Of the 31 heel bones or *calcaneus* of the various species of fauna analysed (including horse), the lower part of the heel bone was struck in 18 instances (Fig. 12). Ankle bones – the *talus* – generally were not struck except for two instances. Single cuts were found on the plantar side of the central heel bone (elk, *os centroquartale*).

Examination of front and rear leg phalanxes (90) revealed a large amount of split bones (69, with artiodactyl phalanxes dominating); the proximal and distal parts of the first and second phalanxes were found mostly. Round holes were found in the bodies of some of the phalanxes (Fig. 13).

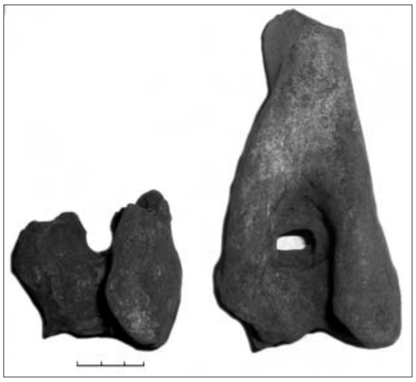


Fig. 7. Distal parts of boar's humerus. Kretuonas 1C

Fig. 8. Chopped ulna o*lecranon*. Kretuonas 1C

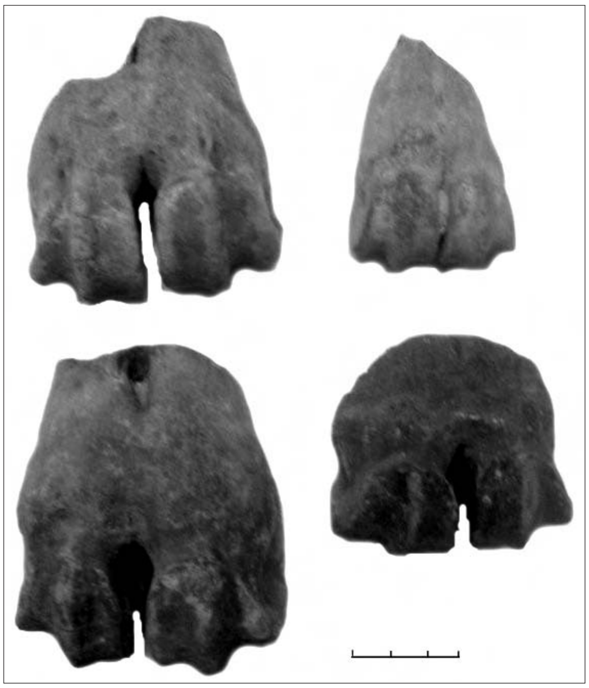


Fig. 9. Distal parts of artiodactyl metacarpals and metatarsals (*ossa metacarpalia/metatarsalia*). Kretuonas 1C

Discussion

A place intended for butchering animals was found for the first time among Lithuania's Stone and Bronze Age settlements. Approximately 70% of all the osteological material excavated from Kretuonas 1C was found in the settlement's butchering locus. Undoubtedly there had to be more such loci in other habitation sites of the same period. The radiocarbon dates obtained from the animal bones (Table 1) from the butchering area's accumulation of bones shows that people lived in this place approximately 300 years, and revealed the people's conception of ecology and sanitary conditions. It is interesting to note that the community members of the Kretuonas 1C settlements lived in pile dwellings, while their economic activities occurred on land, in the territory east of the confluence of a stream and the lake, where the butchering locus was found.

The work tools found in the territory of the Kretuonas 1C settlement help to answer the question of which tools were used to process the carcass meat. A large amount of flint axes were found which were used in processing the meat (Fig. 14). These are hafted flint axes with polished blades, on the surfaces of which work traces from chopping bones with an axe have remained. These preserved features were observed while analysing the flint axe blades via trace analysis. Hafted stone axes with polished surfaces, flint and bone daggers, and knives also could have been used in the butchering process. We believe that flint knives made from wide and massive flakes were used for cutting the meat during the slaughtering process (Fig. 15). Microwear from contact with meat and a hard bone surface can be seen on the tops of their blades. Flint burins also were used to divide long bones longitudinally (Fig. 16). The bones (e.g., metacarpal/ metatarsal) were split in the necessary place with the aid of burins. Needles for weaving nets, spearheads, chisels, and other manufactured items were made from these bones. Flint scrapers and massive scrapers were used for working hides and furs (Girininkas 1994, p.206).

The bone fragments, fracture types, and fragmentation level of the bones (Outram 2005 p. 33-34) encountered in the settlement's butchering locus help to determine the animals' slaughtering technologies (Fig. 17). Butchery methods, only from earlier Palaeolithic to Neolithic periods, were researched by many scientists (Mateos 2005; Magnell 1996, 2005; Outram 2005; Hill *et al.* 2008; Baroz *et al.* 2008). Macroscopic changes in the bone also are described in the mentioned authors' works, and five stages of butchery are distinguished (Rixson 1989). Results of the macroscopic analysis of bone material dated to the Bronze Age support the proposition that the Early Bronze Age inhabitants used the slaughter methods of earlier periods and continued processing carcass meat as their ancestors did. After removing the head from the body and opening the brain cavity, the brains were removed. Skulls were smashed, and parts of the skull around the horns' rosettes were "chopped off," because many splintered skull fragments and horns with frontal bone (*os frontale*) remains were found in the butchering locus. Horns were used for the

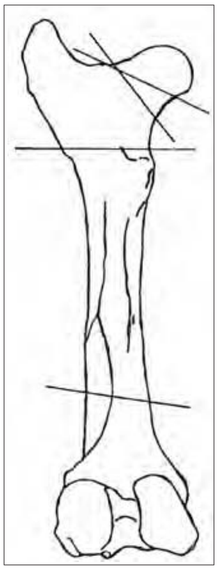


Fig. 10. Fracturing places artiodactyl femurs. Kretuonas 1C.

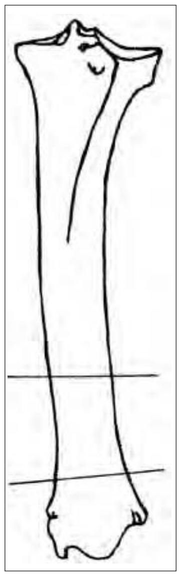


Fig. 11. Fracturing places artiodactyl tibiae. Kretuonas 1C.

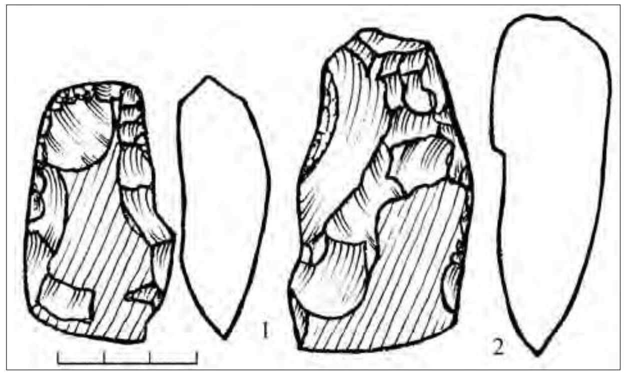


Fig. 14. Flint axes with polished surfaces and blades. Kretuonas 1C.

Fig. 12. Elk's and red deer's chopped through heel bones (*calcaneus*). Kretuonas 1C.

Fig. 13. Elk's phalanxes (*phalanx proximalis*) with small holes. Kretuonas 1C.

production of various tools. At the same time, the animals' mandible would be removed, as were, probably, the teeth, used for amulets-ornaments. The mandible and its disarticulation through the diastema and *ramus mandibula* apparently were necessary for quick access both to the animal's tongue and to the separation of the mandible's joint.

After cutting the shoulder blade's muscles, the forelimb was disarticulated from the chest. The detachment of the rear leg could have ocurred in three ways. By the first and second method, it would be disarticulated using an axe and cutting off the wings of the hip bone (*ala ossis illii*) or the head of the femur, leaving it together with the *acetabulum* after the blow, and in the third method – by separating the head of the femur from the *acetabulum* by knife through the hip joint (*articulatio coxae*), i.e., by cutting off the ligament (*lig. capitis ossis femoris)*. This is confirmed by the chopped up bone fragments found at the Kretuonas 1C settlement as well as authors who have written about such bone chopping (Legge, Rowley-Conwy 1988; Outram, 1999, 2001, 2002, 2004). The appearance of cervical, thoracic, and lumbar vertebral bodies (*corpus vertebrae*) in halves in Kretuonas 1C's osteological material shows the division of the animals into parts. Moreover, many chopped up ribs were found in the butchery locus, whose heads (*capitulum costae*) were separated from the body (*corpus costae*) of the ribs. Large amounts of rib bodies and halved vertebrae or their processes are found in later periods (e.g., in Roman period settlements).

Regarding the articulations of the leg bones, the three bones comprising the elbow joint (*humerus, radius, ulna*) are difficult to separate and were not chopped through uniformly. Thus, the humerus first is separated from the foreleg bones, and the proximal part of the ulna (*olecranon*) needs to be cut. The cuts intended to separate the elbow joint at Kretuono 1C were found nearer the *tuber olecranii*, which we believe to be as-

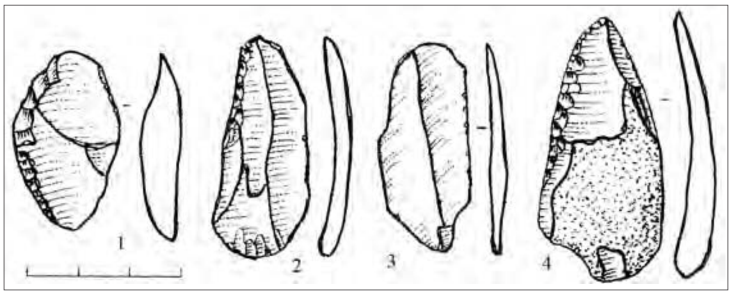


Fig. 15 Flint knives. Kretuonas 1C.

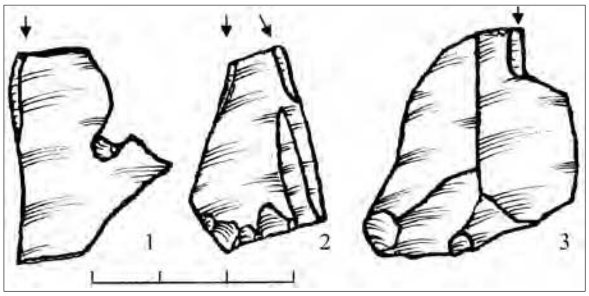


Fig. 16. Flint burins. Kretuonas 1C.

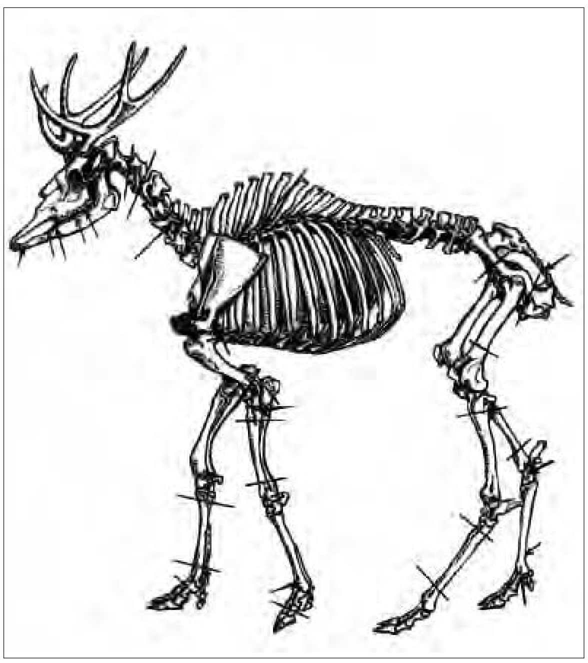


Fig. 17. A generalized artiodactyl skeletal view with indicated cut mark areas by Kretuonas 1C settlement data; elk (*Alces alces*).

sociated with the disarticulation of the *humero-radial-ulnari* joint. However, the stroke separating the distal part of the humerus together with the elbow joint might have served two purposes: to disarticulate the elbow joint and to open the humerus cavity, thereby making it easier to reach the bone marrow. One more very difficult part of the leg to disarticulate is the *articulatio coxae*. D. Rixon successfully accomplished this with a chopper that weighed 1.8 kg (Rixson 1989, p.50), separating the proximal part of the femur from the pelvic bone.

Not only a large amount of phalanxes was found in Kretuonas 1C's butchering locus (13.96% of the general bone count) (Daugnora, Girininkas 1996, p.89), but also phalanxes with drilled holes (Fig.14). Analogous phalanxes (*phalanx proximalis et medium*) with holes have been found not only in the coastal East Baltic ventoji complex of sites (Lithuanian Veterinary Academy, Osteological Laboratory collection), but also in Switzerland's Stone Age habitation sites (Schibler 1980, p.41, Abb.42).

The cut marks observed on the surface of the bones found in the Kretuonas 1C butchering locus show intensive work separating muscles, tendons, and connective tissues from the bony surface (Figs. 4, 7, 10, 11). By microscopically analysing the cuts, it is possible to determine the tools (stone or metal) by which the soft tissues were detached (Greenfield 1999, 2006; 2008; Greenfield *et al*. 2006).

We did not find a portion of the wild animals' front and back leg long bone bodies because of their usage in tool production (Daugnora, Girininkas 2004, pp.239-241; 1995, pp. 88-91). This is confirmed by a large quantity (531 pieces) of horn and bone artefacts found in the settlement territory of Kretuonas 1C. Twaddlers and small spades were made from the proximal part of the scapula, foreleg bones were broken or split when wanting to separate the radius from the ulna before producing daggers and icepicks; metacarpal and metatarsal bones show that they were used in the production of chisels and sheaths for tools (Daugnora, Girininkas 1995, pp.87-89; 1996, p.117). It is interesting to note that the tools usually were made not from the bones of not domestic animals, but rather of wild game. Such a situation is noted not only in the Baltic region, but also in other Northern European settlements, not only in the Bronze Age, but also in later times (Charniavski 2007, pp.35-36; MacGregor 1985).

We consider it a peculiarity of the Kretuonas 1C people's butchering technology that polished flint and stone work tools usually were used throughout the butchering process, since metal artefacts, with the exception of a small wire fragment, were not found in the settlement.

Conclusions

1. We consider the large bone concentration in the eastern part of the Kretuonas 1C settlement to be a buthcering locus.

2. According to the observed split animal bone as well as the chop and cut marks on the bone, the community members of the Kretuonas 1C settlement used to use polished stone and flint axes, knives, daggers, scrapers, and massive scrapers, as well as bone awls and daggers.

3. Macroscopic analysis of the bone material suggests that the Early Bronze Age inhabitants used the same butchery methods as used earlier in the Mesolithic and Neolithic and continued to process the carcass meat in the same way their ancestors did.

Translated by Indre Antanaitis-Jacobs

References

ABE, Y., MAREAN, C. W., NILSSEN, P. J., ASSEFA, Z., STONE, E. C. 2002. The analysis of cutmarks on archaeofauna: A review and critique of quantification procedures and a new image-analysis GIS approach. *American antiquity*, 67, 4, 643-663.

ANTANAITIS, I., OGRINC, N. 2000**.** Chemical analysis of bone : stable isotope evidence of the diet of Neolithic and Bronze Age people in Lithuania. *Istorija*, 45, 3–12.

ANTANAITIS-JACOBS, I., RICHARDS, M., DAUGNORA, L., JANKAUSKAS, R., OGRINC, N. 2009. Diet in Early East Baltic Prehistory and the new Lithuanian stable isotope evidence. *Archaeologia Baltica*, 12, 12-30.

BAR-OZ, G., BELFER-COHEN, A., MESHVELIANI, T., DJAKELI, N.and BAR-YOSEF, O. 2008. Taphonomy and Zooarchaeology of the Upper Palaeolithic cave of Dzudzuana, Republic of Georgia. *International Journal of Osteoarchaeology* 18: 131-151.

CHERNIAVSKI, M. *Kastsianye i pagavyia vyraby na paselishchakh kryvinskaga tarfianiku. Nealit- bronzavy vek*. Minsk: Belaruskaia navuka.

DAUGNORA, L., GIRININKAS, A. 1995. Analysis of Faunal remains from the Kretuonas lake settlement. *International Journal of Osteoarcheology*, 5/1, 83–92.

DAUGNORA, L., GIRININKAS, A. 1996. *Osteoarcheologija Lietuvoje: vidurinysis ir vėlyvasis holocenas*, Vilnius: Savastis.

DAUGNORA, L., GIRININKAS, A. 2004. Kretuono 1C gyvenvietės bendruomenės gyvensena. *Lietuvos archeologija*, 25, 233–250.

DAUGNORA, L., GIRININKAS, A. 2004. *Rytų Pabaltijo bendruomenių gyvensena XI–II tūkst. pr. Kr.*, Kaunas: Lietuvos veterinarijos akademija.

ERIKSSON, G. 2006**.** Stable isotope analysis of human and faunal remains from Zvejnieki. *In:* LARSSON, L. and ZAGORSKA, I. eds. *Back to the origin. New research in the Mesolithic-Neolithic Zvejnieki cemetery and environment, northern Latvia. Acta archaeologica Lundensia*, Series in 8o, 52, Stokholm, 183–215.

GIRININKAS, A. 1988. Senojo žalvario amžiaus Kretuono 1C gyvenvietė. *Archeologiniai tyrinėjimai Lietuvoje 1986 ir 1987 metais*, 12–15.

GIRININKAS, A., 1990. Tyrinėjimai prie Kretuono ežero. *Archeologiniai tyrinėjimai Lietuvoje 1988 ir 1989 metais*, 9–15.

GIRININKAS, A., 1992. Tyrinėjimai prie Kretuono ežero. *Archeologiniai tyrinėjimai Lietuvoje 1990 ir 1991 metais*, 16–20.

GIRININKAS, A., 2008. The Influence of the Environment on the Human Population around Lake Kretuonas during the Stone Age and Early Bronze Age. *Archaeologia Baltica*, 9, 15–32.

GREENFIELD, H. J., 1999. The origins of metallurgy: distinguishing stone from metal cut-marks on bones from archaeological sites. *Journal of archaeological Science*, 26, 797-808.

GREENFIELD, H. J., 2004. The butchered animal bone remains from Ashqelon, Afridar-Area G. *Atigot,* 45, 243-261.

GREENFIELD, H. J. 2006. Slicing cut marks on animal bones diagnostics for identifying stone tool type and raw material. *Journal of field arcgaeology*, 31, 147-163.

GREENFIELD, H. J., GALILI, E., HORWITZ, L. K., 2006. The butchered animal bones from Newe Yam, a submerged pottery Neolithic site of the Carmel coast. *Journal of the Israel prehistoric Society,* 36, 173-200.

HILL, M. G., MAY, D. W., RAPSON, D. J., BOEHM, A. R., OTAROLA-CASTILLO, E. 2008. Faunal exploitation by Early Holocene hunter/gatherers on the Great Plains of North America: evidence from the Clary Ranch sites. *Quaternary International,* 191, 115-130.

LEGGE, A. J. and ROWLEY-CONWY, P. A. 1988. Star Carr revisited. A Re-analysis of the large mammals. Oxford: Alden Press.

LYMAN, L., 1987. Archaeofaunas and butchery studies; A taphonomic perspective. *Advances in Archaeological Method and Theory*, 10, 249-337.

LÕUGAS, L., LIDEN, K., NELSON, E. 1996. Recourse utilization along the Estonian coast during the Stone Age. *In:* HACKENS, T. et. al, eds. *Coastal Estonia: recent advances in environmental and cultural history*, ser. PACT 51, Strasbourg, 399–420.

MacGREGOR, A., 1985. *Bone, antler, ivory, and horn. The technology of Skeletal Materials since the Roman Period*, Sydney: Croom Helm Ltd. Provident House.

MAGNELL, O. 2003. Butchering of wild boar (*Sus scrofa*) in the Mesolithic. *In:* LARSSON, L. et al, eds. *Mesolithic on the move. Papers presented at the sixth International conference on the Mesolithic in Europe,* Stockholm 2000. Oxford: Oxbow Books. 671-679.

MAGNELL, O. 2005. Tracking wild boar and hunters. Osteology of wild boar in Mesolithic South Scandinavia. *Acta Archaeologica Lundensia, Series in 8o, 51, Studies in osteology* 1, 51.

MAREAN, C.W., ASSEFA, Z., 1999. Zooarchaeological evidence for the Faunal Exploitation behavior of Neandertals and Early Modern Humans. *Evolutionary Anthropology*, 8 (1), 1–37.

MATEOS, A. 2005. Meat and fat: intensive exploitation strategies in the Upper Palaeolithic approached from bone fracturing analysis*. 9 th ICAZ Conference, Durham 2002. In:* MULVILLE, J. and OUTRAM, A. K., eds. *The Zooarchaeology of Fat, Oil, Milk and Dairying*. Oxford: Oxbow Books, 150-159.

RIXSON, D., 1989. Butchery evidence on animal bones. *Circaea*, 6/1, 49-62.

ROWLEY-CONWY, P. 1994/1995. Eat, Furs and Skins: Mesolithic animal bones from Ringkloster, a seasonal hunting camp in Jutland. *Journal of Danish Archaeology,* 12, 87-98.

SCHIBLER, J., 1980. Osteologische Untersuchungen der cortaillodzeitlichen Knochenartefakte. *Die neolithischen Ufersiedlungen von Twann.* Bern, 8, 68.

OUTRAM, A. K., 1999. A comparison of paleo-eskimo and medieval norse bone fat exploitation in western Greenland. *Arctic Anthropology* 36, 1/2, 103-117.

OUTRAM, A. K., 2001. A new approach to identifying bone marrow and grease exploitation: why the "indeterminate" fragments should not be ignored. *In: Journal of Archaeological Science*, 28, 401-410.

OUTRAM, A. K., 2002. Identifying dietary stress in marginal environments: bone fats, optimal foraging theory and the seasonal round. *In:* M. MONDINI, S. MUNOZ & S. WICKLER, eds. *9 th ICAZ conference, Durham 2002. Colonisation, Migration and marginal areas*, 74-85.

OUTRAM, A. K., 2003. Comparing level of subsistence stress amongst norse settlers in Iceland and Greenland using levels of bone fat exploitations as an indicator. *In: Environmental Archaeology*, 8, 119-128.

OUTRAM, A. K., 2004. Applied models and indices vs. high-resolution, Observed data: detailed fracture and fragmentation analysis for the investigation of skeletal part abundance patterns. *In: Journal of taphonomy*. 2(3), 167-184.

SMITH, M. J., BRICKLEY, M.B., 2004. Analysis and interpretation of flint toolmarks found on bones from West Tump long barrow, Gloucestershire. *International journal of Osteoarchaeology,* 14, 18–33.

Received: 30 April 2009; Revised: 3 September 2009; Accepted: 15 October 2009

Linas Daugnora
veterinary Academy
Tilžės 18
LT-40181 Kaunas
LITHUANIA
daugnora@lva.lt

Habil.Dr Algirdas Girininkas
Institute of Baltic Sea Region History and Archaeology
Klaipėda University, H. Manto 84
LT-92294 Klaipėda
LITHUANIA
algis@post.skynet.lt

SKERDIMO TECHNOLOGIJA ANKSTYVAJAME BRONZOS AMŽIUJE (PAGAL KRETUONO 1 C GYVENVIETĖS TYRIMŲ DUOMENIS)

Linas Daugnora, Algirdas Girininkas

Santrauka

Analizuojant ankstyvojo bronzos laikotarpio Kretuono 1C gyvenvietėje (Rytų Lietuva) aptiktą osteologinę, archeologinę medžiagą, nustatyta, kad gyvenvietėje sumedžioti žvėrys ir auginami gyvuliai buvo skerdžiami gyvenvietės teritorijoje netoli gyvenamųjų būstų esančioje skerdykloje. Tarp Lietuvos ankstyvojo bronzos amžiaus gyvenviečių pirmą kartą aptinkama gyvūnų skerdimui skirta vieta. Kretuono 1C gyvenvietės skerdyklos vietoje rasta apie 70% visos šioje gyvenvietėje iškastos osteologinės medžiagos. Radiokarboninės datos iš gyvūnų kaulų (1 lent.), gautos iš skerdyklos kaulų sankaupos vietos, rodo, kad šioje vietoje žmonių gyventa apie 300 metų, ir išryškino bronzos amžiaus žmonių buvusią sampratą apie ekologiją ir sanitarines sąlygas.

Remiantis Kretuono 1C gyvenvietės osteologine medžiaga, išanalizuota tuo metu naudota skerdimo technologija. Paskerstų poranagių gyvūnų ašinio skeleto ir ilgųjų kojų kaulų makroskopinė analizė ir naudoti skerdimui darbo įrankiai įgalino nustatyti skerdykloje aptiktų gyvūnų kaulų skaldymą, kirčių ir įkirtų vietas skerdimo procese.

Gyvenvietės skerdyklos vietoje aptikti kaulų fragmentai, skaldymo tipai ir fragmentacijos lygis padeda nustatyti gyvūnų skerdimo technologijas. Makroskopinės kaulinės medžiagos, datuojamos bronzos laikotarpiu, analizės rezultatai leidžia teigti, kad Kretuono 1C gyventojai naudojo ankstesnių laikotarpių gyvūnų skerdimo būdus ir tęsė skerdienos apdorojimą kaip ir jų protėviai. Atskyrus galvą nuo kūno ir atvėrus galvos smegenų ertmę buvo išimamos smegenys. Kaukolės buvo sudaužomos, o apie ragų rozetes kaukolės dalys „nukertamos", nes skerdyklos vietoje aptikta daug sutrupintų gyvūnų kaukolių fragmentų ir ragų su kaktikaulio (*os frontale)* liekanomis. Ragai buvo naudojami įvairių įrankių gamybai. Tuo pat metu buvo atskiriamas gyvūnų apatinis žandikaulis ir, tikėtina, išimami dantys, naudoti amuletams-papuošalams. Apatinis žandikaulis ir jo atidalijimas per diastemą ir apatinio žandikaulio šaką (*ramus mandibula*), matyt, buvo reikalingas kuo

greitesniam priėjimui prie gyvulio liežuvio ir apatinio žandikaulio sąnario atidalijimo.

Atpjovus peties lanko raumenis, priekinė galūnė buvo atskiriama nuo krūtinės. Užpakalinės kojos atidalijimas galėjo vykti trimis būdais. Pirmuoju ir antruoju atveju naudojant kirvį ir nukertant klubakaulio (*ala ossis illii*) sparnus arba šlaunikaulio galvutę, po kirčio ją paliekant kartu su klubaduobe (*acetabulum*), o trečiu atveju – peiliu per klubo sąnarį (*articulatio coxae*) atskiriant šlaunikaulio galvutę nuo klubaduobės, t. y. nupjaunant raištį (*lig. capitis ossis femoris)*. Tą patvirtina Kretuono 1C gyvenvietėje minėtoje vietoje rasti kapoti kaulų fragmentai. Kaklo, krūtinės ir juosmens slankstelių kūnų (*corpus vertebrae*) pusių atsiradimas kaulinėje Kretuono 1C gyvenvietės medžiagoje rodo gyvūno dalijimą į dalis. Be to, skerdimo vietoje aptikta daug sukapotų šonkaulių, kurių galvutės (*capitulum costae*) buvo atkirstos nuo šonkaulio kūno (*corpus costae*).

Kojų kaulų jungtys leidžia teigti, kad alkūnės sąnarį sudarantys trys kaulai (*humerus, radius, ulna*) buvo sunkiai atskiriami ir nevienodai perkertami. Todėl pradžioje buvo atskiriamas petikaulis nuo dilbio kaulų, o tam turi būti kertama proksimalinė alkūnkaulio dalis (*olecranon*). Kretuono 1C gyvenvietėje alkūnės sąnario atidalijimui skirti kirčiai aptikti arčiau *tuber olecranii,* o tai siejasi su *humero-radial-ulnari* atskyrimu. Tačiau kirtis, atskiriantis distalinę petikaulio dalį kartu su alkūnės sąnariu, gali pasitarnauti dviem tikslais: atskirti alkūnės sąnarį ir atverti petikaulio ertmę, tuo lengviau pasiekiant kaulų čiulpus. Dar viena labai sunkiai atidalijama vieta yra šlaunikaulio proksimalinė dalis (*articulatio coxae)*, tam reikia masyvių ar aštrių kirvių. Gyvenvietės teritorijoje aptikti titnaginiai kirviai šlifuotu paviršiumi ir ašmenimis, šlifuoti akmeniniai įtveriamieji kirviai, platūs titnaginiai peiliai, gremžtukai, masyvūs gremžtai, kauliniai ir titnaginiai durklai įgalino sėkmingai sudoroti sumedžiotus žvėris ar auginamus gyvulius.

TO MAKE A MARK ON LAND. FOSSIL FIELDS SYSTEMS AND THE SOCIAL IMPLICATION OF AGRICULTURE DURING THE PRE-ROMAN IRON AGE ON GOTLAND, SWEDEN

ANNA ARNBERG

Abstract

If you make your way through the Gotlandic landscape today, you can still see agricultural remains originating from cultivation that took place two-three thousand years ago. The once cultivated land displays itself as systems of conjoined plots surrounded by baulks. The concern of this paper is the social implications this kind of agriculture had during the Pre-Roman Iron Age (500 BC-AD). This was a time when the practice was conventional and field systems were part of people's surroundings. How did an established, yet changeable landscape structure affect people, and what values, apart from strictly nutritional, did cultivation offer them?

Keywords: Pre-Roman Iron Age, Gotland, Sweden, agriculture, fossil fields, land-use.

Introduction

Walking through the Gotlandic landscape of today, you can still see traces of the agriculture carried during the Bronze Age to Roman times. The cultivated areas, showing similarities to field systems in Estonia, Netherlands and Denmark, consist of plots surrounded by baulks. The plots are conjoined into what often are large systems of up to two square kilometres (figure 1). This paper deals with this kind of agricultural remain and its social implications during Pre-Roman Iron Age Gotland i.e. 500 BC-AD.

Fundamental to the understanding of fossil field systems is when they were formed and how the large areas of conjoined plots came into being. The initial part of this paper therefore comprises a presentation of surveys, excavations and earlier research carried out mainly by *Sven-Olof Lindquist and his colleagues* in Sweden, and by *Valter Lang and his colleagues* in Estonia. As a complement to these studies, I then turn to questions regarding some of the social implications of agriculture. I am mainly interested in why people chose to maintain this kind of agricultural practice for a thousand years or more. Why did people continue to cultivate their fields in a manner which they knew from experience would deprive the fields their fertility? What values, apart from the strictly nutritional, did cultivation and its material effects offer people?

Discovery and morphology

Both on Gotland and in Estonia, research on fossil field systems (also known as "Celtic fields" or "Baltic fields") is a relatively recent phenomenon (Lang 1994, Lindquist, Carlsson, Windelhed 1973). On Gotland, the first systematic research was initiated by the human geographer Sven-Olof Lindquist, and carried out in collaboration with Dan Carlsson and Bengt Windelhed (Lindquist *et al.* 1973). The year was 1968 and the detection of fossil field systems were described as "the most important discovery that has taken place within Gotlandic archaeology during the last quarter of a century" (Jönsson & Löthman 1978, p. 113 (*my transl.);* Lindquist *et al*. 1973).

As implied, Lindquist's discovery was met by great interest. The following surveys showed that many field systems located in unexploited terrain was still visible. Positive was also the discovery that fields systems "erased" by later cultivation, in fortunate cases, could be "reconstructed" through aerial photography. The former baulks defined themselves as light frames against the darker plots (Manneke 1974, p. 33; Windelhed 1984b, p. 89; Figure 2).

Today over a hundred field systems are known on Gotland (Arnberg 2007). The baulks surrounding the separate plots gave the plots their shape, and from that shape we can appreciate the ploughing technique used. The single plots generally varies between 20x20 meters to 50x60 meters in size (Carlsson 1979, p. 50; Gren 1997, p. 109). The quadratic or slightly rectangular form indicates the use of an ard (Carlsson 1979, p. 50; Pedersen & Widgren 1998, p. 301). Since the ard does not have a mouldboard, ploughing in two directions was necessary. The quadratic shape was then ideal, as it minimizes the number of turns needed (Pedersen & Widgren 1998, p. 340; Widgren 1997, p. 12).

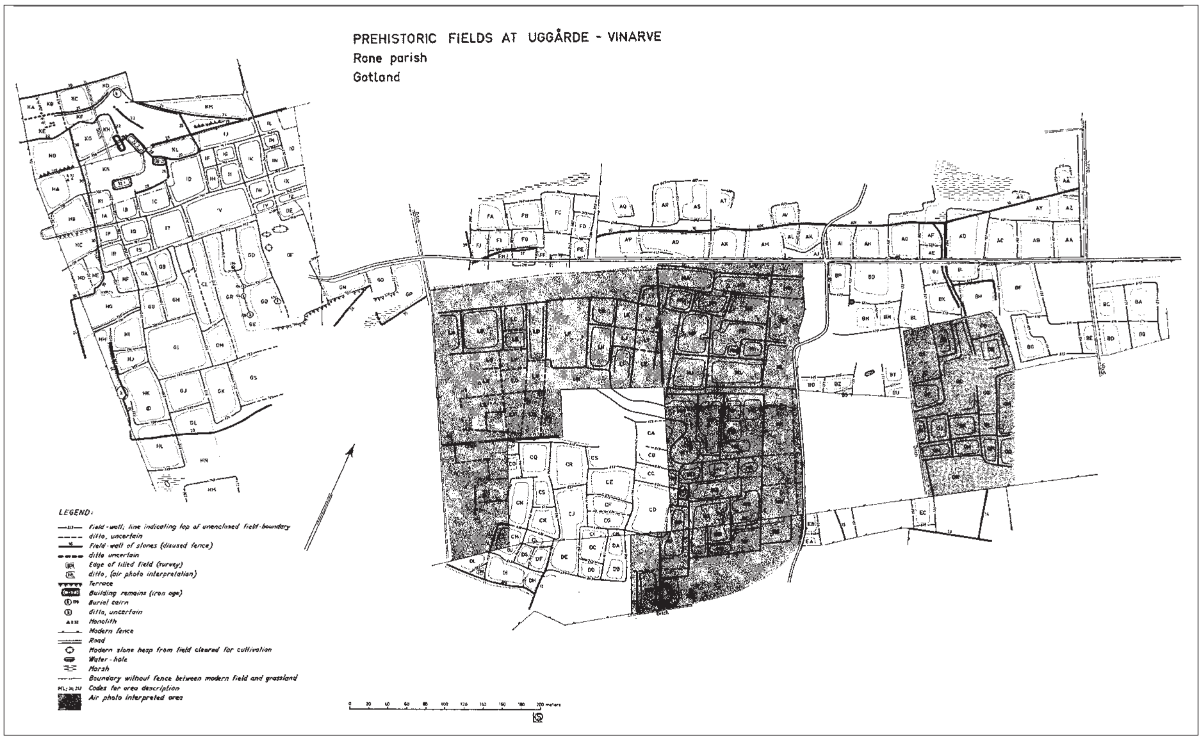


Fig. 1. The fossil field system at Uggårde-Vinarve, Rone parish, Gotland. Mapping carried out under direction of S-O Lindquist, 1973.

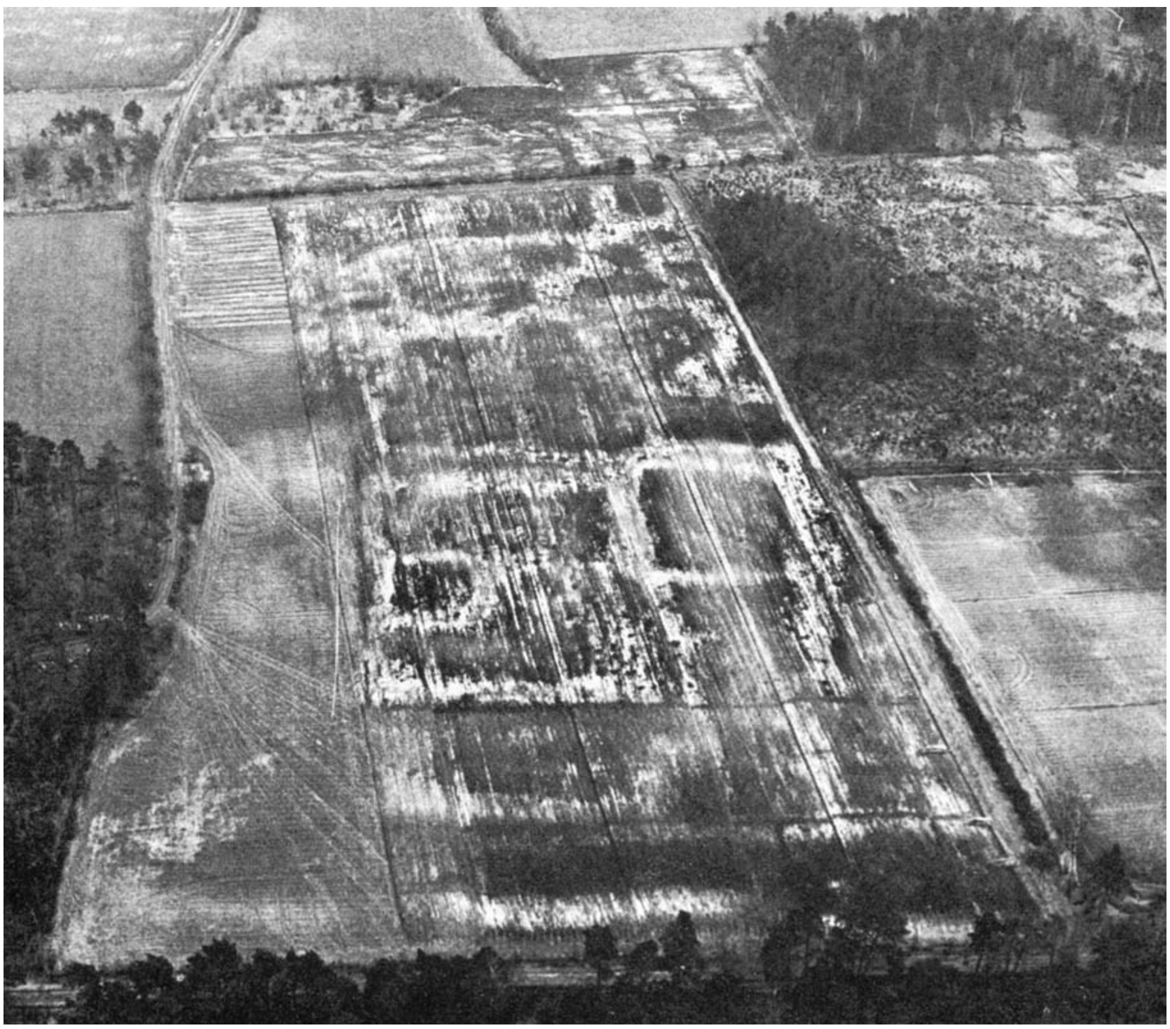


Fig. 2. Aerial photography showing parts of the fossil field systems at Uggårde-Vinarve, Rone parish, Gotland. Photograph by Peter Manneke (Manneke 1974, p. 35).

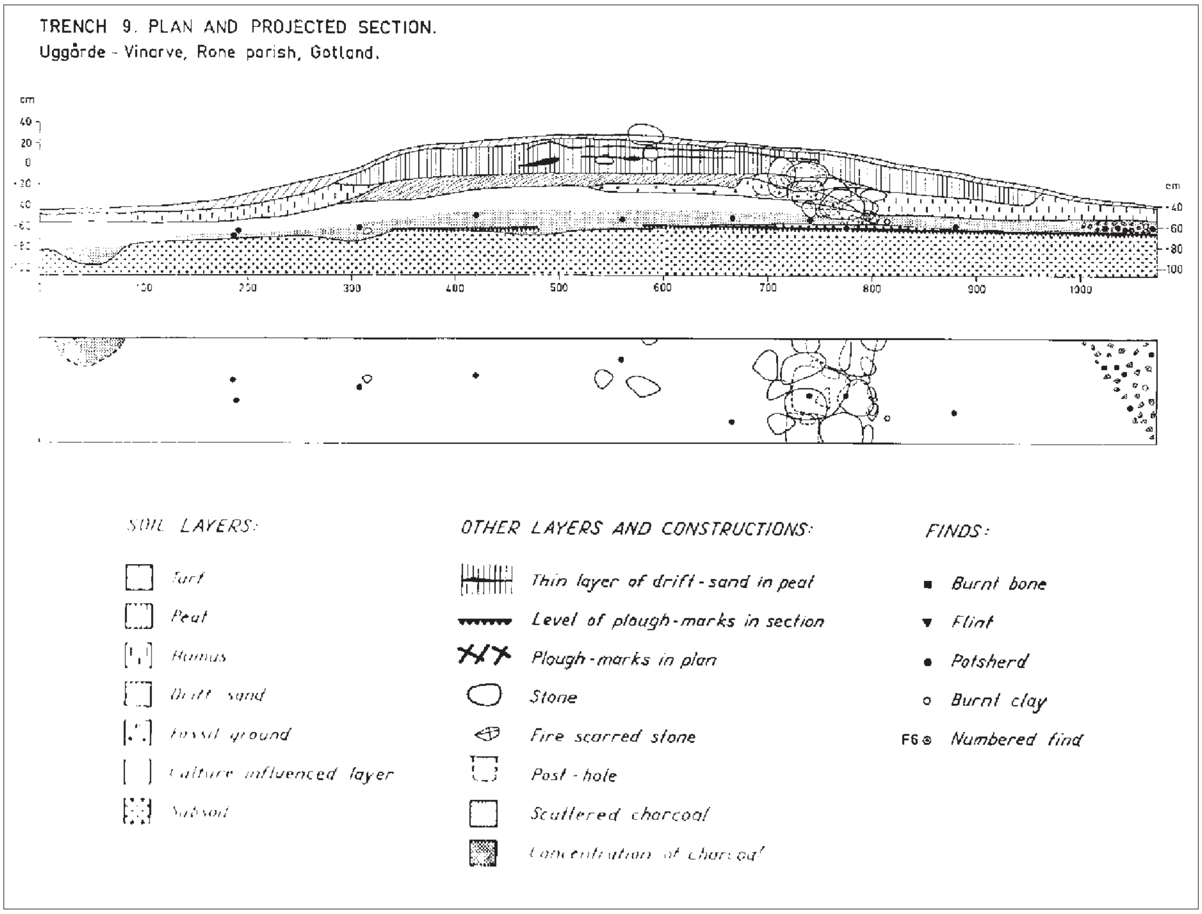


Fig. 3. Section through a field baulk at Uggårde-Vinarve, Rone parish, Gotland (Lindquist 1974, p. 15 and 17).

Uggårde-Vinarve and the initial excavations

The first more extensive excavations of fossil field systems on Gotland were initiated in 1973. The site chosen was Uggårde-Vinarve in Rone parish on the south-east part of the island (Lindquist *et al.* 1973; Lindquist 1974; Manneke 1974). Within an area of approximately 130 hectares were, besides a vast number of plots, settlements, stone enclosures and graves. The plots were mainly slightly rectangular and varied in size between 20x30 meters and 30x40 meters (Lindquist *et al.* 1973; Lindquist 1974; figure 1).

The primarily concern of the Uggårde-Vinarve excavation was to establish a chronology of the site. The researchers aimed both to confirm the relative stratigraphy indicated by previous surveys, i.e. that systems of conjoined plots were older features than stone enclosures and houses with stone foundations (commonly dated to AD 200-550 (Cassel 1998)), and to establish an absolute chronology for different archaeological features (Lindquist 1974, p. 14f).

The relative chronology was confirmed at an early stage. Stone enclosures and houses with stone foundations had repeatedly been laid out over field plots and baulks (Windelhed 1984a:93). Houses with stone foundations are commonly dated to the period AD 200-550, and the fields systems were thus to be older (Cassel 1998, Carlsson 1979; Lindquist 1974). For the establishment of an absolute chronology prospecting was however not enough, which led up to the first excavation of fossil field systems on Gotland.

Excavations were initiated the same year. After shafts had been laid out and the topsoil removed, criss-crossing ard-marks were displayed in the light subsoil within the former plots (Windelhed 1984b; Lindquist 1974). The ard-marks sometimes reached a bit under the baulks, but the centre of the baulks often lacked marks (figure 3). This was interpreted as the baulks originally being strips of grass dividing the plots. When plots were ploughed, the soil was subsequently transported to its edges slowly transforming the strips into baulks (Lindquist 1974, p. 24).

As more and more plots were excavated, it became clear that a large quantity of ard-marks could be present within a single plot. The plentiful ard-marks did most likely not originate from one, but from several ploughing phases. Oldest were those adjoining the baulks (Lindquist 1974, p. 24). In connection to these initial marks, charcoal was found often in such large

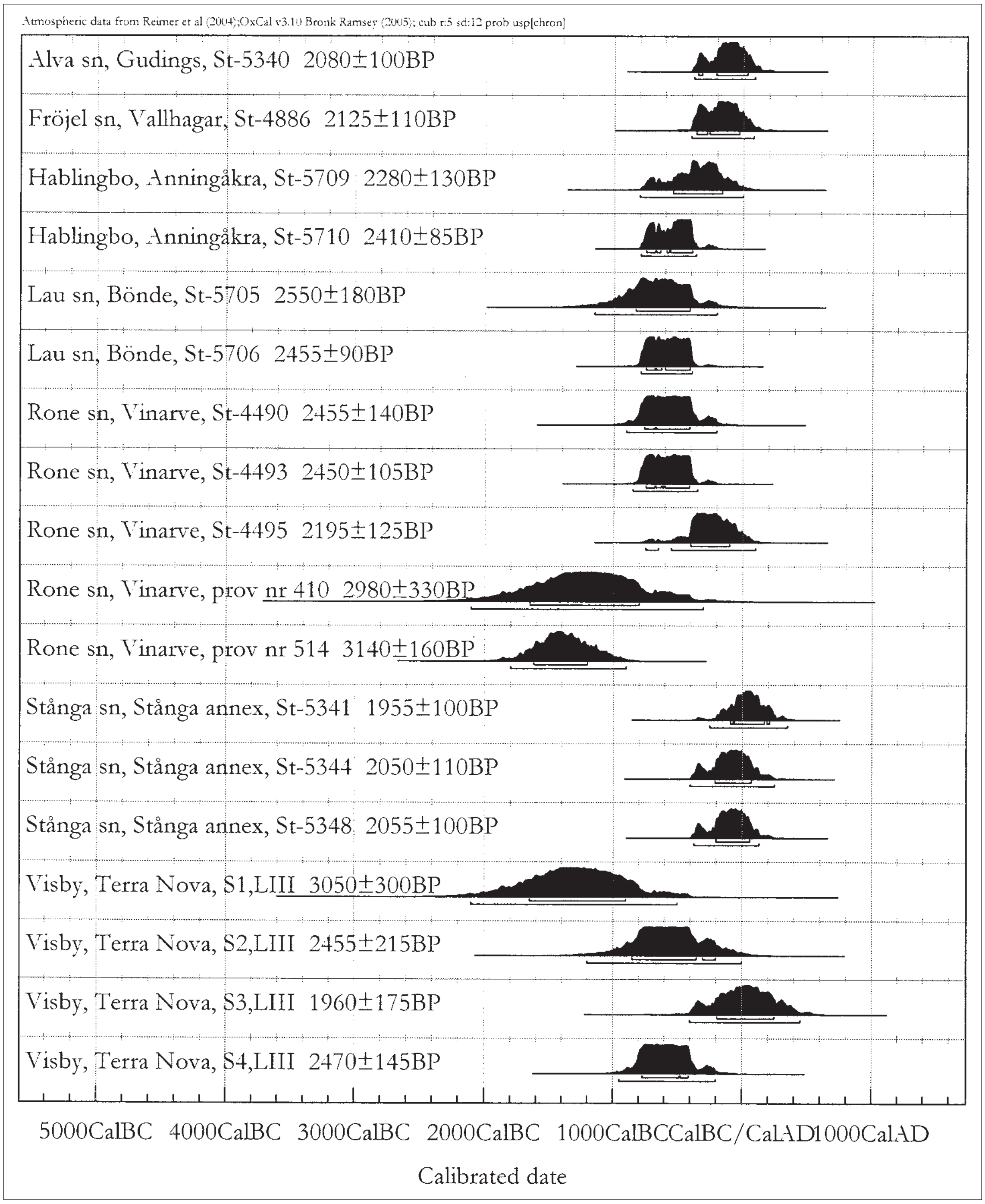


Fig. 4. Radiocarbon dates on charcoal from baulked plots remaining from field clearance. The BP values originate from Carlsson 1979; Lindquist 1974, Windelhed 1984b; Wickman-Nydolf, dnr 413-2493-1998, and calibrated by OxCal v.3.10.

amounts that it could be presumed to derive from field clearance (ibid, p. 17). Radiocarbon dates indicate that plots at Uggårde-Vinarve were first established during the Bronze Age and that the field system was in use to Roman times (figure 4).

The fields of Gotland – further research

The results from Uggårde-Vinarve have been published mainly by Sven-Olof Lindquist (1974) and Bengt Windelhed (1984a, 1984b). Another human geographer whose work has greatly contributed to our knowledge on fossil field systems on Gotland is Dan Carlsson. Carlsson's study comprises about ten localities with conjoined plots surrounded by baulks. Through his wider perspective Carlsson has been able pinpoint similarities as well as variations in the Gotlandic material. For example, he shows that Uggårde-Vinarve is not unique, neither regarding size, composition nor chronological position (figure 4). He also shows that is not uncommon for localities to be smaller. The size of Gotlandic localities varies from one or few, to a couple of hundred hectares (Carlsson 1979).

Today, due to extensive surveying, over a hundred field systems are known on Gotland. Most, especially the large and most visible, are located to the southern parts Gotland. Carlsson, however convincingly argues, that this chorological pattern is not a reflection of the prehistoric settlement pattern– something also indicated by the burial grounds from the pre-Roman Iron Age (Arnberg 2007; Carlsson 1979:53ff; figure 5). Instead the result from surveys, according to him, is due to geological conditions (Carlsson 1979; Figure 5). The formation of distinct baulks is dependent on the soil quality. In areas with sandy soils, as common on southern Gotland, baulks can be up to 10 meters wide and 1 meter high. On clayey soils, on the other hand, the baulks is usually only 3-4 meters wide and 0,1-0,3 meters high. Sandy soils are therefore vantage for visibility, and less common on the northern parts of the island (Carlsson 1979, p. 49-55).

The creation of field systems

Above dating and cultivation techniques, questions on how the fields were laid out, the time frame involved and how cultivation was socially organized has engaged previous researchers. Depending on if the researcher argues that field systems were laid out more or less as a whole, or that their gained their size as the result of a slow growth, different theories on the social organization of cultivation has been presented. While the latter argues the field systems mirrors an agrarian society built around the extended family, the former argues that society was organized in yet larger units (Carlsson 1979; Lindquist 1974; Windelhed 1984a, 1984b).

In the first papers on the results from the Uggårde-Vinarve, Sven-Olof Lindquist (1974) presents the vast field system as being laid out over a short period of time. This according to him, this excluded an intensive land use (Lindquist 1974, p. 29). The alternative was an area-consuming type of tillage, with periods of cultivation alternated with long periods of fallow, which implied that the "society must have been organised in larger units than the extended family" (ibid, p. 29, 31).

According to Sven-Olof Lindquist, the traces of large scale planning could be witnessed in the morphology of fields at Uggårde-Vinarve (Lindquist 1974). Participating in the research project was also Bengt Windelhed. Interestingly enough, his view on the formation and social organisation heavily differed from Lindquist's. Through an evaluation of how the radiocarbon dates of different plots correlate with the locality and morphology of the plot, Windelhed convincingly argues that the size of system were not due to an original large scale planning but organically grown (Windelhed 1984a, 1984b). Windelhed writes: "The field systems as shown on our maps should instead be looked upon as a summary of fields plots established over a period of 1500 years. The picture is due to the fields being cultivated in a way that in time forced people to abandon their plots" (Windelhed 1984a:184, *my transl.*).

Centrally placed within the cultivation area at Uggårde-Vinarve are quadratic plots. The plots are often placed in groups of three to four plots and correlate with sandy soils. In between these groups, are yet more plots of similar shape. In the more peripheral parts of the locality the plots are instead rectangular. The difference in morphology and locality correlate with the establishment of the plots. The centrally placed groups of quadratic plots are from the Bronze Age, while the rectangular ones were established during the early Roman Iron Age and in the outskirts of the sandy soils (Windelhed 1984a, p. 181).

The continuous establishment of new plots, and thus the size of the Gotlandic field systems are, according to Windelhed, the product of exhausting agricultural techniques - techniques that in time forced the abandonment of used plots and the creation of new arable land (Windelhed 1984a, 1984b). The vast areas of conjoined plots are the result of an agricultural practice where the ploughing slowly deprived the plot of its fertile topsoil, repositioning it on the edges. Former

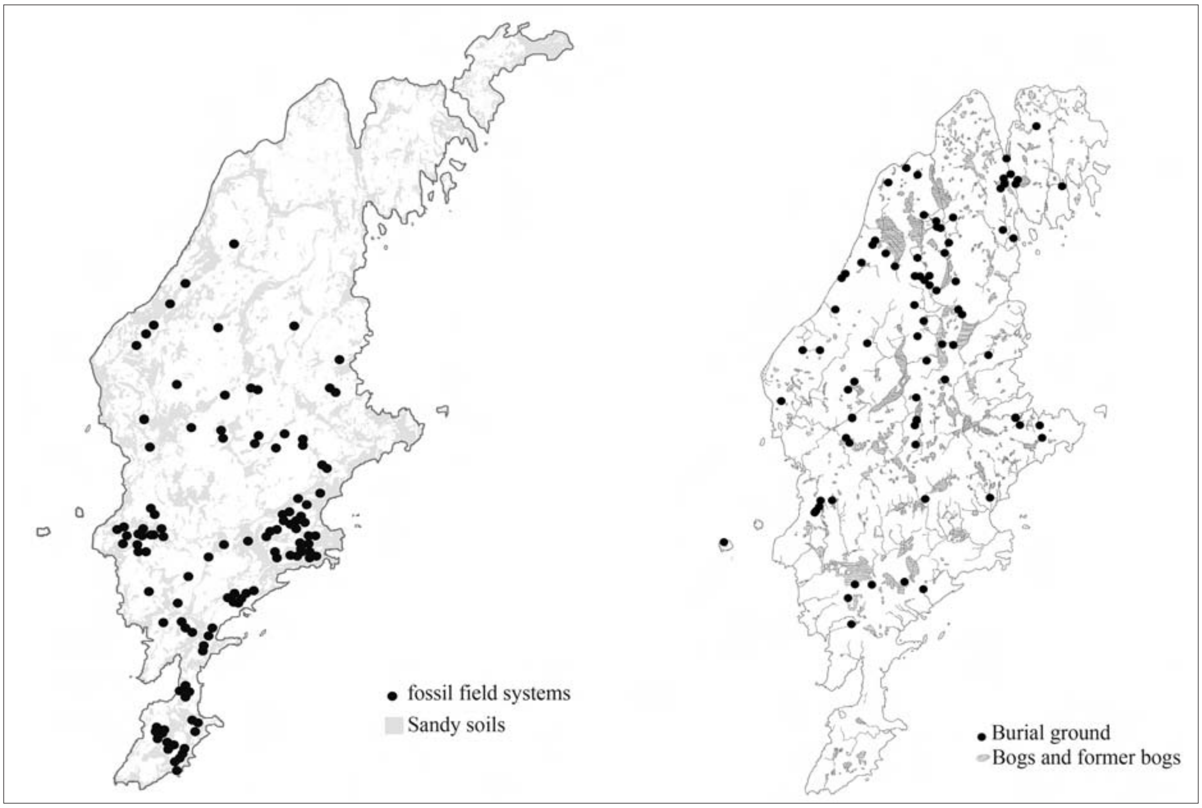


Fig. 5. The distribution of fossil field systems (left) and burial grounds dated to the Pre-Roman Iron Age (right).

fertile plots were in time turned infertile and new land was cleared (Windelhed 1984a, p. 184; 1984b, p. 97ff). Having studied the excavation reports of other Gotlandic localities, I, and other researchers with me, believe that the same line of argument is applicable for other Gotlandic localities as well (Arnberg 2005, 2007; Pedersen & Widgren 1998, p. 278ff). Instead of as a result of a momentous collective effort, the field systems should be looked upon as the result of slow and successive growth.

In most plots excavated, potsherds and animal bone, interpreted as house-hold waste have been detected. In combination with period of fallow, the spreading of waste material might have been used to increase the fertility of the plot (Carlsson 1979, p. 154). Fallow and house-hold waste made it possible to cultivate a plot more times than other should have been possible. This in turn meant that plot was ploughed at more occasions, and that the baulks slowly grew higher and wider, and thus more visible in relation to the surroundings. In time the deprivation caused by the ard depriving the plot its fertile topsoil, however became too intense. The plot was permanently abandoned.

During Pre-Roman times the Gotlandic landscape formed a mosaic of abandoned plots, plots in use, and plots in fallow. Through abandonment and clearance, the landscape was under constant change and cultivation was made a manifest part of the surroundings. Most probably, this picture was improved by vegetation. The agricultural techniques did not just result in baulks surrounding the plots. It also contributed to the variation of soil composition between plot and baulk. Since different vegetation benefit from different soil quality, the flora might have differed between them also under periods of fallow (figure 6). This enhanced the visibility of the fields and made them evident also from a distance. Cultivation was a manifest part of the Pre-Roman landscape. It was an activity that people, through their dwelling in the landscape, hade daily contact with.

Fields with baulks of stone

As indicated by Dan Carlsson's research, most Gotlandic field systems are located to sandy or clayey soils. The baulks of these fields mainly consist of soil. In addition to these localities, there is however a number of field systems with baulks of stone (Carlsson 1979, p. 49f). Such field systems are known from Liffride in Alskog parish, Ekeskogs in Kräklingbo parish (Hallin 2002; Johansson 1993), Ungelhem in Buttle parish (Carlsson 1979, p. 123f), Terra Nova outside Visby (Wickman-Nydolf, ATA dnr 413-2439-1998) and Uggårde-Vinarve Rone parish (Manneke 1974, p. 35). In opposition to fields with baulks of soil, the latter ones are mainly found on moraine or alvar.

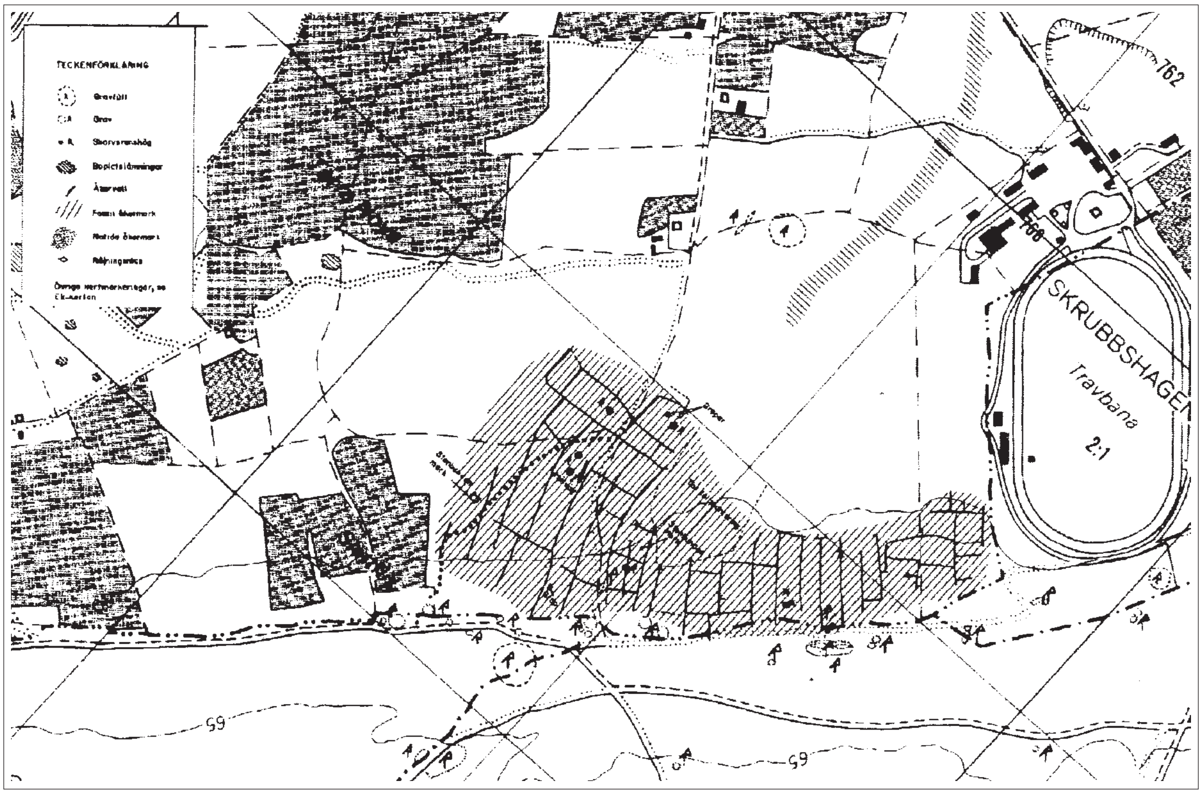


Fig. 6. Fossil field system. Drawing: Charlotte Rinaldo (Pedersen & Widgren 1998, p. 275). The plots were originally defined by strips of land that were not cultivated. Through the use of ard soil was eventually transported from the plot to the edges, and the strips turned into baulks. In time, the ploughing also caused the quality of the soil to vary between plot and baulks. This, in turn, caused flora to differ between plot and baulk even when fallow or taken out of use. Through the variation in vegetation the visual experience of the quadrilateral field pattern was been enhanced.

In opposite to fields with earthen baulks, fields with stone baulks have rarely been under excavation. One exception is Liffride in Alskog parish (Hallin 2002). The radiocarbon dates from Alskog is however uncertain, as there is a possibility that the charcoal dated originate from activities on the sites preceding the cultivation at the side.

Another example is Terra Nova outside Visby, where excavations took place in the early 1990s. Charcoal collected from the top of the trenches were from Roman to Medieval times, while samples further down mainly dated from Bronze Age and Pre-Roman times (Wickman-Nydolf, ATA dnr 413-2439-1998; figure 7). My interpretation is that plots were probably laid out and first cultivated during Bronze Age and Pre-Roman Iron Age, and the area re-used for cultivation during later parts of the Iron Age and during the Middle Ages (Arnberg 2007).

According to this, the fields with stone baulks at Terra Nova were in use at the same time those with earthen baulks at other localities. The chronological position to Bronze Age and Early Iron age is supported other ancient remains at the site. In connection to the field systems at Terra Nova are graves, roads, heaps of fire-cracked stone and settlement from this period. Further, the composition of the landscape at Terra Nova is much similar to that of Ekeskogs and Alskog. At Ekeskogs in the parish of Kräklingbo, for example the fossil landscape consists, besides of field systems, of clearance cairns, stone enclosures, heaps of fire cracked stones, graves and hollow roads (Johansson 1993; figure 8).

In the early 1990s, Estonian archaeologist Valter Lang visited the fossil fields at Ekeskog and Liffride. He stressed their similarities to some Estonia ones, by him called *Baltic fields* (Lang 1994, figures 9 and 10). In Estonia, fossil fields systems were first discovered 1982. The locality, called Rebala, is situated approximately 15 kilometres east of Tallinn. The cultivation area comprised of less than ten plots surrounded by stone baulks. One of the baulks was through later excavations indirectly dated by a hearth dug into it. The hearth was radiocarbon dated to the 1^{st} century BC (ibid, p.203).

About a decade later to two other Estonian localities, Saha-Loo and Proosa, were under excavation. The two localities were located to the on the same alvar - a type of landscape also found on Gotland. Saha-Loo comprised, like the field systems of Ekeskogs and Liffride on Gotland, of irregular plots surrounded by stone baulks and clearance cairns (Lang 1994, p. 203ff; fig-

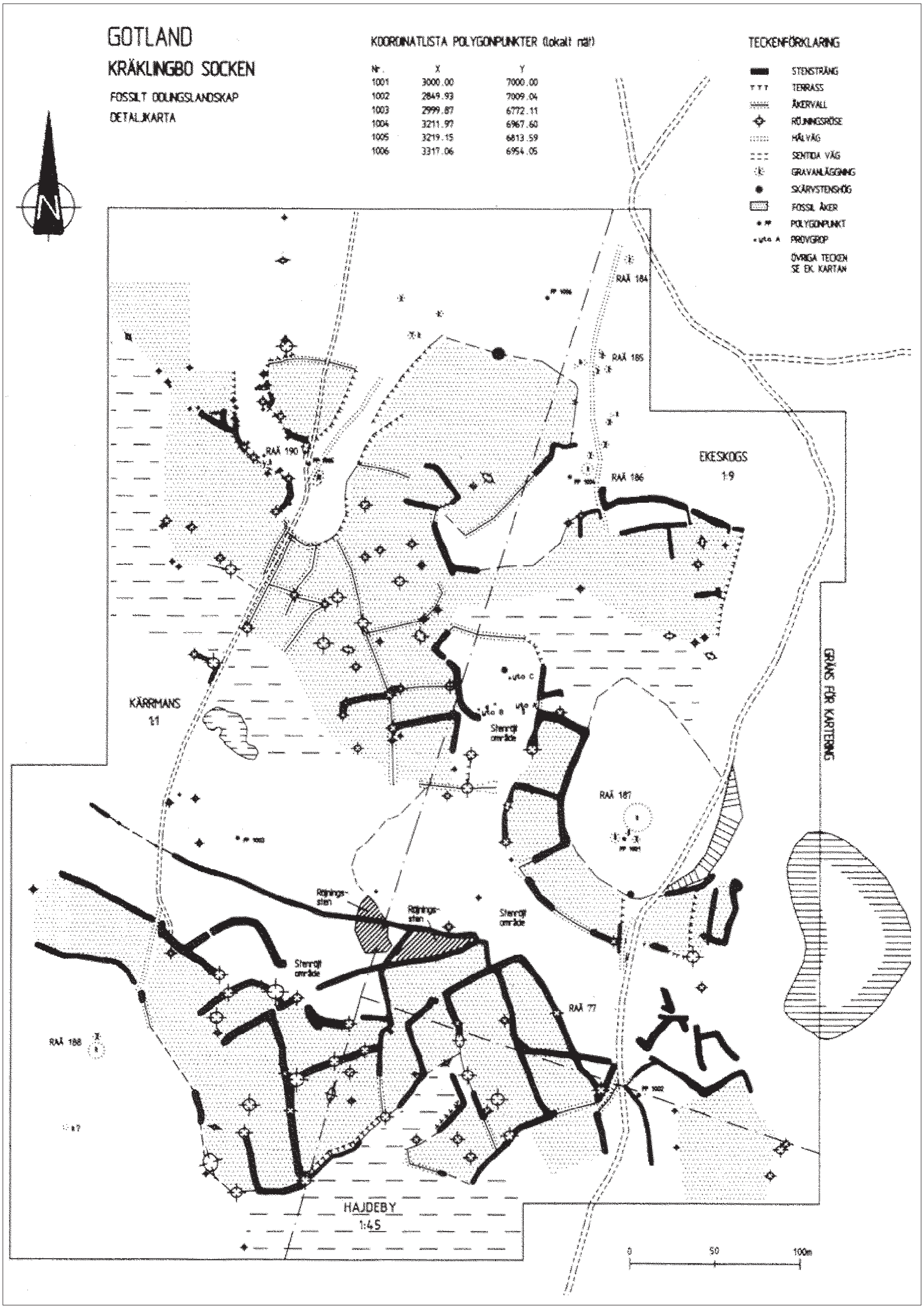


Fig. 7. Terra Nova outside Visby. The fossil field system measures 1,6 hectares and lay mainly on moraine. East of the field system is an ancient road, and by the road lay burial grounds, ship-settings and a cairn (Hallin 2002, p. 58).

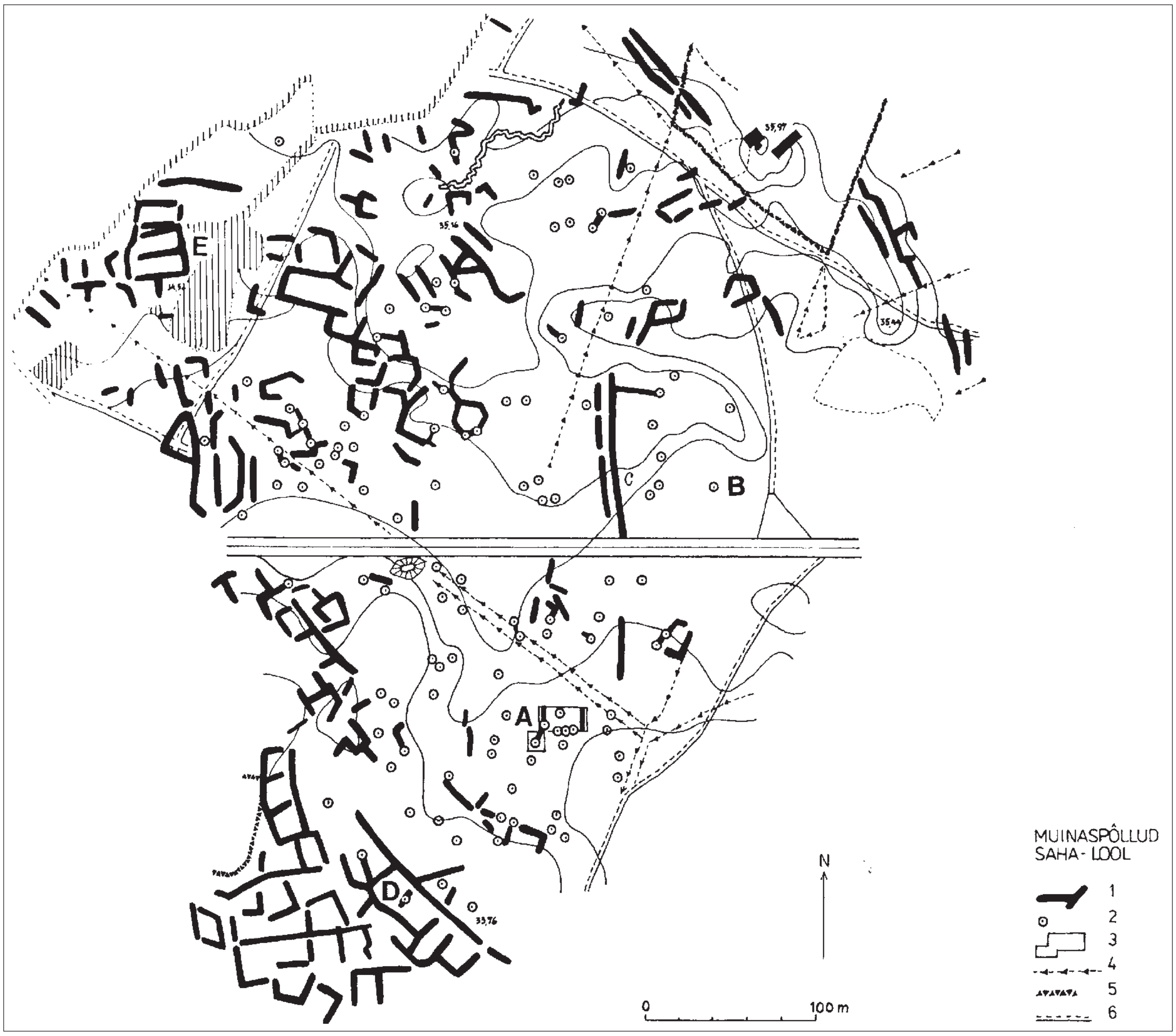


Fig. 8. The agricultural landscape at Ekeskogs in the parish of Kräklingbo (Johansson 1993, p. 14).

ure 8). The plots at Proosa were more regular in shape and more similar to those of Terra Nova (figure 6 and 9).

Excavations at Saha-Loo and Proosa were also carried out in 1994 and 1995 respectively. It was concluded that regular field system at Proosa was probably established during Pre-Roman times. Saha-Loo was on the other hand cultivated already during the Bronze Age, and cultivation continued during the Pre-Roman Iron Age (Lang *et al.* 2005; Lang & Laneman 2006). Valter Lang sees the possibility that there is a connection between the chronology of the sites and morphology of the field systems. The irregular and presumably older field-type he calls *Baltic fields,* while the younger and regular ones is referred to as *Celtic fields* (1994, p.212ff). Though this might be the case on the eastern side of the Baltic, the distinction does not seem to be applicable to Gotland. Her regular field plots, for example in Terra Nova and Uggårde-Vinarve, have been radiocarbon dated to the Bronze Age, which rules out them as a younger landscape feature.

On account of the irregular fields of Saha-Loo, Lang and his colleagues further concludes, that all of the plots within the system were not contemporaneous. The cultivated area, which all in all measured 22 hectares, consisted of several smaller groups of plots (app. 0,5-0,6 hectares each), for which radiocarbon dates indicated that they were cleared and cultivated consequently. New areas were successively turned into arable land, and the groupings of plots represent, "consequent steps in the spread of tillage and land clearance at this site" (Lang *et al.* 2005). In other words, the interpretation of the formation of these fields are much alike that of Windelhed for the formation of the field system at Uggårde-Vinarve, Gotland.

In combination with radiocarbon dates, the composition of the fields at Saha-Loo, led Lang to the following conclusion for the formation plots at the site – a conclusion, he argues, is applicable to the fields at Liffride and Alskog on Gotland as well. He emphasizes that the baulks of the single plots, as well as the field systems, were formed stepwise, the former through

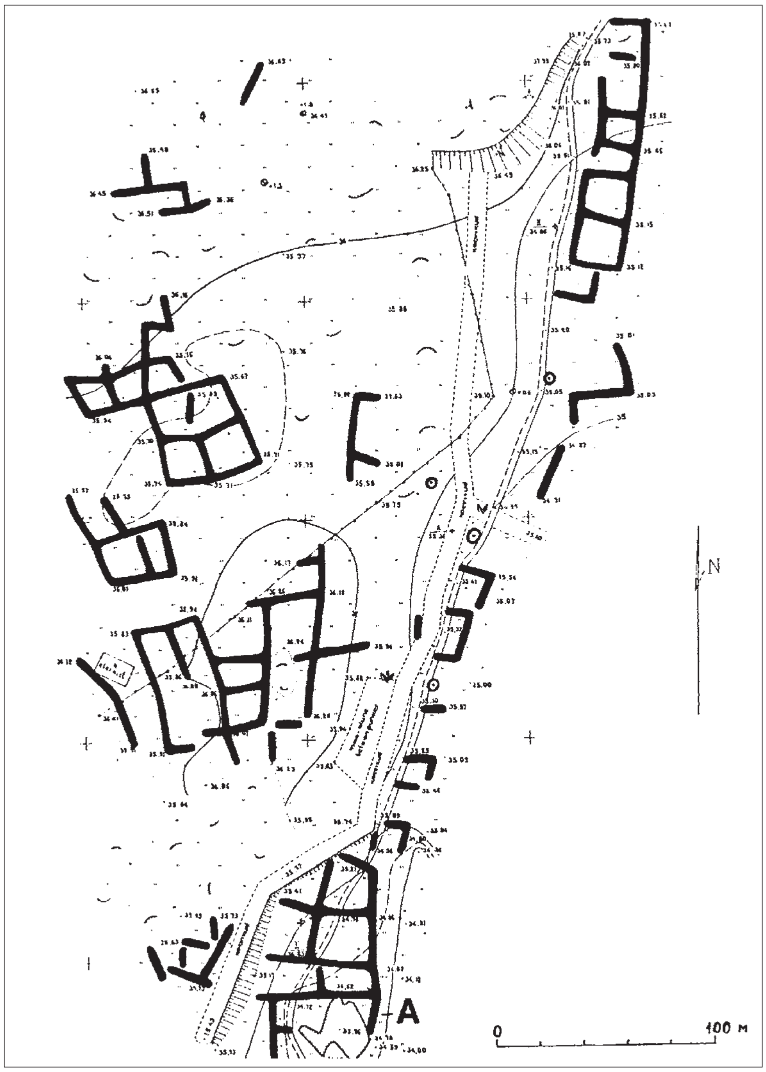


Fig. 9. Fossil fields at Saha-Loo, Estonia. Legend: 1) baulk, 2) clearance cairn, 3) excavation area of 1992, 4) buried stone walls, 5) preserved stone walls, 6) field path (Lang 1994, p. 205).

Fig. 10. The fossil fields at Proosa Estonia. Legend as figure 8 (Lang 1994, p. 212).

the interconnection of clearance cairns (Lang 1994, p. 214f). Regarding the chronological relation between the clearance cairns and stone baulks, he sees this as a short process: "(the) first baulks were formed very soon after the beginning of clearance and heaping up of the first cairns" (Lang 1994, p.215).

Fields with baulks of stone in comparison to those with earthen baulks

As mentioned, the fields with stone baulks correlate on Gotland to swaths of moraine or alvar. Plots with earthen baulks in turn connect to sandy or clayey soils. It thus seems to be a correlation between the geological conditions and the morphology of the single plots. As regards the construction material, the baulks of stone and soil respectively also bear witness to somewhat different cultivation practices. The earthen baulks have come into being as the result of the ard slowly depriving the plot of its topsoil and repositioning it on the edges (Windelhed 1984a, 1984b). The stone baulks are on the other hand the result of the use of ard in combination with the putting up of stone (Lang 1994). The consequence is a partly different material expression, caused by a partly different practice.

In many other aspects, fields with earthen and stone baulks however show similarities. The creation of baulked plots joined together in a web-like system is similar. The same goes for many of the tasks leading forward to these expressions. The single plots are often concave, something that in combination with the presence of ard-marks and an ard point at Saha-Loo indicate that both types of fields were ploughed by ard. Further, the amount of charcoal found in connection to the fields indicates that cultivation in both cases was preceded by fire clearance (Carlsson 1979; Lang 1994; Lindquist 1974; Windelhed 1984a, 1984b). From a Gotlandic perspective systems of conjoined plots, regardless if the field baulks are of soil or stone, regular or irregular seem to be contemporaneous phenomena. On account of the visual similarities, the chronology and the task leading up to these remains, I therefore understand these kinds of field systems as expressions of the same line of thought. The systems of conjoined plots are to my mind products of the same society and mentality, and will in the following be dealt with jointly.

Cultivation as environment and daily life – some sources of inspiration

The process of cultivation was a process of reoccurring events. Time after time the ecological conditions were transformed in order to create a better setting for other types of growth. Fire and tools cleared the chosen spot, and stones were removed. The soil was then ploughed, the crop sown and harvested, and the grain was ground. Some years later, the plots lay fallow. New plots were used, while the fallow or abandoned ones might have been used for other purposes such as pasture or for carrying out different types of crafts.

Cultivation was, through its central position in people's landscape and daily life, important for people on numerous levels. It structured their days, surroundings and the organisation of society. It provided people with food and drink, simultaneously as it engaged them in mutual activities. Cultivation got people to cooperate and communicate, and thus had numerous social and cultural implications.

As pointed out, the purpose of this article is, besides presenting prior research on Gotlandic field systems, to present some of the values, except from the strictly nutritional, this type of agriculture offered people during the Pre-Roman Iron Age. This was a time when field systems were already part of the Gotlandic landscape. The aim is thus not a search of the origin this agricultural practice. In instead, focus is put on understanding how an already existing practice and landscape feature affected, and was affected by people.

A theoretical framework I believe to be fruitful in this context is present in Anthony Giddens' *Theory of Structuration.* With this theory, Giddens' gives an alternative to both strictly subjective and objective social theories, as he stresses the importance of interaction between structure and agency in the creation of society (Giddens 1984, 1987). The structure is to be understood as rules and resources in a society (Giddens 1984, p. xxxi, 185, 337). Transferred to the Gotlandic field systems, the structure comprise the physical landscape and common views connected to agriculture, while the agency is represented by the individual and his or her intentions.

The structure is, according to Giddes, created by human agency. At the same time it is the prerequisite for agency (Giddens 1984, p. 25ff). Every action is by necessity unique, even if its intention is to copy a prior action. It relates to the structure, simultaneously as it contributes to changing the structure. History will thus never repeat itself. It can however be most useful in the understanding of a society (Cassel 1998, p. 24, Wobst 2000, p. 40).

Similar acts, or attempts to repeat earlier acts, have created patterns in the archaeological material. This patterns that can be observed and given meaning through archaeology. Applied on the fossil field systems, the *Theory of Structuration* imply that the meaning of the tasks creating the baulked fields were constant over the centuries. Even thought people's very intention might have been to adhere to an established practice, they acted in relation to a different structure and the circumstances were not completely the same. In other words, the Gotlandic people's perceptions on baulked fields were not the same during the Bronze Age when the first plots were laid out, as under the Pre-Roman Iron Age when vast fossil field systems had been made manifest parts of their landscape.

Another source of inspiration on how people acted in relation to their surroundings is found in Tim Ingold's paper "The Temporality of the Landscape" and the concept *taskscape* (2000, p. 189-208). *Task*, as defined by Ingold, is "any practical operation, carried out by a skilled agent in an environment, as part of his or her normal business of life" (Ingold 2000, p. 195). Ingold states that no task is carried out in a vacuum. Each task gets its meaning through its relation to other tasks. Besides this, tasks are often carried out by many people together. It is this web of interconnected tasks that Ingold aims at with the concept of *taskscape.*

According to Ingold, the landscape gets it physical form side by side with the activities forming the taskscape. The landscape is the taskscape embodied (Ingold 2000, p. 198). In addition, the taskscape holds knowledge of the landscape. It incorporates the past and the lives of previous generations that have contributed to its shape. Ingold writes: "(…) the landscape is constituted as an enduring record of – and testimony to – the lives and works of past generations who have dwelt in it, and in so doing, have left there something of themselves" (ibid, p. 189). The past is present in the landscape, as will the present be part of tomorrow's landscape.

Cultivation as social interaction

Food production may be regarded as the prime purpose of agriculture, but at stated, cultivation also had social and material consequences. When involved in the act of tillage, people acquired a role in relation to the surrounding society. Though one individual could, theoretically, have carried out many tasks solely, the chain from sowing to eating often involved several people - people who were in different ways connected to each other. People lived together, ate together and cultivated land together. From this perspective, tillage may be regarded as a medium for the creation social relations, and the fields as physical places for this creative act.

The fields were besides places of physical work, places of conversations and story-telling. As an area for communication, the fields might have been a place where people learned why land was worked in this way and certainly also one of the places where stories of the world and of people's places in it were told. The knowledge, completed in the progression of agricultural techniques, acquired physical form by repeatedly being handed down to the next generation. In the field systems the acts carried out were materialized - acts that over the centuries had involved a great number of people.

As a consequence, cultivation was not the concern of one generation solely, but and act linking generations together. The field systems grew through the continuous repetition of interlinked tasks and involved the majority of the people living on Gotland. The continuance of agriculture of course demanded that knowledge was transferred from generation to generation. But how was this done, and how come the same practice was accepted and overtaken by the younger members of society for over a millennium? In other words, what kind of values did this agricultural practice has that other practice did not?

The Pre-Roman Age was on Gotland an oral culture. Since no written manuals existed, we must presume that the continuance of agricultural techniques was in each and every case based on direct contact between people. In the book *Orality and Literacy. The Technologizing of the Word (*Sw. Muntlig och skriftlig kultur. Teknologiseringen av ordet (1990 [1982])), Walter J. Ong lets us know how knowledge is produced and transferred in oral and literate societies respectively. He argues that vital to the spreading of knowledge in oral societies, is the formation of story-telling techniques and other mnemonic devices. Since nothing is written down, you basically only know what you remember (ibid, p. 46ff). While memories in literate societies often are connected to a text, oral memory to a higher degree depends on somatic features. Rosaries, gestures or dances can, for example, be used to structure and recall certain memories (ibid, p.72, 82f).

For many types of crafts, such as cultivation, the learning process is dependent on memories being created in interplay between communication and bodily movements. You learn your trade by observation and practice (Ong 1990 [1982], p. 56f). Knowledge grows from experience and from people's engagement with their surroundings (Ingold 2000:189). As knowledge is not written down, it must constantly be repeated or communicated to others to not be forgotten (Ong 1990 [1982], p.47-54).

From a mnemonic point of view, the process of cultivation was ideal. Though its repetitive character with several recurrent moments and tasks, cultivation gave the young members of society, as they were working side by side with the older members, plenty of opportunities both to acquire new knowledge and to practice what they had already learned. Hence, knowledge had both to do with interaction between generations and with people's bodily engagement with the world.

The knowledge gained from agriculture was partly practical – you learned how land was cultivated in "the right way" -, partly social. Through the opening of new plots and slow creation of baulks, people were given guidelines for time and space, as well as information on the relationship between their own generation and prior ones. The knowledge, completed in the progression of agricultural techniques, acquired physical form by repeatedly being handed down to the next generation. In the field systems the acts carried out were materialized, acts that over the centuries had involved a great number of people. To use Tim Ingold's words, the fossil field systems are the taskscape visualised.

In time, the agricultural landscape could be described as a quilt, created over centuries and embodying multiple life-stories. The fields worked, like many quilts, as mnemonic devices to which stories were connected. The landscape was composed by a mosaic of fields in use, fields in fallow and fields abandoned, and the stories could include both present and previous generations. Moving through the landscape, people passed fields at different stages of their life histories, and the stories could be told over and over again.

Pre-Roman people dwelled in a landscape infused with past activity. Though cultivation, the lives of the ancestors parts of people's daily life. The direct knowledge on how the abandoned fields were formed, offered them insights in the chronological dimension of the landscape. Most certainly it also informed them that they themselves through their work would make a permanent mark on land. That they themselves were to be manifest parts of the landscape. The materialization of agriculture thus enabled people to relate their own existence to of both past life and to a future that would come (Arnberg 2004, 2005). Cultivation made people part of the surroundings – a surrounding that were partly oriented towards one's own society, partly to the lives and works of previous generations.

To make a mark on land

Already at the beginning of the Pre-Roman Iron Age, tillage had left former fertile land unfertile. Baulks framed the former plots and the act of cultivation had materialized itself in the landscape. With my early 21st century eyes, this agriculture practice would best be described as a deterioration of natural resources. But the really important question is, of course, how did the cultivators themselves perceive their depletion of fertile land?

Presumably not in such negative terms. For though some steps were taken to prolong the fertility of the plot (which may mean that people found the depletion somewhat problematic), people nevertheless continued to threat land as they had "always" done. To my mind traditions like this one do last, not because people are unable to carry out tasks in other ways, but because traditions offer something to the people maintaining them. Richard Bradley writes: "People did not make artefacts or build structures according to a traditional format because they were unable to think of anything else. Rather, they did so as one way of adhering to tradition and maintaining links with what they knew of their past. Making a decorated pot to a time-honoured formula was an act of remembering as much as visiting and maintaining a burial mound" (Bradley 2002, p.11). The quote is applicable to the Gotlandic fields as well. The Pre-Roman People took, in their agricultural practice, consideration to traditions and made them part of the present. Through agriculture, people related both to long-established customs and existing landscape features. Cultivation connected people, at the same time as it connected people and place.

With the aim to portray the relationship between the Pre-Roman cultivators and they land cultivated, I have once again turned to Tim Ingold - this time to his work on *tenure* as expressed in the article "Territoriality and Tenure". Tenure is, according to Ingold, a form of land-maintenance in which the land is metonymical to its cultivator. The cultivated land is thus so much more than an object to be exploited. By the work invested it gets involved in social relationships (Ingold 1986, p.136ff). To sum up, tenure is "about the ways in which a resource locale is worked or bound into the biography of the subject, or into the developmental trajectory of those groups, domestic or otherwise, of which he is a member" (ibid, p. 137).Another important part of the concept of tenure, is that the relationships between man and land are neither stable nor fixed. It is the result of an ongoing process and constituted by the performance of certain tasks accepted by the society (Ingold 1986, p.136ff).

When clearing, ploughing, sowing and harvesting the soil, Pre-Roman people invested work in a place. In a contemporaneous perspective, the clearance and continuous maintenance of a plot might have been what gave people the right to its offspring. The land cultivated was as not viewed as a fixed territory, but as areas to be maintained to be used. Through the work infused in the fields tasks, the cultivators were tied to the arable land - a relationship visualized and manifested by the creation baulks.

Land maintenance was thus related to practices of ancient origin. It was linked ancestors and to the upholding of traditions – traditions that, through being maintained over the centuries, remained socially active and vital in the constitution of society. To act on land in other ways meant breaking with existing praxis's and values. The picture was thus both intricate and complicated. Since the agricultural technique had its roots in bygone times, a change in cultivation would not only have questioned the rules and values of one's own society. It would also have called for a change in the relationship between the past and the present, i.e. in the links between the cultivators and their ancestors.

The values the systems of conjoined baulked plots offered people in the Pre-Roman Iron Age, besides providing them with food, might thus partly explained as involving them in a historically established process. It was a way of maintaining land that as a phenomenon and material expression reached beyond the individual and the individual's lifetime. The tradition did not just connect people in a contemporary perspective. In the landscape of conjoined plots, relation between people, between past and present, and between people and place attained physical form. Through the continuance of agricultural techniques, the cultivators were literary woven into these materialized relations, at the same time as these cross-generational connections were preserved. What might be considered, with my own values, as the deterioration of fertile land, might with these associations instead have been perceived as something attractive and desirable. It was these associations that, according to me, not just "justified", but "necessitated" the waste of productive land.

Summary

If you make your way through the Gotlandic landscape today, you can still see traces of the agriculture carried out more than two thousand years ago. The cultivated areas consist of plots surrounded by ridges that are conjoined into what often are large systems of areas up to two square kilometres.

Fundamental to the understanding of these fields is when they were formed and how the large areas of conjoined plots came into being. The paper therefore starts with a presentation of the surveys and excavations carried out mainly by the Department of Human Geography at Stockholm University and Valter Lang and his colleagues in Estonia, and the results of these projects. As a complement to these research projects, I then turn to questions regarding the social consequences of agriculture. I am mainly interested in why people chose to maintain this kind of agricultural practice for a thousand years or more. Why did people continue to cultivate their fields in a manner which they knew from experience would deprive the fields of their fertility? What values, apart from the strictly nutritional, did cultivation and its material effects offer people in the pre-Roman Iron Age?

The area on Gotland most intensely investigated regarding this kind of agricultural feature is Uggårde-Vinarve in the parish of Rone, where excavations started in 1973. After the topsoil had been removed, criss-crossing ard marks were visible in the light subsoil. In connection with these marks, charcoal was found in such large amounts that it was presumed to derive from the clearance of the plot. The ^{14}C values indicated that the field systems were in use at least from the Bronze Age to the Roman Iron Age (figure 4). They also indicated that the majority of the plots were not in use at the same time. The vast areas of conjoined plots should instead be looked upon as a result of successive growth; they were created over a long period of time. The field systems had developed out of sequences of interlinked tasks carried out in a similar way over the centuries. Time after time the ecological conditions were transformed in order to create a better setting for other types of growth. Fire and tools cleared the chosen spot, and stones were removed. The soil was then ploughed, the crop sown and harvested, and the grain was ground. Some years later, the plots lay fallow. New plots were used, while the fallow or abandoned ones might have been used for other purposes such as pasture or for carrying out different types of crafts.

Food production may be regarded as the primary purpose of agriculture, but in a pre-Roman perspective tillage also had social and material consequences. When involved in the act of cultivation, people acquired a role in relation to the surrounding society. Though many tasks could, theoretically, have been carried out by one individual, the chain from clearing the fields to putting food on the table often involved several people, who were connected to each other in different ways. People lived together, ate together, and cultivated land together. In this perspective, cultivation may be regarded as a medium for the creation of relations between people, and the fields as physical places for this creative act.

The field systems, as they are visible today, are the result of a process in time. The procedure stayed more or less the same for up to a thousand years or longer. As a consequence, cultivation was not the concern of one generation solely, but an act that linked generations together. The older members of society passed the tradition on to the younger members while working side by

side with them. Hence, knowledge has in this context as much to do with conversations and with people's bodily engagements with the world, as with abstract thought. As a place for labour, the fields were the arenas where the youth were taught how to carry out the relevant tasks in a proper manner. As an arena for communication, the fields might also have been the place where the youth learned why land was worked in this way. The knowledge, completed in the progression of agricultural techniques, acquired physical form by repeatedly being handed down to the next generation. In the field systems the acts carried out were materialized, acts that over the centuries involved a great number of people.

Because the ard depleted the soil of the plot, areas formerly used for cultivation were eventually transformed into infertile land. To my mind this kind of agricultural technique could best be described as the deterioration of natural resources. But the question is: how did the cultivators perceive their depletion of fertile land? Presumably it was not in such negative terms. For though some steps were taken to prolong the fertility of the plot, which may mean that people found the depletion somewhat problematic, they nevertheless continued to treat the land as they always had done. In my view, traditions like this one do last, not because people are unable to carry out tasks in other ways, but because traditions offer something to the people maintaining them. The values that agriculture offered people in the pre-Roman Iron Age, besides providing them with food, might partly be explained as involving them in a historically established process. It was a way of maintaining land that as a phenomenon and material expression reached beyond the individual and the individual's lifetime. In other words, this tradition did not just connect people in a contemporary perspective. In the landscape of conjoined plots, relations between people, between present and past, and between people and place attained physical form. Through the continuance of the agrarian techniques, the cultivators were literally woven into these materialized relations, at the same time as these cross-generational connections were preserved. What might be considered, with my own values, as the deterioration of fertile land, might with these associations instead have been perceived as something attractive and desirable. Perhaps it was these associations that "justified" the waste of productive land.

Literature

ARNBERG, A., Horisontell monumentalitet. Några tankar kring det förromerska landskapet på Gotland. *Aktuell arkeologi VIII*. Eds. Von Hackwitz, K & Werner, T. Stockholm. XXX

ARNBERG, A., 2005. Fields, Funerals and Furnaces. On the Use of Fire during the Pre-Roman Iron Age on the Island of Gotland. *Current Swedish Archaeology. Vol 13*. Ed. Cassel, K. & Gustafsson, A. Stockholm., 7-24.

ARNBERG, A., 2007. *Där människor, handling och tid möts. En studie av det förromerska landskapet på Gotland*. Stockholm.

BRADLEY, R., 2002. *The Past in Prehistoric Societies*. London.

CARLSSON, D., 1979. *Kulturlandskapets utveckling på Gotland. En studie av jordbruks- och bebyggelseförändringar under järnåldern*. Visby.

CASSEL, K., 1998. *Från grav till gård. Romersk järnålder på Gotland*. Stockholm.

GIDDENS, A., 1984. *The Construction of Society. Outline of the Theory of Structuration*. Cambridge.

GIDDENS, A., 1987. *Social Theory and Modern Sociology*. Stanford.

GREN, L., 1997. *Fossil åkermark. Äldre tiders jordbruk – spåren i landskapet och de historiska sammanhangen*. Stockholm.

HALLIN, G., 2002. *Kummel, skepp och koksten. En studie om bosättningsområden och social struktur under bronsåldern på Gotland*. Stockholm.

INGOLD, T., 1986. Territoriality and Tenure. The Appropriation of Space in Huntering and Gathering Societies. *The Appropriation of Nature. Essays of Human Ecology and Social Relations*. Manchester. Ingold, T., 2000. *The Perception of the Environment. Essays of Livelihood, Dwelling and Skill*. London, New York.

JOHANSSON, S., 1993. *Fossil åkermark i Kräklingbo och Alskogs socknar, Gotland. En jämförande analys av två fossila åkerområden*. Stockholm.

JÖNSSON, S. & LÖTHMAN, L., 1978. Gotländska fornlämningar, gotländska kulturminnen. Inventering 40 år efteråt. *Fornvännen*, 108-120.

LANG, V,, KALTRE, H. & LANEMAN, M., 2005. Fossil Fields at Saha-Loo, North Estonia, as Revealed by New Excavations. *Archaeological Fieldwork in Estonia 2004*.

LANG, V. & LANEMAN, M., 2006. New Investigations at Fossil Fields at Proosa, North Estonia. *Archaeological Fieldwork in Estonia 2005*. LANG, V., 1994. Celtic and Baltic fields in North Estonia. Fossil Field Systems of the Late Bronze and Pre-Roman Iron Age at Saha-Loo and Proosa. *Acta Archaeologica. Vol 65*, 203-219.

LINDQUIST, S.-O., CARLSSON, D. & WINDELHED, B., 1973. Gotländskt kulturlandskap under äldre järnåldern. Ett forskningsprojekt. *Gotländskt arkiv*, 9-12.

LINDQUIST, S.-O., 1974. The Development of the Agrarian Landscape on Gotland during the Early Iron Age. *Norwegian Archaeological Review, Vol 7:1*, 6-32.

MANNEKE, P., 1974. Aerial photography of "Celtic Fields" on Gotland. *Norwegian Archaeological Review, Vol 7:1*. Pp 32-38.

Ong, W. J., 1990[1982]. *Muntlig och skriftlig kultur. Teknologiseringen av ordet*. Göteborg.

PEDERSEN, E. A. & WIDGREN, M., 1998. Järnålder 500 f.Kr-1000 e.Kr. *Det svenska jordbrukets historia. Jordbrukets första femtusen år, 4000 f.Kr-1000 e.Kr*. Ed. Myrdal, J. Stockholm.

WICKMAN-NYDOLF, G., ATA dnr 413-2493-1998. *Kartering och undersökning. Gotland, Visby, Stadsäga 769, 906, 907, fornlämning*. Topografiska serien, fasta fornlämningar, Gotland, Visby.

WIDGREN, M., 1997. *Fossila landskap. En forskningsöversikt over odlingslandskapets utveckling från yngre bronsålder till tidig medeltid.* Stockholm.

WINDELHED, B., 1984a. Tidiga gotländska produktionsenheter och deras markanvändning. Erfarenheter från en lokal studie av förändringar av kulturlandskap från förhistorisk tid till tidig medeltid vid Vinarve i Rone socken på Gotland. *Gård och kulturlandskap under järnåldern. Svensk-norskt seminarium i Hudiksvall 18-20 augusti 1983.* Eds. Liedgren, L & Widgren, M. Stockholm, 173-195.

WINDELHED, B., 1984b. "Celtic fields" and Prehistoric Agrarian Landscapes. Approach, Methods and Results from a Human Geographical Study of Reasons for the Development of the Agrarian Society at Vinarve in Rone Parish on Gotland, Sweden. *Settlement and Economy in Later Scandinavian Prehistory.* Ed. KRISTIANSEN, K. Oxford, 85-110.

WOBST, M., 2000. Agency in (Spite of) Material Culture. *Agency in Archaeology.* Eds. Dobres, M-A & ROBB, J. E., London. New York.

Received: 15 February 2008; Revised: 10 May 2008;
Accepted: 15 September 2009

Anna Arnberg
Department of Archaeology and Classical Studies
Stockholm University
SE-10691 Stockholm
Sweden

ŽEMĖJE LIKĘ ŽYMENYS. GOTLANDO (ŠVEDIJA) ANKSTYVOJO GELEŽIES AMŽIAUS SENOSIOS LAUKŲ SISTEMOS IR JŲ SOCIALINĖ REIKŠMĖ ŽEMDIRBYSTEI

Anna Arnberg

Santrauka

Keliaujant per Gotlando teritoriją, galima pamatyti prieš du tūkstantmečius vykdytos žemdirbystės pėdsakus. Apdirbami žemės arealai, susidedantys iš nedidelių laukelių, apjuostų ežiomis, sudaro didžiules sistemas, kartais apimančias dviejų kvadratinių kilometrų plotą. Svarbu yra suprasti, kada šie laukai formavosi ir kaip iš nedidelių laukelių susiformavo ši sistema. Todėl šis straipsnis pradedamas tyrinėjimų, vykdytų Stokholmo universiteto Geografijos skyriaus ir Valterio Lango su kolegomis iš Estijos, apžvalga. Pagarbiai atsižvelgdama į šiuos projektus, straipsnio autorė žemdirbystės formavimąsi nagrinėja socialinių santykių kontekste. Svarbiausia, ką reikėtų suprasti, yra tai, kodėl tūkstantį ar daugiau metų žmonės rinkosi tokią žemdirbystės sistemą, kodėl jos nenutraukė, iš patirties žinodami apie greitą šių laukų žemės nualinimą? Kokią vertę, išskyrus prasimaitinimą, toks žemės kultivavimas turėjo ankstyvojo geležies amžiaus laikotarpiu?

Tokios sudėties žemdirbystės laukai Gotlande Uggårde-Vinarve vietovėje Ronos apylinkėje buvo pradėti tyrinėti 1973 metais. Pašalinus viršutinį žemės sluoksnį, atsidengė kryžmai arklu suartas dirvožemis. Suartoje dirvoje buvo aptikta daug anglių, kurios išliko valant laukelius nuo augmenijos. Radiokarboniniai duomenys rodo, kad ši laukų sistema buvo naudojama nuo bronzos iki romėniškojo geležies amžiaus laikotarpio. Radiokarbonu gautas laukelių datavimas taip pat rodo, kad dauguma jų kurį laiką buvo nenaudojami. Dideli žemdirbystei naudojami plotai, susidedantys iš mažesnių laukelių, susidarė per ilgą laiką. Laukų sistemos vystėsi ištisus šimtmečius, nuosekliai susijungiant laukeliams. Laukų plėtra kito pakartotinai keičiantis ekologinėms sąlygoms. Iš laukų buvo šalinami akmenys, ugnimi ir darbo įrankiais išvalomos laukelių vietos. Tada dirva buvo suariama, apsėjama, derlius nuimamas, o grūdai sumalami. Po kelerių metų laukelis paliekamas pūdymui. Paskui, kai buvo įdirbami nauji laukeliai, pūdymas ar apleistas laukelis galėjo būti panaudojamas kitiems tikslams – ganiavai ar atliekant juose kitus darbus.

Svarbiausias žemdirbystės tikslas buvo maisto produkcijos gamyba, tačiau ikiromėniškuoju laikotarpiu su žemės kultivavimu buvo glaudžiai susiję ir socialiniai klausimai. Kai žmonės įsitraukė į žemės apdirbimą, didelę reikšmę jiems turėjo ryšiai su aplinkinėmis bendruomenėmis. Vis dėlto teoriškai laukeliuose daugelį dalykų galėjo atlikti vienas žmogus, tačiau procese nuo derliaus nuėmimo iki maisto patekimo ant stalo dalyvauta keleto žmonių, kurie vienas su kitu buvo įvairiai susiję. Žmonės gyveno kartu, kartu valgė ir kartu apdirbo žemę. Vėliau, apdirbant žemę, santykiuose tarp žmonių ir žemės priklausomumo atsirado problemų.

Laukų sistemos, kurios pastebimos šiandien, yra ilgo proceso rezultatas. Šis procesas tęsėsi daugmaž tūkstantmetį ar ilgiau. Todėl žemės apdirbimas buvo ne vienos žmonių kartos rūpestis. Vyresni bendruomenės nariai savo laukų įdirbimo tradicijas perduodavo jaunesnei kartai, kuri juose dirbo kartu su vyresniąja karta.

Laukas buvo ta darbo vieta, kur jaunimas mokėsi deramai atlikti svarbias žemės apdirbimo užduotis. Žmonių kartoms bendraujant, laukai galėjo būti ta vieta, kur jaunimas mokėsi įdirbti žemę. Patyrimas, sukauptas vystantis žemės apdirbimo technikai, tapo verte, kuri žmonių buvo perduodama iš kartos į kartą. Šimtmečiais formavosi laukų sistemos, įsitraukiant didelėms žmonių grupėms.

Galiausiai intensyviai kultivuojama žemė tapo nederlinga. Autorės nuomone, technikos tobulėjimas sumažino gamtinius išteklius. Tačiau kyla klausimas, kodėl žmonės išsekino derlingą žemę perprasdami žemės apdirbimo technologiją? Matyt, tai nebuvo nepalankių žemdirbystei sąlygų rezultatas. Žmonės stengėsi kuo ilgiau pratęsti plotelių derlingumą, o tai reiškė, kad jie rado kažką dirvos derlingumui išsaugoti, nes ir toliau žemės derlingumas kilo. Autorės nuomone, vėliau laikydamiesi tradicijų jie nieko negalėjo padaryti tolesniam žemės derlingumui pakelti. Žemdirbystės raida ankstyvajame geležies amžiuje gali iš dalies paaiškinti, kaip jie dalyvavo šiame istoriniame procese, nes jo metu žemė tapo privačia nuosavybe.

Gotlando kraštovaizdyje pastebimi žemės ploteliai yra socialinių santykių tarp žmonių rezultatas, ryšių tarp praeities ir dabarties, tarp žmonių ir žemės pasekmė. Taikant agrarinės technologijos tęstinumą, žemdirbiai buvo įtraukti į to meto visuomenės santykius, kurių jungtys tarp atskirų kartų tuo metu buvo išlikusios ir suvokiamos kaip kažkas patrauklaus ir pageidautino. Galbūt tai buvo visuomenės santykių pasekmė, „pateisinanti“, kodėl to meto žemdirbių liko nepanaudota derlinga žemė.

Vertė Algirdas Girininkas

WHAT DID THE ORDER'S BROTHERS EAT IN THE KLAIPĖDA CASTLE? (THE HISTORICAL AND ZOOARCHAEOLOGICAL DATA)

VLADAS ŽULKUS, LINAS DAUGNORA

Abstract

Built in 1252 by the Livonian Order and later passed over to the Teutonic Order, the Klaipėda castle (German – Memelburg) was the northernmost castle of the Order in Prussia. For both geographical and political reasons, it was separated from the hinterlands of the Order's state, making its survival strategy here specific. This article analyses the zooarchaeological material found during the 1997-1999 archaeological excavations and dated to the 14th-17th centuries.

The analysis of the historical data and zooarchaeological material showed that in the 14th-17th centuries, the inhabitants of the Klaipėda castle (the Order's brothers, their servants, the outwork's artisans, and the townspeople who hid in the outwork) reared and slaughtered domesticated animals, hunted large game and consumed its meat, processed cheese, ground grain, drank mead and ale. The bulk of the meat consisted of beef, mutton, and pork, as well as goats' meat starting 1434. An examination of the species and number of bones of domestic and wild animals in Klaipėda's castle shows that in all of the Klaipėda castle time periods analysed, differences were found between the historical source information and the zooarchaeological collection. Domestic animal bones dominated in the latter, especially that of ruminants (cattle, sheep, goats); pigs comprised the second group according to quantity. The growing quantity of small ruminants (sheep, goats) starting 1434 also is reflected in the zooarchaeological material; from the 16th to 17th centuries, the number of bones of these animals doubled. The amount of riding horses markedly grows in the inventory books starting the middle of the 15th century, and this also is confirmed by zooarchaeological material. When comparing the results of the zooarchaeological material's analysis with the known 14th-16th century inventories of Klaipėda's castle in which there are data regarding the domestic animals (cattle, sheep/ goats, horses, pigs) reared for the castle's needs and the food eaten by the castle's inhabitants, changes are observed in the faunal species and amounts of the zooarchaeological material that post-date 1521, when 31.25% consists of pig (*Sus suis*) bones, while the number of species and bone counts of large wild animals (aurochs/ European bison, elk, red deer) and fur-bearing animals (beaver, bear) grows significantly (from 5.5% to 22.92%). Various kinds of fish caught in the sea near Klaipėda and in the Curonian Lagoon held an important place in the diet of the castle's garrison. Fowl comprised only a small part of the food.

Key words: Teutonic Order, Klaipėda castle (Memelburg), zooarchaeological data, Lithuania.

Introduction

Archaeological excavations began at the Klaipėda castle site in 1975 and still continue (with breaks). V. Žulkus headed the excavations at the site of the former German Order's castle until 2003. The excavation data were used in a book published in 2002 (Žulkus 2002), however, the Klaipėda castle site's zooarchaeological material was discussed only in fragments in this book. This article analyses the zooarchaeological material found during the 1997-1999 excavations. A large part of the excavated territory in those excavations consisted of the 14th-15th century's outwork.

Built in 1252 by the Livonian Order and later passed over to the Teutonic Order, the Klaipėda castle was the northernmost castle of the Order in Prussia. For both geographical and political reasons, it was separated from the hinterlands of the Order's state, making its survival strategy here specific. There are comparatively many data from historical sources about the diet of Klaipėda castle's inhabitants, however a certain part of the archaeological finds – the actual animal bones – had not received much of the investigators' attention until now.

We trust that the research data of the archaeozoological material that dates from the last quarter of the 14th century to the beginning of the 17th century will help to more precisely establish the dietary structure of the Order's castle in Klaipėda, to better understand the peculiarities of the economy and diet, and to evaluate the significance of hunting and fishing in the castle's way of life. The research results of the osteological material presented in this article will supplement our knowledge of the lifestyle of Klaipėda castle's inhabitants and townspeople. Moreover, the research constitutes good comparative material of the lifestyle, dietary commonalities and peculiarities of the castles founded by the Order in its conquered territories.

Methods

The territory excavated in 1997-1999 was in the northwestern part of the castle site where there had been an outwork as well as castle's and outwork's fortifications in the 14th-15th centuries. The cultural layer in the excavated area was up to 3.5 meters thick. Many wooden constructions were found in the cultural layers: remains of buildings, wooden pavement, remains of wooden defensive fortifications (Žulkus 1998; 1999; 2000). The cultural layers were well distinguished stratigraphically and it was possible to date the cultural layers dendrochronologically (Brazauskas 2000). In this way, comparatively precise dates were obtained of the layers from which the bone material researched in this article was collected. The fairly well defined chronology of the layers enabled a comparison of the zooarchaeological material's research results with the known 14th-16th century inventories of the Klaipėda castle which contain information regarding the domesticated animals reared for the castle's needs as well as the food consumed by the castle's inhabitants.

The bones excavated from the Klaipėda castle are dated by layer and divided into periods. The very earliest bones belong to the last quarter of the 14th century (post–1365-1377). The bones dated to the 15th century are divided into two groups: the bones of the first half and middle of the 15th century, and the bones of the second half of the 15th century (post-1443). The remaining animal bones excavated from the Klaipėda castle are dated to the first half of the 16th century and the 16th-17th centuries.

The osteological material's analyses were conducted at Klaipėda University's Institute of Baltic Sea Region History and Archaeology. The comparative animal, bird, and fish bone collection housed at the Lithuanian Veterinary Academy's Osteological Laboratory was used for bone identification. In the determination of the faunal composition and number of individuals, we employed the MNI (minimum number of individuals) method (White 1953).

The provision of food

The Klaipėda castle built by the Livonian Order in 1252 was like a small island, surrounded by the suspicious Curonians – suspicious from the Order's point of view. Soon thereafter, when the peaceful period of the Order's and Curonians' coexistence ended after 1260 and the wars not only with the local Curonians, but also with the Samogitians and Lithuania started, the Order's Klaipėda castle and forming town were definitively cut off from the country's economic development. Moreover, the country was ravaged by mutual marches and in the 13th-14th centuries, the number of inhabitants in Northern Curonia dramatically lessened and their economic power similarily weakened. The Order and the townspeople who lived in the castle were barely able to supply themselves with food from local sources. Just like when the castle was being founded, food and weapons had to be provided by way of the sea. Apparently, food often would be scarce in the land governed by the Teutonic Knights in the 13th-14th centuries and thus not only in Klaipėda, but also in other castles of the Order, the people had to supply themselves with food largely from what they could bring over the sea or rivers from the southern Baltic shores.

On the border of the Samogitians and the Lithuanians, the Teutonic Knights were unable to organize normal economic activities and so their economics took on predatory features here. The Order's warriors would attack the Lithuanian castles and rob various crops, grains, and animals for themselves. Some marches to Lithuania appear to have been intentionally organized in autumn with the aim of robbing the harvest of crops already stocked in the granaries. The Order's soldiers attacked the Pūtvė castle near the Jūra River "when the lower ward was restored <...>, and all the grains and crops were piled there" (PD, p.254). A similar march to the Junigeda and Pieštvė castles was organized in the fall of 1318. The lower wards, in which "much of the new harvest's grains were stored," were burnt down during the march (PD, p. 271). The Samogitians and Lithuanians also would destroy the Order's harvests during their attacks. On August 15, 1315, when retreating near Ragainė (German – Ragnit), the Samogitians trampled and destroyed all the crops in the fields (PD, p.66).

Aside from captives, horses and cattle seem to have been the most desirable war-time plunder of the Order's soldiers. The Order stole many horses and cattle from a Sudovian village in 1278 (PD, p.202). In the winter or spring of 1294, the Order's warriors from Ragainė attacked the Pieštvė castle that was in the Seredžius district near the Nemunas River and stole an entire herd of cattle (PD, pp.232, 417). In 1323, the Teutonic Knights stole 34 horses near the Paštuva castle, and the following year they drove 100 horses and many other animals out from the Gardinas district (PD, p.235). The Lithuanians did the same thing; when they could, they drove out horses and cattle. It is written (PD, p.235) that in the summer of 1295, for example, they stole "all of the brothers' horses and cattle" from the island near the Ragainė castle.

A part of the food for Klaipėda was brought over by sea til the very middle of the 15th century, especially after the Samogitians' and Lithuanians' attacks, or after lean years, or during wars. It was so cold in the winter of 1323 that "almost all the fruit trees in Livonia and Prussia either dried up or became so sickly that for a long time they could not yield any fruit" (PD, p.274). Apparently, 1402 also was a lean year because help with food was rendered not only to Klaipėda, but also to the surrounding inhabitants. In July and in the fall, Klaipėda's commander helped the locals by giving the Curonians flour, peas, groats, and oats (Sembritzki 1926, p.45). An entry in the Marienburg account books notes that Klaipėda's commander once again received food aid by being sent flour as well as money to buy rye, wheat, and oats (Willoweit 1969, p.70). Soon thereafter, in a letter dated February 2, 1418, the Grand Master of the Teutonic Order appealed to the Livonian Order's Master with a request to send 40 lasts[1] of grain via boats to Klaipėda. Part of the grain was supposed to be floated to the Order's castle in Ragainė. Information also is known about the transport of grain from Livonia in 1439 (Acten Bd. 1. Nr. 170, pp.209, 211; Acten Bd. 2. Nr. 71, pp.110-111).

The food requirements of the Klaipėda castle's inhabitants was very diverse. It was an important, but small castle that consistently housed a small garrison. Even in 1507 under the direction of the Grand Master, the Klaipėda castle held a garrison of only 60 people. The garrison of Ragainė at the time was comprised of 200 people, that of Königsberg – 400 (Baczko 1793, pp.179-181). When the need arose, the garrison was supplemented; in the first quarter of the 16th century, Klaipėda's castle had weapons designated for 150-180 people (Willoweit 1969, pp.75, 76). During times of war, food would be brought over to Klaipėda together with the warriors. It is known that during the Thirteen Year War in 1457, military and food were sent to Klaipėda from Lübeck and Hamburg (Sembritzki 1926, p.47). When the castle was being reconstructed, much more food would be needed than usual. Hundreds of people worked here in 1399-1409 when the castle was being rebuilt and fortified. In 1402, about 500 people from Warmia were restoring the Klaipėda castle (Baczko 1793, p.259).

In 1365, Winrich von Kniprode granted the town a new privilege. The agricultural possibilities of the Klaipėda townspeople also were described, granting a few of the inhabitants the right to use only those pastures and meadows closest to the town. Much of the land and many of the pastures were not needed anyway, since the main occupations of the Klaipėda townspeople at the time were fishing and commerce (Sembritzki 1926, pp.38-39).

In the second half of the 15th century, when peaceful relations settled between the Order and Lithuania and the economy recovered in Curonia, sometimes a surplus of grain formed which could be sold. Rye, wheat, and oats, as well as malt and mead were brought over to Gdańsk from Livonia and Curonia in 1468 (Stark 1973, p.82). Klaipėda's part in such an export of grain could not have been big.

Mills were very important in the provision of food. In 1256, soon after the foundation of the town and with the approval of Bishop Heinrich, Master Anno von Sangershausen of the Livonian Order conceived the idea to build a mill for the needs of the people of the castle and its surroundings (LEK I, p.290). Two mills already existed in Klaipėda in 1290 (MT, p.22). The construction of a horse mill in the Klaipėda castle in 1399 also is mentioned (Semrau 1929, p.95). When the castle was demolished in 1402, this mill also was demolished (Willoweit 1969 1969, p.117), however, it already was rebuilt the following year (MT, p.276). A (water?) mill was built in approximately 1430 during the fortification of Klaipėda's castle and town (Regesta, Nr. 27653). The horse mill, in which there were two millstones, was mentioned again in the castle's inventory in 1447 (Willoweit 1969, p.117). For a long time, the peasants and poorer inhabitants of the town and outwork would grind their grain themselves for their provisions, despite the prohibition of hand mills in town in the second half of the 16th century. "Prussian" hand mills called *quirlen,* that ground very coarsely, were used (Quellenbeitrag, p.64).

Aside from the main food products that were imported during famine or war-time, the Klaipėda townspeople consistently needed imported products that were not available from the surrounding lands and forests. Ale, wine, mead, and salt were brought in from various lands by boat in the 14th-15th centuries. Salt was brought to Klaipėda by boat either directly from various ports, for example from Baye in France and from Flanders (The Flemish Region), or by intermediate harbours. Written sources mention that in 1462, the people of Danzig (Gdańsk) took the salt intended for Klaipėda from a boat from Lübeck (Willoweit 1969, p.76, 146). The brothers of the Order kept honey in the castle (Willoweit 1969, p.79) and would drink local mead – "honey wine" (PD, p.273). In the beginning they would import ale from elsewhere, but later they made it themselves. In 1404-1447, aside from the various types of ale and other food reserves stored in the castle, Klaipėda castle's inventories mention rye, barley, oats, malt, hops, flour, peas, salt. There also were rarer and more exotic food products: onions, figs, raisins, almonds, mustard, vinegar (Willoweit 1969, pp.79, 80).

An abundance of woods and lakes was characterisitc of East Prussia. Large forests, flooded in places, extended throughout the lowlands of the Vistula, Nemunas,

[1] 1 last is approximately 2000 kg (Transpress 1988, p.340) or a little more – 2160 kg (Zemzaris 1981, p.111).

and other smaller rivers and deltas. Peter Suchenwirt described Duke of Austria Albert III's 1377 march from Königsberg to Samogitia through the Įsrutis and Nemunas: "Over 1000 people walked, clearing their way with axes through the forests, through ditch and field, across deep waters, swamps, and streams, through marshes. The soldiers and horses got caught in tree branches, the winds knocked down huge trees, and they had to force their way through dumps of trees" (SRP II, p.164). The natural landscape transformed into a cultural landscape comparativley late in Prussia, however, in the 16th century, compared with the 13th-14th centuries, only 60% of the forests remained. The forests quickly thinned out due to slash and burn agriculture, but after wars and plagues, the number of settlements would decrease and forest plots would increase once again. The number of villages decreased seven times after the Thirteen Year War (1454-1466). In 1582, Dionysius Runau wrote: "... Barrel-wide oaks, beech, birch, and spruce stand where there used to be cultivated land, and rye and wheat used to grow." Mixed forests grew in Prussia, dominated by deciduous trees (Mager 1960, pp.20-22, 25, 44, 63-65, 150).

Forests dominated all of Curonia in the Middle Ages; there was a shortage of tillable plots of land, especially in the morainal coastal plains. The blowing of sand along the coast from Klaipėda and to the north interfered with agriculture. In 1576, the former meadows already were straw-coloured along the coast, and an historical source writes in 1623 that the Nemirseta village had not given its tributary of seven barrels of oats already for a number of years because their pasturelands were covered up with sand and the people were impoverished (Mager 1960, pp.255-260).

Samogitia was less forested with more available land to cultivate (Žulkus 2004, pp.66, 149), but during times of war Samogitia's ability to provide food to Klaipėda was limited. The rations of the people of Klaipėda would be supplemented by meat of wild game from Lithuania's and Prussia's forests. According to the information collected from Herberstein's 1526 journey, Lithuania's noblemen hunted aurochs, bison, elk. Guagnini wrote in 1578 that Samogitia's forests have bears, bison, elk, lynx, foxes, particularly many wolves and hares, wolverines (Jurginis 1983, pp.58-59, 63, 68). Up until the 18th century, elk, hares, foxes, beavers, partridges, snipes, and ducks were hunted on the Curonian Spit (Willoweit 1969, p.197). The forests gave the inhabitants of Klaipėda many of the things they needed to survive: meat, furs and hides, honey, beeswax. There were places for the cattle to graze in the forest, grass and hay, food for the pigs. Starting with the 15th century, the forests' wealth became an important part of Klaipėda's exports.

More information also is available about the export of food products from Klaipėda starting with the 17th century. Boats would carry out traditional food products reared or grown or made by the local inhabitants: live goats and calves, cows and horses, meat, bacon, beef fat, lard, butter, hops, linseed, honey, onions. They would import salt, sometimes fish and grain, ale, wine (Groth 1996, p.48; Groth 2009, p.19- 23).

The Klaipėda castle's outwork as the place of economics of Klaipėda's inhabitants

The Livonian Order put many political and economic hopes into the establishment of the town of Klaipėda. The castle, built on Curonian land in 1252, was supposed to be only the beginning. An outwork that was supposed to be a rudiment of the town was immediately established near the castle. It was believed that an ecclesistical and secular center of Curonia with a bishop's residence, Capitula's curia, and several churches would be founded (Jähnig 1994, pp.20-21). Because of this, the Lübeck law was hurriedly offered to Klaipėda in 1254. The two hundred year long wars between Livonia (later the Teutonic Order) and Lithuania ruined those plans and Klaipėda did not grow into a town until the turn of the 15th to 16th century. Until the very beginning of the 17th century, the town did not have better fortifications, so often it was demolished and burnt. The townspeople suffered the most from the frequent attacks. Afterward, the town and economy would need to be brought to life again. The castle would be attacked almost every ten years (1255, 1256, aproximately 1279, 1323, 1353, 1367, 1379, 1380, 1393, 1402, 1409, 1414, 1454, 1457, 1459, 1464, 1472) and the town always suffered (Žulkus 2002, p.7). For example, the Lithuanians burnt the town of Klaipėda and its castle in the spring of 1393 (Posilge, pp.110-111). The Samogitians burnt the town of Klaipėda in 1393 (Posilge, pp.189-190, 192). They attacked again in 1402 and 1409 and burnt the town, whose fortification still was not finished (Zurkalowski 1909, p. 94; Semrau 1929, pp.90, 95). Vytautas's army burnt the town in the spring of 1414 (Klimas 1933, p.111). In 1454, the Samogitians again burnt the town and a part of the castle (Sembritzki 1926, pp.47-48). The Lithuanians seized Klaipėda's castle in 1472 (Acten Königl., 277, Nr. 105) and undoubtedly burnt the town as well. The town also would be ravaged in the 16th century. Soldiers from three Gdansk battle ships burnt half the town in May of 1520 (Regesta 23751, 23758, 23764; Baczko 1793, p.85; Sembritzki 1926, p.58) and Samogitians devastated Klaipėda in the winter of the same year (Roerdansz 1792, p.17).

After suck attacks, Klaipėda would be provided with food by boats from other towns. Bad harvests and epidemics would provoke the same consequences. That is how the plague that began in 1406 in the Order's lands beat down all of the Klaipėda's castle's defenders in 1409 (Posilge, pp.283, 303).

Until the wrecked little town near the castle was rebuilt, Klaipėda's inhabitants would take up residence in the fortified outwork together with the artisans and workers who served the castle. The Order in Constance blamed Vytautas for burning the town, breaking into the castle, and making more than 3000 people leave in the spring of 1414 (Klimas 1933, p.111; LIŠ, 86, Nr. 120). This count of the castle's and outwork's inhabitants clearly was exaggerated.

The economic growth of the castles and outworks was very important, especially in those lands without a stable and sufficiently developed economic structure. Among the Klaipėda Order's first wooden castle constructed in 1252, agricultural buildings are mentioned, which included a pigsty (LEK, Abt.1, Bd 1, Nr. CCXXXVI, CCXXXVII, CCXLI, CCXLV). The agricultural buildings constantly were rebuilt after fires and attacks; newly constructed cattle sheds are mentioned in1402 (Sembritzki 1926, p.45), and other animal sheds or barns belonging to the castle are mentioned in 1376 (Willoweit 1969, pp.118-119). In the beginning of the 16th century, the Order's barns already were further from the castle, on the outskirts of Klaipėda. A new sheep pen was established near the town in Althof in 1558. The old sheep pen held the milch cows and sheep, the new one – the dry cows and sheep (Sembritzki 1926, p.79).

Until the appearance of independent artisans in the town, trade crafts also developed in Klaipėda's outwork. The everyday life and daily dietary habits of the outwork's inhabitants also were largely charactersitic of Klaipėda's townspeople.

The excavated cultural layers and masonry remains show that the outwork of the 14th century was reinforced with brick defensive walls and towers with gates. The length of the northern defensive wall was approximately 70 m. The roads near the towers were paved with stone (Žulkus 2002, p.35).

During the archaeological excavation of a former outwork, approximately 3.5-4 m above water on a hill, fragments of wooden pavement as well as remains of brick and wooden buildings were uncovered in the cultural layers dated to the second half of the 14th century. The layers were dated by coins and dendrochronology. While excavating the outwork's western part, at a depth of about 2 m, a narrow wooden street with its adjacent former little buildings was found. The surface of an even older street was found underneath this roadway. The older street also was made of variously sized poles. Inbetween the two wooden pavements was a layer of mud in which many animal bones were found. The dendrochronological date of the bottom street's pavement is approximately 1374 (Brazauskas 2000). The uncovered pavements of the little streets and the remains of buildings near them occurred after the 1360 reconstruction of the outwork. A portion of the buildings apparently were burnt in the fire of 1379. Alongside the narrow road's wooden pavement, at a depth of 2.5-2.7 m, the fragments of a totally burnt 3 x 3 m large building were found. The walls of the building of unclear construction were daubed with clay. Many bone and horn cuttings, half-finished products were found beside the walls; apparently, bone and horn processing workshops were located here. Many traces of smith's work were found while excavating (Žulkus 2002, p.37). Smithies, workshops, stables, servants' residences, breweries, and other agricultural buildings constituted a typical attribute of the outwork of the Order's castle, encircled by a stone and brick wall (Schmidt 1938, pp.8-9).

The dietary habits of the castle's inhabitants (Order's brothers and their servants) and outwork's inhabitants (artisans and lower class servants) are difficult to distinguish from each other by the current archaeological excavation material. Thus, in discussing the diet of the Klaipėda castle's inhabitants, we lean more heavily on the outwork's finds.

Fish

The fish of the Curonian Lagoon, Nemunas River, and the sea comprised an important part of the Klaipėda castle's and townspeople's food rations, especially when there was a shortage of meat or bad harvests. A rather large amount of fish would be caught, although the Order's knights tried to monopolize the right to fish and limit their subjects' rights to fish even for their own needs (Boockmann 2003, p.170). In 1328, Klaipėda's fishermen were allowed to sell the fish they caught (mostly in the Curonian Lagoon) freely and in unlimited quantities to the brothers of the Order in the Goldingen castle, but only after the needs of the Klaipėda castle's brothers were fully met. Instructions to sell fish to Goldingen also were given in 1331 and 1341. Klaipėda's commandry had the conscription to supply fish to Marienburg and other castles of the Order (Königsberg, Elbing). As a special delivery in 1407, Klaipėda's commandry presented 39 barrels of cod to Marienburg. Klaipėda's commandry had fishing boats for fishing – ten in 1376, six in 1377, and five in

1389. In addition to the boats, the inventories mention a large amount of various types of fishing nets (Willoweit 1969, pp.121-123).

Just as in the other commandries of the Order, the earnings received from fishing in Klaipėda's commandry were administered by the *Fischmeister* – a lower officer of the Order (Boockmann 2003, p.160). Klaipėda's *Fischmeister* is mentioned in Marienburg's account books in 1400, 1402, and 1403, and in 1434 it is written that he had a separate boat (Willoweit 1969, p.120).

In the second half of the 15th century, as the number of Klaipėda's inhabitants grew, the townspeople were granted the right to fish in the sea (1462) and in the bay (1486), however, just as earlier, before they could freely sell the fish, they had to first satisfy the castle's needs (Willoweit 1969, p.124). Klaipėda's commander himself traded in fish; his load – fish and timber – was held back and sold in Lübeck after 1468 (Willoweit 1969, p.147). Among the fish imported into Lübeck from Prussia in 1492-1493, cod, sturgeon, and herring are mentioned (Stark 1973, pp.142-144).

The inventories describe what kind of fish the locals would deliver to the Klaipėda castle and in what quantities. Data are available from 1376, 1377, 1379, 1389, and 1398. From these data we know that the castle's inhabitants would eat mostly bream (*Abramis brama*) and twait shad (*Alosa fallax*), next came cod (*Gadus morhua*), pikeperch (*Lucioperca lucioperca*), and pike (*Esox lucius*). Herring (*Clupea*) are mentioned in barrels in 1376 and 1379 (Willoweit 1969, pp.122-123).

The fish menu of the castle's inhabitants changed somewhat in the 15th century; the 1402-1447 inventories barely mention bream and there are no more twait shad, but sturgeon (*Acipenser sturio*), salmon (*Salmo salar*), sea trout (*Salmo truta truta*), cod, European eel (*Angilla angilla*), vimba (*Vimba vimba*), and artificially grown common carp (*Cyprinus karpio*) appear. In 1402, as many as 28,800 carp were consumed (Willoweit 1969, pp.126-127). In a privilege granted to the townspeople in 1475 (as well as later), the tools and right to catch salmon, vimba, eel, and strugeon are mentioned (Sembritzki 1926, pp.49-52). The most highly valued and most caught were salmon and pikeperch. Baltic sturgeon constantly are mentioned in the 15th century. The same fish also were caught later: pike, salmon, pikeperch, bream, eel, perch (*Perca fluviatilis*), carp, burbot (*Lota lota*), rudd (*Scardinius erythrophthalmus*), cod, herring, flounder and halibut (*Pleuronectidae*), European smelt (*Osmerus eperlanus eperlanus*), European sprat (*Sprattus sprattus*). Baltic sturgeon still were caught along the shores in the Curonian Lagoon and sea in the 17th century (the right to fish for them was granted to the English trader Johann Scarlet in 1685). Lamprey (*Lampetra planeri*) are mentioned among the fish exported from Klaipėda's ports in 1680 and 1681 (Willoweit 1969, pp.230-237). Eel mostly was caught in the Curonian Lagoon. Even in the 19th century, Juodkrantė was the most important place to catch eel for all of Germany (Eschment, Heyden, Schulze 1994, pp.341-349).

Herring to the inhabitants of Prussia, just as in other Catholic countries, was an important food in times of fasting. Herring was caught by local fishermen, but there was not always enough of it; for example, herring dramatically decreased in Prussian waters in 1313 (PD, p.319). It is mentioned that the fish died out in 1524; there was so little of it, that there was barely enough for the fishers' families to subsist on (Dovydenko 2004). In the years when fish was in abundance, the herring caught in Prussia was exported elsewhere as well. In the 15th century, it would reach Lübeck, and from there it sometimes also would be exported to more distant towns in Germany (Stark 1973, pp.142-144). Usually Prussian towns and the inhabitants of the Order's castles ate herring caught along Scandinavia's shores. At the end of the 15th century, herring took third place among the goods imported from Lübeck to Gdańsk by boat – after drinks, hides and furs. The cost of herring depended on where it was caught, at what time it was caught, and how it was preserved, as well as, undoubtedly, in what abundance it was caught. A portion of the herring would arrive in Gdańsk from Swedish towns, a portion – from Bergen in Norway (Stark 1973, pp.65-66, 140). A portion of the Norwegian herring from Gdańsk undoubtedly also came to Klaipėda.

The single fish (large sturgeon, pikeperch, pike) bones and scales from the analysed zooarchaeological bone collections of the Klaipėda castle site do not allow for a broader interpretation nor add to the known historical source information of the assortment of fish eaten in Klaipėda in the 14th-17th centuries.

The consumption of meat. Data from historical sources and the zooarchaeological material's research results

The Order's state was about 58,000 km^2 large (38,500 km^2 between the Vistula and Nemunas Rivers). Many people lived in such a large state. Both for their own subsistence and in order to provide food support to the established castles in the newly conquered lands, well developed farming was a necessity. The basis of economy in the state of the Order was comprised of service estates as well as the farms of the local Prussian and Curonian inhabitants. The number of the Order's unas-

Table 1. The animals kept in Klaipėda castle's animal pens, mentioned in the inventories of the 14th – beginning of the 16th century (Willoweit 1969, pp.118-119).

Year	**Horses**	**Fillies**	**Oxen**	**Cattle**	**Cows**	**Pigs**	**Sheep**	**Goats**	**Geese**	**Total**
1376	7	-	7	-	22	-	34	-	-	70
1377	3	13	-	-	17	-	-	-	-	33
1379	15	-	-	-	7	-	-	-	-	22
1389	17	2	-	9	-	15	6	-	-	49
1398	29	-	-	9	-	13	-	-	-	52
1402	24	-	-	-	-	10	-	-	-	34
1404	19	-	29	-	6	48	-	-	-	102
1414	-	-	-	-	-	-	-	-	-	-
1415	4	-	-	8	-	14	-	-	-	26
1416	10	-	-	22	17	30	-	-	-	79
1420	8	-	15	-	9	30	-	-	-	62
1434	19	1	10	-	72	28	115	39	-	284
1437	30	6	18	72	-	175	150	50	15	516
1447	30	6	4	95	-	71	144	60	18	428
First 1/4 of 16th cen.	60	13	48	21	61	60	100	32	-	419

similated Prussians in 1300 was approximately 90,000, and approximately 140,000 in 1400 (Boockmann 2003, p.91). We have no available data about the number of Curonian inhabitants. According to inventory data, the Order's estates in Prussia in 1370 held 10,482 cattle, 18,992 pigs, 61,252 sheep, and approximately 13,887 horses[2] (Jähnig 1989, p.125). Thirty years later (c. 1400), the inventory data cite that the people of the Order had 9,000 cattle, 71,000 sheep, 21,000 pigs, and 10,000 to 12,000 horses on their farms (Samsonowicz 1989, pp.107, 108). The animal species did not change during this period – only their quantities changed (cattle decreased from 10.02% to 7.96%; the number of pigs did not change, but rather wavered from 18.15% to 18.58%; the quantity of sheep rose from 58.55% to 62.83%; no comparative data for horses are available).

The inventories of the 14th to beginning of the 16th century describe the kinds of animals held in the barns that belonged to the Klaipėda castle (Willoweit 1969, pp.118-119). These data are presented in **Table 1**. The 14th and 15th century inventories of Klaipėda's commandry testify that horses, cattle, cows, pigs, sheep, and later – goats were tended and fed at that time (Willoweit 1969, pp.118-119, 216).

The 1404-1447, Klaipėda castle inventories mention that in addition to the various kinds of ale, other food suplies kept in stock at the castle were rye, barley, oats, malt, hops, flour, peas, salt, butter, cheese, meat (hams and chucks), and various kinds of freshwater and sea fish. Birds are not mentioned in the inventories (Willoweit 1969, pp.79, 80, 82). Wild game carcass meat (barrels with boar meat, elk meat, and deer meet) is mentioned in the inventories of 1415, 1437, and the first quarter of the 16th century (Willoweit 1969, pp.79, 80).

The main food products mentioned in the written sources are the various kinds of fish, meat (mainly beef and mutton), and cheeses that were made from the milk of cows and sheep or goats. A couple hundred to a thousand pieces or units of cheese reserves were stored in the Klaipėda castle, except for 1402, when 2300 units intended for the "gentlemen" and 3800 units intended for the "servants" are mentioned (Willoweit 1969, p.82). Such a large stock of cheeses was necessary to feed hundreds of people engaged in the work of rebuilding the castle. The meat was salted and jerked. Pork is directly mentioned only in 1416, later using the terms "fatty meat (1434)," and bacon (1437). Nonetheless, pigs are regularly mentioned in Klaipėda's animal pen starting 1389, and from 1434 – sheep and goats. The quantity of sheep was the highest from 1434 until the first quarter of the 16th century (Willoweit 1969, pp.79, 80).

According to the data of the available sources regarding Klaipėda castle's farming, the principal domestic animals were ruminants (sheep and cows / cattle in 1376). The counts of animals actually change significantly. For example, in 1402 there are very few animals in the inventory books compared to 1379, while in the inventories of 1414, domestic animals are not

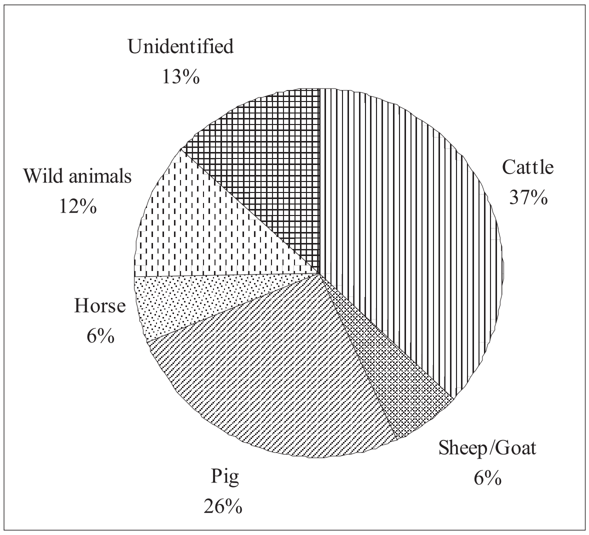
[2] The horse count is indicated for c. 1400.

mentioned at all (Table 1). This could be explained in two ways: either the data did not survive, or there really were no animals, since precisely in the spring of 1414, Klaipėda was occupied by Lithuanians (Klimas 1933, p.111; LIŠ, p.86, Nr. 120).

The inventories mention (Table 1) that there were 22 cows and seven cattle (a 3:1 ratio) in the Klaipėda castle in 1376, whereas after the castle burned in the spring of 1402 (Semrau 1929, p.95) and during its reconstruction in 1404, the ratio is in reverse; the number of cattle dominates in relation to cows (at a ratio of 4.8:1, i.e., 29 cattle and 6 cows). Almost all of the food reserves apparently were destroyed in the spring of 1402. Twenty-four war horses and only ten pigs are mentioned in Klaipėda castle's animal pen that year (Willoweit 1969, pp.118 -119). 1402 might have been a bad harvest year since in July as well as in that autumn, Klaipėda's commander gave the local Curonians flour, peas, grain, and oats as aide (Sembritzki 1926, p.45).

One hundred thirty-five bones or bone fragments were identified in the analysis of the osteological material excavated from the Klaipėda castle and dated to the last quarter of the 14th century (Graph 1). From the established count, we attributed 50 bones or bone fragments to cattle (*Bos taurus*), with an MNI (minimum number of individuals) of four. The age of one of the cattle was 36-42 months, and another one was young because several of the cattle vertebrae's discs were loose. Having completed the analysis of 35 pig (*Sus suis*) bones, we established the minimum number of individuals (MNI – 6) and their age (a maximum of 24 months and 42 months). Eight bones (MNI of 2) of sheep / goat (*Ovis aries/Capra hircus*) also were found in this material as well as a fragment of horse (*Equus caballus*) vertebra, two metacarpi and phalanxes, as well as a metatarsus bone (MNI – 2). A dog's (*Canis familiaris*) antebrachium bone was identified. A single fish bone also was found. Bone fragments of four species of wild game were excavated from this period: aurochs / bison (*Bos primigenius/Bison bonasus* L.), elk (*Alces alces*), red deer (*Cervus elaphus*), and bear (*Ursus arctos*). We believe that a few of the bones could have belonged to boar (3 skull fragments, a canine tooth, and a tibia). The inflammation (*arthritis*) of a cattle's pelvic bone's acetabulum also was established in this period's collection.

No bird bones were found in the 14th century bone collection from Klaipėda's castle. They are found, however, in Lithuanian archaeological sites of that period. In the 13th-14th century layers of Kernavė in the Pajauta valley, 28 domestic bones were found. In the same area at the Altar (Aukuras) hill, not only domestic bird species, but also wild ones were found among the



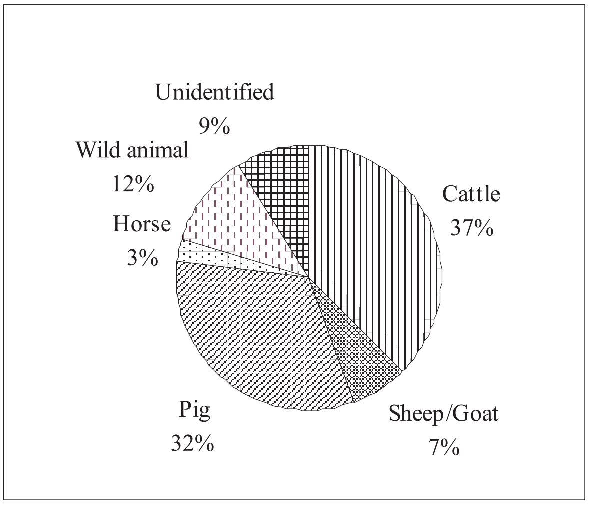
Graph 1. Klaipėda castle after 1365-1377 (4th 1/4 of 14th cen.).

131 bird bones – wood grouse (*Tetrao urogallus*) and raven (*Corvus corax*). Single bones of domestic chicken and domestic duck also were excavated from the 1385-1390 layer of the Kaunas castle yard (Bilskienė, Daugnora 2001 p.255).

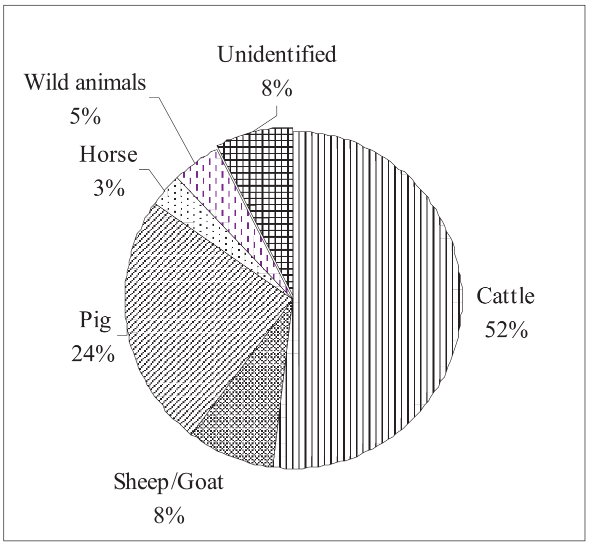
Aurochs / bison (6 bone fragments), red deer (1 bone), cattle (1 bone), and pig (4 bone fragments; MNI of 2, with one individual over 28 months old and the other individual at 1-1.5 months old) were identified in the zooarchaeological collection from the Kaunas castle dated to the 14th century. The analysis of 282 bones from the second half of the 15th century revealed a domination of domesticated animals at the Kaunas castle (cattle comprised 32.98%, goats / sheep – 14.18%, pigs – 9.57%, horses – 6.38%). Elk (5.67%) and bird (hen – 2.48%) bones also were identified.

In the 15th century, the same animals as before (horses, catle, pigs) were fed and held in Klaipėda castle's animal pen, but there were significantly more. The 1434 list (Table 1) mentions 72 cows, 10 oxen, and 60 goats (the ratio of cows to cattle is 7:1). The large number of cows and sheep / goats suggests that their milk was used in the production of "local" cheeses. From 1434 on, the number of animals grows significantly and surpasses five hundred heads (the list is supplemented by goats and fillies; birds also appear).

The analysis of the 255 bones excavated from Klaipėda castle site's layers (dated after 1443; the mid-15th – second half of the 15th century) (Graph 2) indicated that cattle bones dominated during this period (68 bone fragments; MNI – 4). The age of one of the individuals was 42- 48 months. Of the 13 identified sheep / goat bones, two belong to goats; the age of one of the individuals was 10-17 months, the other was 18-23 months. Fifty-nine pig bones belonged to



Graph 2. Klaipėda castle after 1443 (mid-15th - 2nd 1/2 15th cen.).



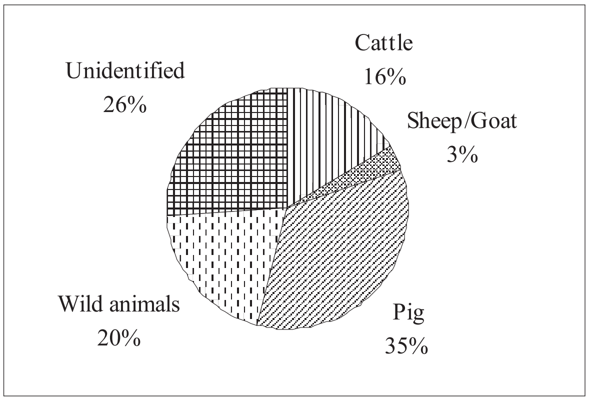
Graph 3. Klaipėda castle 1st 1/2 of 16th cen.

six individuals (their ages were from 17-22 months, 24 months, 24-30 months, and 42 months). Five bones belonged to the horse (MNI – 2; one of them was a stallion). The proximal part of a dog's (*Canis familiaris*) left leg's humerus was found. Single bones of wild game also were found in this layer: two vertebrae and a metacarpus bone of an aurochs / bison, an antler fragment, part of a vertebra, and pelvic bone of an elk. A beaver's femur, fragment of a fox's femur, and a red deer's calcaneus and phalanx were identified. We believe that two large mandibles and canine tooth fragments might have belonged to a boar / pig (*Sus scrofa/ Sus suis*) and this individual was slaughtered / hunted when it was more than 36 months old. Birds (geese) are mentioned for the first time in the inventory books in 1437 (Willoweit 1969, pp.118-119). The following bird bones were identified from the mid-15th and second half of the 15th century's layers of the Klaipėda castle site: a chicken's (*Galus domesticus*) humerus and tibiotarsus, a rooster's left foot's tarsometatarsus, and a grey goose's (*Anser anser*) right side's coracoideum (Bilskienė, Daugnora 2001, pp.255-256). Single bones of pike (*Esox lucius*; dentale) and pikeperch (*Lucioperca lucioperca*; operculum) also were found in the Klaipėda castle.

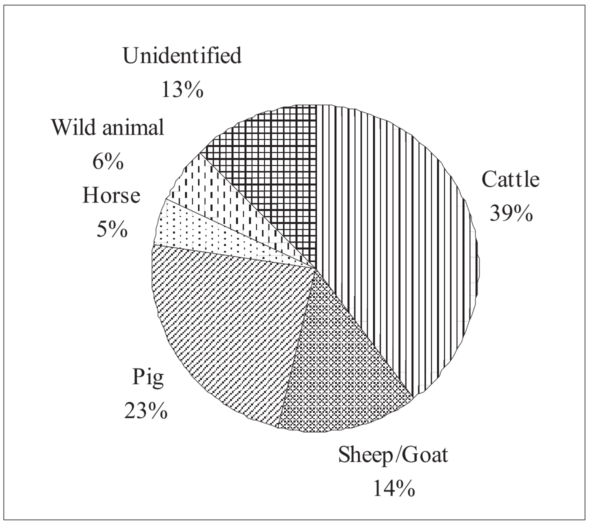
In the first quarter of the 16th century, a rather large quantity of animals already was held in Klaipėda castle's animal sheds (419): horses, fillies, cattle (including oxen and cows), and sheep / goats (Table 1). The increased amount of animals could signify the castle's and town's recovered economy. In the first half of the 16th century, Klaipėda castle's inhabitants might have eaten cattle that were reared in Samogitia. In 1512, Klaipėda's commander had to purchase 50 cattle for the Grand Master's kitchen needs, by the latter's order. There also is news from 1522 about the shipment of Samogitian cattle (*Rindvieh* in German) from Klaipėda to the Grand Master (Willoweit 1969, pp.148-149).

After analysing 152 bones from the layers of the first half of the 16th century (Graph 3), it became clear that their majority was constituted by cattle (MNI – 4). Their age could have been between 42 and 48 months and younger. One of the ox's neck vertebra was chopped into, which would suggest that the slaughter method characteristic of the Middle Ages was employed here. The analysis of 11 goat / sheep bones revealed the absence (*oligodontia*) of a mandible's third molar. The analysis of 32 pig bones revealed a group of younger individuals and an older individual over 36 months old. The skull fragment of a dog (*Canis lupus*) as well as the humerus, antebrachium, pelvic, and femur bones of a cat (we think a domestic cat (*Felis silvestris*; MNI –1) were found. Part of a mandible and canine tooth fragment were ascribed to a boar / pig. An antler fragment and chest vertebra of an elk were identified, as were part of a red deer's (*Cervus elaphus*) antler and a femur fragment of a bear (*Ursus arctos*).

The bone material collected from the layers dated to "after 1521 – the second half of the 16th century" (61 bones) is presented in Graph 4. A large amount of split tubular bones and small fragments prevented the identification of the anatomical part and species affiliation of a third of the animal bones. The examination of ten cattle bones revealed a pathology of the mandible bone. The absence of molars (*oligodontia*) in the mandible bone of a shee / goat was established. We distinguished several age groups from the analysis of the (21 fragments of) pig bones (18-24 months, 24-30 months, 24 months). A relatively large amount of wild animal bones was establsihed (elk, aurochs



Graph 4. Klaipėda castle after 1521 (16th cen. - 2nd 1/2 16th cen.).



Graph 5. Klaipėda castle 1st 1/2 16th -17th cens.

/ bison). The waist vertebra of a harbour porpoise (*Phocaena Phocaena*) also was attributed to this period. Also found were an unidentified species of bird's humerus and a rodent's vertebra fragments.

Analysis of the 142 bones found in the layers date to the end of the 16th – beginning of the 17th century showed the same animal species (Graph 5). In the analysis of 57 cattle bones, the age of two individuals (28-34 months and 36-42 months; MNI – 3) was established. Analysis of the goat / sheep bones showed a large amount of corneous tines (20 total; 12 cornutus). Three of the corneous tines belonged to adult goats. The analysis of 34 pig bones (MNI – 2) revealed groups of both young and adult animals (8-24 months, 17-22 months, 24-30 months). Single humerus and metacarpus bones as well as a tooth of pig / boar (MNI – 2) were found. Among the carnivorous animal remains were a dog's skull and mandible bone as well as a domestic cat's femur. Bones of wild game also were established: a beaver's (*Castor fiber*) calcaneus and a bear's (*Ursus arctos*) mandible fragment.

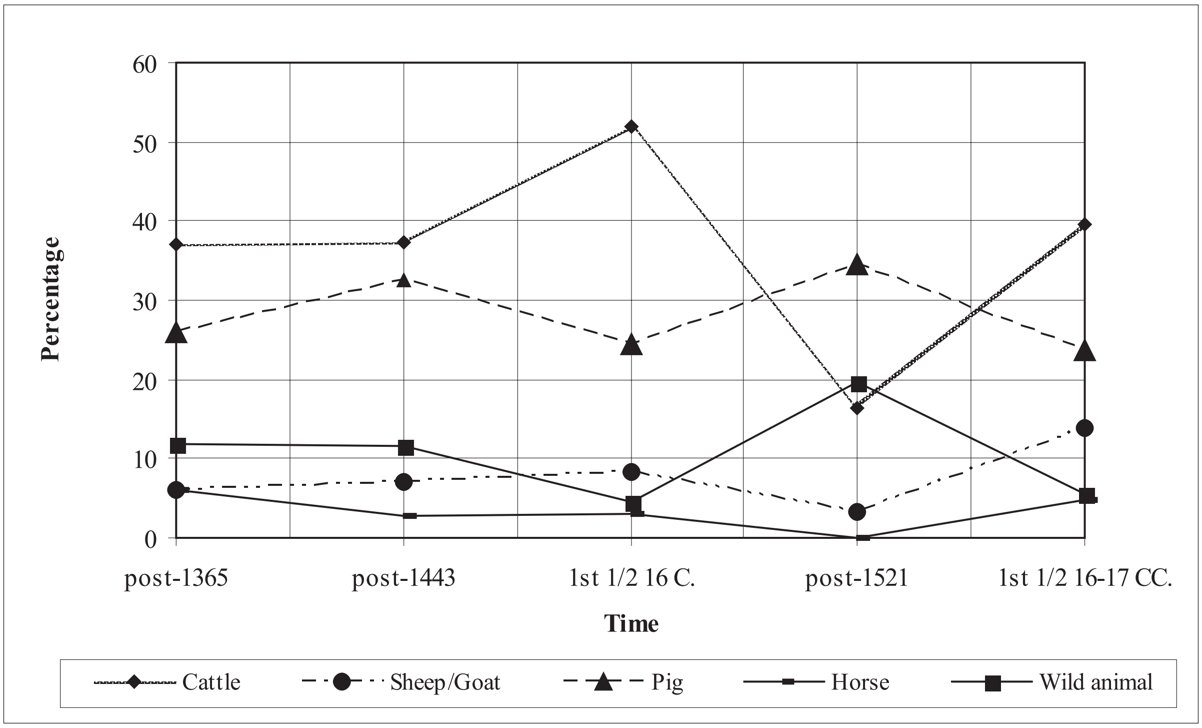
We found no specific pathological changes that appear in the spine and terminal phalanxes with the pulling of a plough or wagon for a longer period of time in the excavated cattle bones' collection of Klaipėda's castle (Groot 2005; Telldahl 2005; Fabiš 2005). The cattle undoubtedly were used for ploughing; ploughs and ploughshares are mentioned in the Order's inventories. In c. 1400, the Herrengrebin castle had 14 ploughs, the Lesewitz castle – ten ploughs (Jähnig 1989, p.125). There were few draught animals in Klaipėda's commandry; only three to seven ploughs, two furrowers, and 14-18 scythes were held in 1414 (Willoweit 1969, p.119).

In summarizing the excavated zooarchaeological material from Klaipėda's castle, we distinguish two animal groups: domesticated animals and wild animals (Graph 6). Bones of ruminants dominate among the domestic animals (cattle / sheep / goats), while pigs comprise the second group of most abundant animals.

The small quantity of horse bones prevents a wider interpretation of the available material. It is expedient to propose that horses would be eaten only to avert starvation in besieged castles or during marches if no other food was available. Marshal Henrik marched to the Krivichians land (an eastern Slavic tribe) in September of 1314, but after the battles, upon returning to Novgorod after the march, they lost the food provisions left at the rests and had to retreat to the wastelands. They remained there for many days without bread and several of them ate their horses from hunger, while others subsisted on grasses and their roots (PD, p.265).

From the entire researched period's wild animal group, we distinguished the large wild animals (aurochs / bison, elk, red deer) and the fur-bearing animals used for fur or medicine (bear, fox, beaver). Reserves of wild game meat are mentioned in the written sources. One boar was hunted in 1415, one barrel of game meat was inventoried in 1437, and one barrel of boar meat, one barrel of elk meat, and two barrels of deer meat – in the first quarter of the 16th century (Willoweit 1969, pp.79, 80). True, a portion of the bones might have been crushed or eaten by dogs. Single dog bones are found from the last quarter of the 14th century or other periods.

We find no significant differences when comparing the excavated bone material of the Order's Klaipėda castle with that from Latvia's territory (the Selpils castle's outwork). Bones of cattle (36.0%) and sheep / goats (36.6%) as well as pigs (21.4%) dominated in the



Graph 6. Klaipėda castle animal bone by species through time.

Selpils outwork. Single bones of horse, dog, elk, and hare were identified in this site (Šnore, Zariņa, 1980).

The preliminary analysis of the Vilnius lower castle's animal bones (871 animal bones dated to the 14th-15th centuries) showed that 672 or 77.1% belonged to domesticated animals and 188 or 21.6% belonged to wild animals. Of the 684 bones dated from the end of the 16th century – first half of the 17th century, 633 (92.5%) belonged to domestic animals and 26 (3.8%) – to wild animals. Cattle (*Bos bovis*) bones dominated in both groups – 42% and 66.3% (Daugnora, Piličiauskienė, 2005, p.207). Later analyses of the bone material from Vilnius's lower castle confirmed the proposition that domesticated animals dominated in this castle's territory. In the 14th-15th centuries, cattle constituted 52.9% of osteological material by number of bones and 28.5% by MNI; pigs – 16.2% / MNI 25.0%; sheep or goats – 8.8% / MNI 15.0%. Wild game, on the other hand, constituted 15.3% / MNI 46.23%. In the 16th – first half of the 17th century, the amount of domesticated animals comprised 67.63% by number of bones and 82.94% by MNI, while the wild animal count was 8.7% by number of bones and 17.06% by MNI. (Piličiauskienė 2008, p.31).

No significant differences were found between the zooarchaeological material of Klaipėda's castle and the settlement of Birutė's hill in Palanga dated to the 13th-14th centuries (Žulkus, 2007).

The "miserly" information mentioned in the inventories regarding animals' age and sex (young fillies, cattle, cows) prevent a broader interpretation of the source material, thus the few osteometric data can supplement the historical source information. The young age of the identified cattle (26-48 months) suggests that two age groups of cattle were held in that period's castles (1.5-2 years and 3-5 years). Similar groups of two different ages also were found in the sheep flocks / goat herds (10-17 months, 18-23 months). It is interesting that the Klaipėda castle's inventories mention young fillies. In 1377, there were 13 such fillies (1-3 years of age) in Klaipėda's castle. Compared to three horses, that is a large number. We do not know if the fillies were stolen or reared locally. We believe that the horses mentioned in the 1379-1404 inventories could have been stallions and horses intended for use in battle. Such a ratio of riding horses to mares also was characteristic of other castles in the Order. For example, in 1419 the stables of Marienburg castle held 77 mares and 1-3 year old fillies (5, 12, and 19 in different stables); 1-2 year old war horses also were reared (17 and 14, respectively 17 one year olds and 14 two year olds) (Jähnig 1989, p.126). That the rearing of horses was an important branch part of the castle's economy is shown by how many were kept in Klaipėda castle's stables in the first quarter of the 16th century (60 horses and 13 fillies) (Willoweit 1996, pp.118-119).

The metacarpus measurements of various cattle excavated from separate archaeological sites dated to the

Grand Duchy of Lithuania in the 13th-17th centuries enabled the identification of their sex. Of 95 measured metacarpi, 55 (57.89%) belonged to cows, 18 (29.47%) – to oxen, and 12 (12.63%) – to bulls (Daugnora 2002, pp. 25-26). From this, the ratio of cows to oxen would be 3.05:1. However, the analysis of the available data by separate periods and archaeological sites also showed certain differences. For example, only cow and oxen bones were identified at Kernavė (in the Pajauta valley, dated from the end of the 13th-beginning of the 14th century), with a ratio of 3.6:1, but in Rotušės Square Nr. 14 in Kaunas, dated to the 15th century, 54.54% of the analysed metacarpi belonged to bulls. The measurements of the right legs' metacarpi of cattle bones excavated from the Kaunas castle showed that of 28 metacarpi, 16 belonged to cows, four – to bulls, and eight – to oxen. Cows' metacarpus bones dominated in other sites (Vilnius's presidential mansion in the 17th century and Vilnius's lower castle in the 17th century) (Daugnora 2002, pp. 25-26).

We divided the pig bones excavated from the Klaipėda castle into three groups: Group I – up to 12 months old (8-12 months), Group II – 17-24 months old, and Group III – 2-3.5 year old pigs. After completing the analysis of bones of slaughtered pigs in the Ostrow Lednicki castle dated to the 10th-15th centuries, D. Makowiecki distinguished four groups (Group I – 6-10 months, Group II – 12-16 months, Group III – 16-24 months, and an adult pig group comprised of 2-3.5 year old pigs (Makowiecki 2001).

Compared to the Lithuanian Grand Duchy and the zooarchaeological material excavated from her towns, comparatively few bones of wild animals were found in the Klaipėda castle. We can explain this fact with the fact that the Order's brothers, monks, and warriors who lived in the castle were forbidden to hunt (Mugurēvičs 2002).

Conclusions

The analysis of the historical data and zooarchaeological material showed that in the 14th-17th centuries, the inhabitants of the Klaipėda castle (the Order's brothers, their servants, the outwork's artisans, and the townspeople who hid in the outwork) reared and slaughtered domesticated animals, hunted large game and consumed its meat, processed cheese, ground grain, drank mead and ale. The bulk of the meat consisted of beef, mutton, and pork, as well as goats' meat starting 1434. When comparing the domestic animal bones excavated from Klaipėda's castle, it is noticeable that the bones of ruminants (cattle, sheep, goats) dominated during all of the Klaipėda castle's periods, while pigs constituted the second most abundant group. The increasing quantity of small ruminants (sheep and goats) starting 1434 is reflected in the zooarchaeological material; by the 16th century – beginning of the 17th century, the amount of these animals' bones doubles.

The amount of horses significantly increases in the inventory books starting from the middle of the 15th century, something confirmed by the zooarchaeological material. The research results of the zooarchaeological material are compared with the known inventories of Klaipėda castle in the 14th-16th centuries, which contain data about the domestic animals reared for the castle's needs and the food consumed by the castle's inhabitants. In the zooarchaeological material dated to the "after 1521" period, changes in faunal species and amounts are noted. According to this material, pigs (*Sus suis*) comprise 31.25% of the bones, while the number of species and bones of large wild game (aurochs / bison, elk, red deer) and fur-bearing animals (beaver, bear) significantly increases (from 5.5 to 22.92%). Various kinds of fish caught in the sea near Klaipėda and in the Curonian Lagoon held an important place in the diet of the castle's garrison. Fowl constituted an insignificant part of the food.

Bearing in mind that in the 13th-15th centuries, Klaipėda was only a small town, continuously destroyed and burnt, while its small number of inhabitants would seek refuge in the castle rather often, the zooarchaeological material collected in the Klaipėda castle also reflects the dietary habits of Klaipėda's townspeople at that time.

Translated by Indrė Antanaitis-Jacobs

Written sources

Abbreviations

Acten – Acten der Ständetage Preussens unter Herrschaft des Deutschen Ordens. Hrsg. M. Toeppen. Ed. I – III, Leipzig. 1878 – 1882

Acten Königl. – Acten der Ständetage Preussens, Königlichen Anteils. Hrsg. F. Thunert. Bd I. Aalen (Neudruck). 1979

Annal. Thorun. – Scriptores rerum Prussicarum. Bd. III. Leipzig, 1866

Das Große Zinsbuch – Das Große Zinsbuch des Deutschen Ritterordens (1414 – 1438). Hrsg. von P. G. Thielen. Marburg, 1958

LEK – Liv-, Est-und Kurländisches Urkundenbuch, Bd. 1. Aalen (Nachdruck). 1967. Lietuvos istorijos šaltiniai. T. 1. Vilnius, 1958

MT – Das Marienburger Tresslerbuch der Jahre 1399 – 1409. Königsberg, 1896 (Bremerhaven, 1973)

PD – Dusburgietis P. *Prūsijos žemės kronika*. Vilnius, 1985

Posilge – *Johann von Posilge Chronik*. SRP. Bd. III. Leipzig, 1864

Quellenbeitrag – Kaspars von Nostitz Haushaltungsbuch des Fürstentums Preussen. 1587. Ein Quellenbeitrag zur politischen und Wirtschaftsgeschichte Altpreussens. In: *Aufträge des Vereins für die Geschichte von Ost und Westpreussen*. Herg. Karl Lohmeyer. Leipzig, 1893

Regesta historico-diplomatica – Regesta historico-diplomatica Ordinis S. Mariae Theutonicorum (Hrg. E. Joachim, W. Hubatsch) Pars I: Regesten zum Ordensbriefarchiv. Göttingen. 1973

SRP – *Scriptores rerum Prussicarum*. Bd. I, 1861; Bd. II, 1863; Bd. III. Leipzig, 1866

Manuscripts

BRAZAUSKAS, M., 2000. Klaipėdos piliavietės archeologinės medienos datavimas. *In:* Žulkus, V. 2000. Klaipėdos piliavietė. 1999 m. archeologijos kasinėjimų ataskaita. In: *Archive of Lithuanian Institute of History*. Fund 1, file 3496, 38-43.

ŽULKUS, V., 1998. Klaipėdos piliavietė. 1997 m. ataskaita. *In: Archive of Lithuanian Institute of History.* Fund F. 1. file 2963.

ŽULKUS, V., 1999. Klaipėdos piliavietė. 1998 m. ataskaita. *In: Archive of Lithuanian Institute of History*. Fund F. 1, file 3212.

ŽULKUS, V., 2000. Klaipėdos piliavietė. 1999 m. archeologijos kasinėjimų ataskaita. *In: Archive of Lithuanian Institute of History*. Fund 1, file 3496.

Literature

BACZKO, L., 1793. *Geschichte Preussens.* II/7. Königsberg.

BILSKIENĖ, R., DAUGNORA, L., 2001. Paukščiai Lietuvos pilyse. Lietuvos pilių archeologija. Sudarytojai J. Genys, Vl. Žulkus, Klaipėda, 251 – 260.

BOOCKMANN, H., *Vokiečių ordinas. Dvylika jo istorijos skyrių*. Vilnius: Aidai.

DAUGNORA, L. 2002. Galvijų plaštakos kaulų, datuojamų XIII – XVII a. analizė. Veterinarija ir Zootechnika. T. 18(40) p. 22 – 28.

DAUGNORA, L., PILIČIAUSKIENĖ G. 2005. XIV – XVII a. Osteologinės medžiagos, 1988-1990 m. Iškastos Vilniaus Žemutinės pilies teritorijoje, analizė. Lietuvos archeologija. T. 28, p. 207-216.

DOVYDENKO, L. V., 2004. *Tajny Pillau*. Kaliningrad.

ESCHMENT, D., HEYDEN, D., SCHULZE, D., 1994. *Wald und Forstwirtschaft in Ostpreußen - von der Frühzeit bis zum Jahr 1939 - eine Dokumentation.*I, *Aus dem Walde,* Langenhagen, 47.

FABIŠ, M., 2005. Pathological alteration of cattle skeletons – evidence for the draught exploitation of animals? Diet and health in past animal population (eds. J. Davies, M. Fabiš et al) 9th ICAZ conference, Durham 2002. 2005. 58-62.

GROOT M., 2005. Palaeopathological evidence for draught cattle on Roman site in the Netherlands. Diet and health in past animal population (eds. J. Davies, M. Fabiš et al) 9th ICAZ conference, Durham 2002, 52-57.

GROTH, A., 1996. *Źegluga i handel morski Klajpedy w latach 1664-1722.* Gdańsk: Vyd. UG.

GROTH, A., 2009. Klaipėdos jūrų prekybos mastai ir struktūra 1664-1722 metais. In: Vėjas rėjose. Burlaivių epochos atspindžiai Lietuvoje. (Sudarė D. Elertas). Klaipėda: Lietuvos jūrų muziejus, 2009, 19-30.

JURGINIS, J. 1983. *Kraštas ir žmonės*. Vilnius: Mintis.

JÄHNIG, B., 1989. Zur Wirtschaftsführung des Deutschen Ordens in Preußen vornehmlich vom 13. bis zum 15. Jahrhundert. In: U. ARNOLD (ed.), *Zur Wirtschaftsentwicklung des Deutschen Ordens im Mittelalter. Quellen und Studien zur Geschichte des Deutschen Ordens* 38, 113-147.

KLIMAS, P., 1933. Ghillebert de Lanney. In: *Praeitis,* II, Kaunas.

MAGER, F., 1960. *Der Wald in Altpreussen als Wirtschaftsraum*. I, II, Köln-Graz: Böhlau Verlag.

MUGURĒVIČS, Ē., 2002. Forest animals and hunting in medieval Livonia. In: *Centre. Region. Periphery.* Medieval Europe Basel 2002: [3rd International Conference of Medieval and Later Archaeology, 10–15 September 2002, Basel (Switzerland): Preprinted Papers]. – Hertingen, 2002. – Vol. 1. – P. 177–181.

PILIČIAUSKIENĖ, G., 2008.Galvijų kaulų iš Vilniaus žemutinės pilies teritorijos osteologinė analizė ir amžiaus nustatymas pagal dantų struktūrą. Daktaro disertacijos santrauka, Kaunas, 2008.

ROERDANSZ, J., 1792. *Sammlung einiger Denkwürdigkeiten von der königlich Preussischen Immediat-Stadt Memel.* Königsberg.

SAMSONOWICZ, H., 1989. Der Deutsche Orden als Wirtschaftsmacht des Ostseeraumes. In: U. ARNOLD (ed.), *Zur Wirtschaftsentwicklung des Deutschen Ordens im Mittelalter. Quellen und Studien zur Geschichte des Deutschen Ordens.* 38, Marburg, 101- 112.

SCHMIDT, B., 1938. *Die Burgen des Deutschen Ritterordens in Preussen.* Marienburg.

SEMBRITZKI, J., 1926. *Geschichte der königlich preussischen See- und Handelsstadt Memel.* Memel: Druck und Verlag von F. W. Siebert.

SEMRAU, A., 1929. Beiträge zur Topographie der Burg und der Stadt Memel im Mittelalter. In: *Mitteilungen der Copernicus Vereins fur Wissenschaft und Kunst zu Thorn.* 37, Thorn, 89-116.

STARK, W., 1973. *Lübeck und Danzig in der zweiten Hälfte des 15. Jahrhunderts. Abhandlungen zur Handels- und Sozialgeschichte*, XI, Weimar.

ŠNORE, E., ZARINA A. 1980. Senā Sēlpils. – Rīga, p.168-170, tab.9, 10.Castle Sēlpils

TELLDAHL ,Y., 2005. Can palaeopathology be used as evidence for draught animals? Diet and health in past animal population (eds. J. Davies, M. Fabiš et al) 9th ICAZ conference, Durham 2002, 63-67.

TRANSPRESS. 1988. *Transpress Lexikon. Schiffahrt.* Berlin.
WILLOWEIT, G., 1969. *Die Wirtschaftsgeschichte des Memellandes.* I. Wissenschaftliche Beiträge zur Geschichte und Landeskunde Ost-Mitteleuropas. Im Auftrage des Johann Gottfried Herder-Instituts (Hrg. E. Bahr). Nr. 85/I. Marburg/Lahn.
WHITE, T.E., 1953. A method of calculating the dietary percentage of various food animals utilized by aboriginal people. American Antiquity. Vol. 18(4) 396-398.
ZEMZARIS, J., 1981. *Mers un svars Latvija 13.-19. gs.* Riga.
ZURKALOWSKI, E., 1909. Neue Beiträge zur Geschichte der Stadt Memel. In: *Altpreussische Monatsschrift.* 46/1.
ŽULKUS, V., 2002. *Viduramžių Klaipėda. Miestas ir pilis, archeologija ir istorija.* Vilnius: Žara.
ŽULKUS, V., 2004. *Kuršiai Baltijos jūros erdvėje.* Vilnius:Versus aureus.
ŽULKUS, V., 2007. *Palanga in the Middle Ages. Ancient settlements*. Vilnius: Versus aureus.

Received: 15 May 2009; Revised: 10 September 2009; Accepted: 15 February 2009

Vladas Žulkus
Institute of Baltic Sea Region History and Archaeology
Klaipėda University Herkaus Manto g. 84
LT-92291 Klaipėda
LITHUANIA
E-mail: vladas.zulkus@ku.lt

Linas Daugnora
Institute of Baltic Sea Region History and Archaeology
Klaipėda University Herkaus Manto g. 84
LT-92291 Klaipėda
LITHUANIA
E-mail: daugnora@lva.lt

KLAIPĖDOS PILIES GYVENTOJŲ MAISTAS XIV–XVII AMŽIAIS ISTORIJOS IR ZOOARCHEOLOGIJOS DUOMENIMIS

Vladas Žulkus, Linas Daugnora

Santrauka

Straipsnyje analizuojama zooarcheologinė medžiaga, kuri buvo rasta 1997–1999 m. kasinėjimų piliavietėje metu. Didesnė dalis tyrimų vyko buvusiame XIV–XV a. priešpilyje. XIV a. paskutiniu ketvirčiu – XVII a. pradžia datuojamos archeozoologinės medžiagos tyrimo duomenys padės geriau suprasti Ordino pilies Klaipėdoje ekonomikos ir jos gyventojų mitybos ypatumus bei įvertinti medžioklės ir žvejybos reikšmę.

Istorinių duomenų ir zooarcheologinės medžiagos analizė parodė, kad Klaipėdos pilies gyventojai (Ordino broliai, jų tarnai, priešpilio amatininkai ir miestiečiai, kurie slėpėsi priešpilyje), XIV–XVII a. pr. augino ir skerdė naminius gyvulius, medžiojo stambius laukinius gyvūnus ir vartojo jų mėsą, gamino sūrį, malė grūdus, gėrė midų ir alų. Mėsos pagrindą sudarė jautiena, aviena ir kiauliena, nuo 1434 m. pradėta vartoti ožkiena. Lyginant Klaipėdos pilyje iškastų naminių gyvulių kaulus pastebėta, kad visais Klaipėdos pilies laikotarpiais dominavo atrajotojų kaulai (galvijai / avys / ožkos), antrą pagal gausumą gyvulių grupę sudarė kiaulės. Smulkių atrajotojų (avių / ožkų) skaičiaus didėjimas nuo 1434 m. atsispindi ir zooarcheologinėje medžiagoje – nuo XVI–XVII a. pr. dvigubai padidėja šių gyvūnų kaulų kiekis. Žirgų kiekis inventorinėse knygose ženkliai kinta nuo XV a. vidurio, tą patvirtina ir zooarcheologinė medžiaga. Atlikus atskirais laikotarpiais suskirstytos kaulinės medžiagos analizę, ypač išsiskyrė zooarcheologinė medžiaga, datuota po 1521 m., kai 31,25 proc. sudarė kiaulių (*Sus suis*) kaulai, o stambių laukinių gyvūnų (tauras / stumbras, briedis, taurusis elnias) ir kailinių žvėrių (bebras, lokys) rūšių kiekis ir kaulų skaičius ženkliai didėjo (nuo 5,5 iki 22,92 proc.). Svarbią vietą pilies įgulos mityboje užėmė įvairios žuvų rūšys, gaudomos jūroje prie Klaipėdos ir Kuršių mariose. Nedidelę maisto dalį sudarė paukštiena.

Turint omenyje, jog XIII–XV a. Klaipėda buvo tik nedidelis miestelis, tolydžio griaunamas ir deginamas, o jo negausūs gyventojai gana dažnai ieškodavo prieglobsčio pilyje, Klaipėdos pilyje surinkta zooarcheologinė medžiaga atspindi ir to meto Klaipėdos miestiečių mitybos įpročius.

DENTAL WEAR PATTERNS IN LITHUANIAN AND LATVIAN PALEOANTHROPOLOGICAL SAMPLES

ŽYDRŪNĖ MILIAUSKIENĖ, RIMANTAS JANKAUSKAS

Abstract

Numerous researchers have stressed significance of tooth wear scoring for evaluation of earlier nutrition patterns and cultural practices. The aim of this study was to evaluate dental occlusal wear in several representative samples. The hypothesis tested was if transition from foraging subsistence to agriculture and later social stratification indeed was reflected by dental wear changes. According to results, the remarkable changes in nutrition patterns in the Baltic region occurred only in the Iron Age, which does not correspond with "classical" Neolithization model. The next substantial change in dental wear patterns is connected with increased social stratification in Late Medieval period.

Key words: dental wear, nutrition, hunter-gatherers, agriculture, social stratification.

Introduction

Tooth enamel that covers tooth crown consists of acellular inorganic substances that are being formed before tooth erupts, and is not remodeled during subsequent life. The use of teeth during eating results in the wearing of occlusal surfaces: loss of enamel covering these surfaces that is followed by secondary dentin deposition, when upper and lower teeth come into contact with each other during food mastication. This process, caused by dental abrasion (result of contact between the tooth crown and the food) and dental attrition (caused by direct tooth-to tooth contact) is age-dependent and varies widely between populations (Larsen 1997). Numerous researchers have stressed significance of tooth wear scoring for evaluation of earlier nutrition patterns and cultural practices. Wear severity is related to the characteristics of food and the ways of its preparation. Temporal shifts in teeth wear often indicate dietary changes. The decrease in dental wear was noted among numerous North American Indian populations experiencing transition from foraging to farming subsistence (Walker 1978). The same trends were detected during the Neolithic transition in Portugal (Lubell et al. 1994). Similar tendencies were noted for later periods: there was a marked reduction in the coarseness of foods resulting in dental wear decrease in Britain from about the 17th century (Mays 1998). This phenomenon, explained by general decrease of masticatory load, however, is not universal: extensive use of grinding stones for grain preparation can add small stone or sand particles into consumed foods serving as abrasives. It means that detailed analysis of dental wear patterns could supplement our knowledge about dietary habits in the past, and possible diachronic and social differences could suggest in differences in the mode of life.

As no systematic studies in the Baltics on dental wear patterns were performed, the aim of this study was to evaluate dental occlusal wear in several representative samples. The hypothesis tested was if transition from foraging subsistence to agriculture and later social stratification indeed was reflected by dental wear changes.

Materials and methods

Analysis was performed on selected archaeological populations, 459 adult individuals in total. All material was organized in four samples, based on different chronology and subsistence: Stone Age, Iron Age, Medieval rural and Medieval nobility. Dates, age structure and quantity of the samples are given in Table 1.

The Stone Age sample is represented by Zvejnieki site. The site is situated in northern Latvia and constitutes one of the largest Stone Age cemeteries in Northern Europe. Excavated by F. Zagorskis in 1964-1978, Zvejnieki includes burials from middle Mesolithic to late Neolithic and Bronze/Iron Age. Only individuals dated middle Mesolithic – late Neolithic and undated individuals, referred as Stone Age were included in the study. As our earlier study (Palubeckaitė and Jankauskas 2006) revealed no statistical differences in dental attrition among different chronological periods of Zvejnieki, all individuals were pooled.

Other samples are composed of Lithuanian archeological material. The Iron Age sample is represented by Obeliai (excavated by V. Urbanavičius in 1979-1982) and Plinkaigalis (excavated by V. Kazakevičius in 1978-1984). Both populations belong to the same Middle Iron Age period in Lithuanian archeological chronology. Absence of the differences in dental wear allowed us to pool all individuals into one sample.

Table 1. Number of individuals and teeth included in the study

Age at death \ Sample	Stone Age (7500-2600 BC)	Iron Age (5-6th c.c.)	Medieval rural (15-17th c.c.)	Medieval nobility (16-18th c.c.)	Total
<25 years					
No. of indiv.	18	49	31	2	100
No. of teeth	414	1325	859	47	2645
25-35 years					
No. of indiv.	46	52	41	4	143
No. of teeth	1103	1410	1065	100	3678
35-45 years					
No. of indiv.	21	45	34	6	106
No. of teeth	464	1061	770	153	2448
>45 years					
No. of indiv.	26	52	28	4	110
No. of teeth	456	1079	579	81	2195
Total					
No. of indiv.	111	198	134	16	459
No. of teeth	2473	4875	3273	381	10966

The Medieval rural sample consists of Bazorai, Leipalingis and Vink niniai (excavated by E. Svetikas in 1981-1987) and Rukliai (excavated by D. Ribokas in 1989-1998). These burials from eastern and southern Lithuania include medieval rural parish cemeteries. No differences in tooth wear among the four populations were found. The Medieval nobility sample includes inhumations from the Cathedral of Vilnius (excavated by A. Lisanka in 1986-1988). These individuals represent the elite of medieval society.

Dental attrition was recorded on all teeth according to Smith (1984). Results are given in average degree for each tooth category. Because there is generally little left-right discrepancy in dental attrition (Hillson 1996), the two sides were averaged. Taking into account that tooth wear is an age-related phenomenon, all comparisons between the samples were made according to age at death group. Statistical analysis was performed using the SPSS statistical package (ANOVA, Student's T-test procedures).

Results

Comparison of all samples revealed differences with peculiarities according to tooth category and age at death (Fig. 1-4). The highest average wear of anterior teeth was found in the Stone Age sample, while the lowest anterior teeth wear was characteristic for the Medieval nobility. Individuals of the Iron Age and the Medieval rural samples had similar rates of anterior tooth wear, which was in between and statistically differ both from the Stone Age and the Medieval nobility samples (statistical differences are presented in Table 2). The greatest differences in anterior teeth wear were found among the youngest individuals, however, the same trend persists through all age groups.

Wear of premolars of individuals under 35 years was almost equal in all samples. Among older individuals, the lowest wear of premolars was characteristic for the Medieval nobility. The difference between the latter and the other samples was statistically significant only in 35-45 year age group, yet the same tendency persists in the oldest age group. The greatest difference in molar wear was found in attrition of the first molar. Among the youngest individuals (under 25 years) the lowest degree of molar wear was characteristic for the Stone Age sample. The 35-45 year old individuals of the Stone Age and the Medieval nobility had equal attrition of the first molar, which was statistically lower than the Iron Age or the Medieval rural molar wear. Among older individuals, statistically lower wear of molars was characteristic for the Medieval nobility.

Analysis of age influence on dental wear rates revealed a clear trend of increasing attrition with advancing age at death in the Stone Age, the Iron Age and the Medieval rural samples (Fig. 5-7; Table 3). However, differences were found in anterior versus posterior teeth wear. In the Stone Age sample attrition of anterior teeth was more pronounced compared to molars. This unequal wear was most prominent among individuals under 25 years and persists until 35 years; after 35 years anterior and posterior teeth wear became almost equal. In the Iron Age and the Medieval rural sample the youngest individuals expressed almost equal attrition of anterior and posterior teeth, while after 25 years molar wear became more prominent compared to anterior

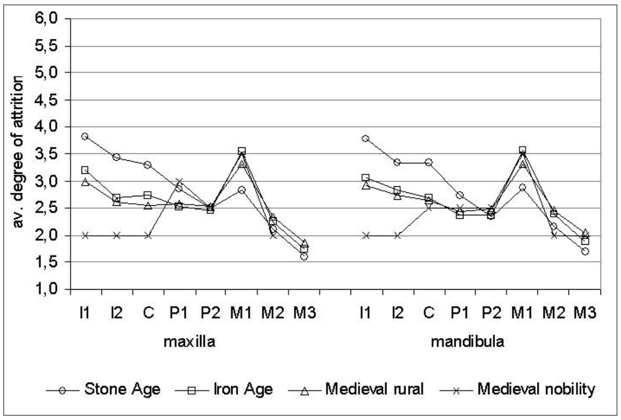


Fig. 1. Dental attrition in the <25 year at death age group.

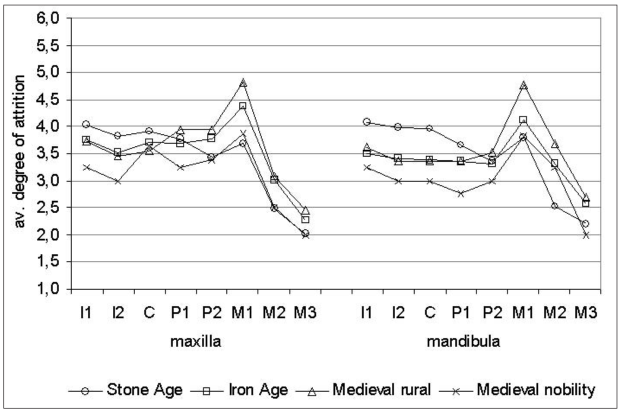


Fig. 2. Dental attrition in the 25-35 year at death age group.

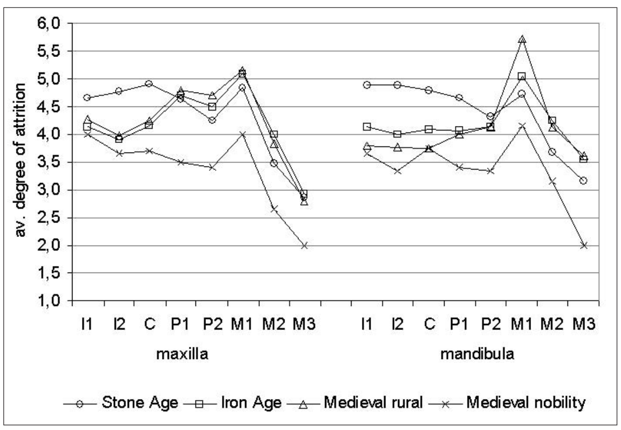


Fig. 3. Dental attrition in the 35-45 year at death age group.

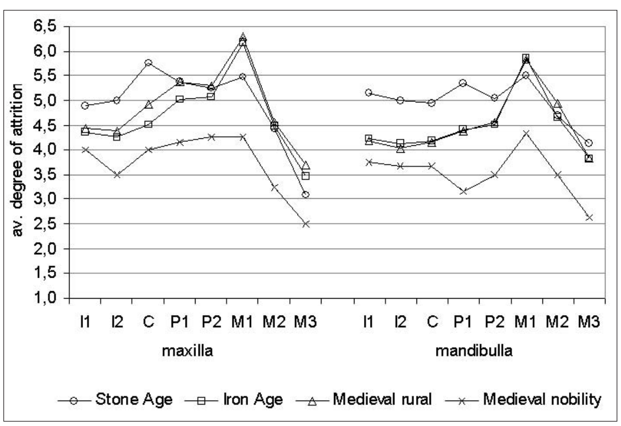


Fig. 4. Dental attrition in the >45 year at death age group.

Table 2. Statistical differences in the average degree of dental attrition among the samples according to age at death group (p – probability of ANOVA test; difference is significant when $p<0.05$)

p / Tooth	<25 years	25-35 years	35-45 years	>45 years
Maxilla				
I1	0.00	0.01	0.24	0.66
I2	0.00	0.04	0.02	0.41
C	0.00	0.14	0.01	0.04
P1	0.31	0.31	0.04	0.45
P2	0.94	0.09	0.04	0.27
M1	0.00	0.00	0.04	0.00
M2	0.27	0.00	0.03	0.09
M3	0.25	0.30	0.42	0.49
Mandibula				
I1	0.00	0.00	0.00	0.01
I2	0.00	0.00	0.00	0.00
C	0.00	0.00	0.00	0.00
P1	0.27	0.03	0.00	0.00
P2	0.82	0.57	0.04	0.14
M1	0.01	0.00	0.02	0.05
M2	0.23	0.00	0.02	0.05
M3	0.19	0.05	0.04	0.04

teeth. Individuals of the Medieval nobility sample had similar attrition of anterior and posterior teeth (Fig. 8). Although there was a trend that degree of attrition in nobility slightly increased with age, statistical differences were found only among the youngest versus the oldest individuals.

Discussion

Our analysis revealed differences in dental wear rates and patterns. Tooth wear was pronounced through all periods, from the Stone Age to the Medieval. However, the Stone Age sample was characterized by prominent attrition of anterior teeth, while the Iron Age sample and the Medieval rural sample revealed pronounced molar wear. The Medieval nobility sample revealed a low average degree of attrition and equal anterior-posterior teeth wear.

Dental wear rates are highly influenced by the consistency and texture of food and by the manner of its preparation (Littleton and Frohlich 1993; Larsen 1997; Mays 1998). Populations, which subsistence is based on hunting and gathering usually expressed heavy dental attrition (Bennike 1985; Larsen 1995; Alexandersen 2003; Eshed et al. 2006; Lieverse et

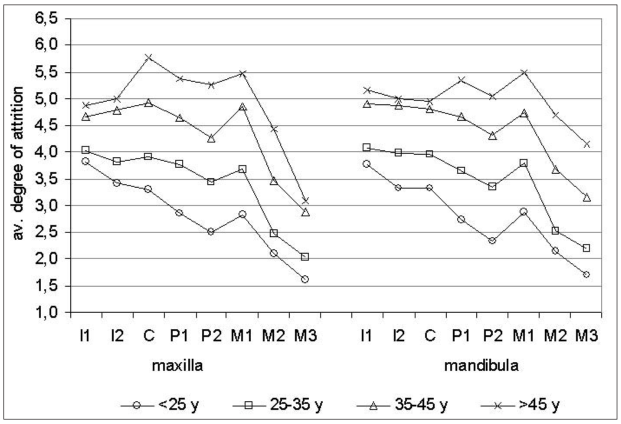


Fig. 5. Age influence on dental attrition in the Stone Age sample.

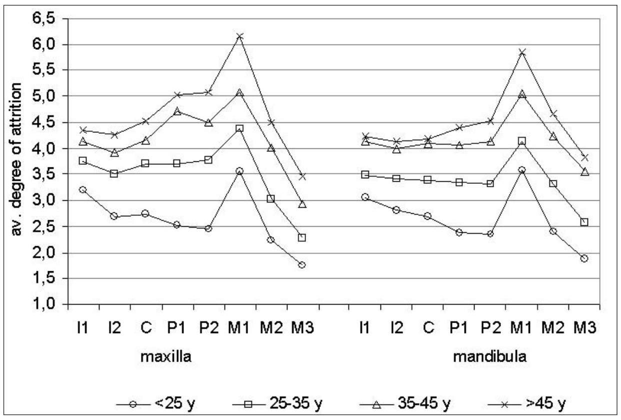


Fig. 6. Age influence on dental attrition in the Iron Age sample.

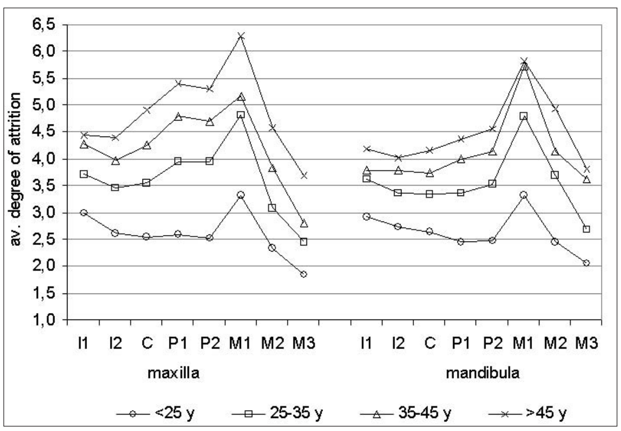


Fig. 7. Age influence on dental attrition in the Medieval rural sample.

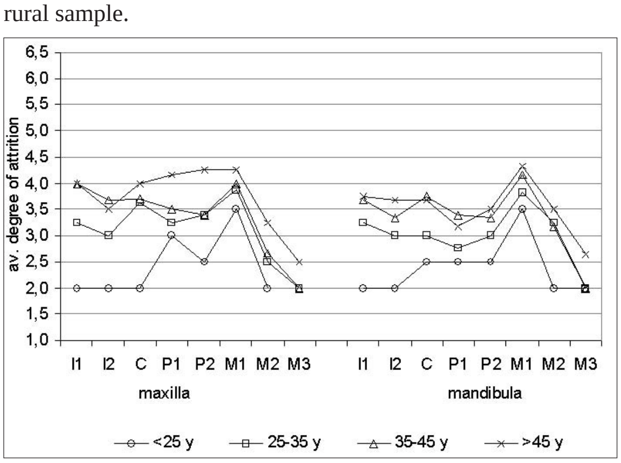


Fig. 8. Age influence on dental attrition in the Medieval nobility sample.

Table 3. Influence of the age at death on the average degree of dental attrition (p – probability of ANOVA test; difference is significant when p<0.05)

p / Tooth	Stone Age	Iron Age	Medieval rural	Medieval nobility
Maxilla				
I1	0.00	0.00	0.00	0.07
I2	0.00	0.00	0.00	0.06
C	0.00	0.00	0.00	0.03
P1	0.00	0.00	0.00	0.43
P2	0.00	0.00	0.00	0.12
M1	0.00	0.00	0.00	0.17
M2	0.00	0.00	0.00	0.46
M3	0.00	0.00	0.00	0.13
Mandibula				
I1	0.00	0.00	0.00	0.06
I2	0.00	0.00	0.00	0.06
C	0.00	0.00	0.00	0.08
P1	0.00	0.00	0.00	0.37
P2	0.00	0.00	0.00	0.52
M1	0.00	0.00	0.00	0.24
M2	0.00	0.00	0.00	0.06
M3	0.00	0.00	0.00	0.05

al. 2007). The diet of those people generally consisted of hard textured, fibrous food products that require heavy mastication, e.g. not-well roasted and dried meat and fish, shellfish, nuts, various roots and tuber-crops. In addition, the presence of soil and sand in incompletely clean products also caused severe tooth wear (Bennike 1985; Littleton and Frohlich 1993; Eshed et al. 2006). Such abrasive diet could be a reason of a high dental wear in the Stone Age sample. Stable isotope analysis and zooarhaeological research confirmed that fishing, hunting and gathering were the main subsistence strategies for people from Zvejnieki (Eriksson 2006; Lõugas 2006). Our earlier study of dental status of the Zvejnieki (Palubeckaitė and Jankauskas 2006) revealed no significant differences in dental attrition according to chronological period, suggesting that no dramatical changes in food composition and preparation have occurred during the Stone Age in this region. This corresponds with recent palynological and macrobotanical evidence, which indicates that a shift to agricultural products in the East Baltic region appeared only in the late Neolithic/early Bronze Age (Antanaitis 2001).

The most conspicuous feature of the Stone Age dental wear was a pronounced attrition of anterior teeth. Such an unequal tooth wear was noticed in some other hunter-gatherer's populations (Alexandersen 1988; Littleton and Frohlich 1993; Bonfiglioli et al. 2004; Molleson 2005; Lieverse et al. 2007). Hard texture of food alone cannot explain asymmetry in dental wear. According to authors, it is probably due to implements in activities other than eating. Ethnographical studies of Inuit populations have revealed a similar attrition pattern, which was due to intensive use of teeth as tools, e.g. in softening the skin, holding skin while sewing, making baskets or tightening lines (Merbs 1983). Intensive use of teeth as tools also result in damaged teeth and cause unusual wear facets (Larsen et al. 1998). Such cases of antemortally broken and fractured teeth and specific grooves on occlusal and interproximal dental surfaces were found in Zvejnieki (Palubeckaitė and Jankauskas 2006). Thus, it is reasonable to suggest that extramasticatory activities mentioned above was most responsible for severe anterior dental attrition in the Stone Age sample.

Daily subsistence of people of the Iron Age sample was based on agriculture products (mostly barley, wheat, peas and beans) and husbandry (beef, pork, sheep and goat) (Tautavičius 1996). Comparisons between hunter-gatherers and agriculturalists or populations undergoing agricultural intensification usually revealed a decrease in severity of tooth wear (Littleton and Frohlich, 1993; Larsen 1995, 1997; Eshed et al. 2006; Keenleyside 2008). According to authors, this trend reflects the reduction in consistency, hardness or abrasiveness of food consumed by farmers. Our results did reveal a significant decrease in anterior teeth wear in the Iron Age sample compared to the Stone Age. However, attrition of posterior teeth remained the same or even increased. The similar increase in molar wear was noticed in Danish Iron Age populations (Bennike 1985) and in agriculturalists of Northwest Mexico (Watson 2008). Changes in food processing practices that occurred during intensification of agriculture involved an increase in the use of grinding stones for making flour from cereal grains. It is likely, that increased reliance on the stone-ground flour, which contained a substantial amount of grit (Watson 2008), resulted in fast posterior dental wear in the Iron Age sample. The decreased in attrition of anterior teeth is probably a result of a simultaneous effect of changes in tool making technologies and increased mechanical processing (softening) of dietary products. These changes highly reduced the use of teeth as tools and decreased a role of anterior teeth in the initial preparation of food.

The Medieval rural sample was also characterized by severe molar wear and moderate attrition of anterior teeth. High dental attrition was not an unusual feature in medieval populations (Bennike 1985; Varrela 1991; Alexandersen 2003). The diet of ordinary villagers consisted of agricultural products, mainly dark rye and bran bread, porridges and gruels, which still contained a substantial amount of coarse residues from milling (Moore and Corbet 1973). A high consumption of dried and salted fish and meat during winter seasons and famines and increased reliance on turnips could also promote tooth wear (Česnys and Balčiūnienė 1988; Varrela 1991). Our analysis revealed no differences in tooth wear rates and pattern between the Medieval rural and the Iron Age samples. Thus, it could be supposed that a daily subsistence of medieval peasants did not differ substantially from the people of the Middle Iron Age. The diet still consisted of rough, not refined, coarse products. If there was an improvement in food processing technologies, it did not substantially lowered abrasiveness of the diet.

However, a different situation was found in the Medieval nobility sample. The significantly lower dental wear and only a slight increase in degree of attrition with age indicate a consumption of soft, refined food products. Dental wear differences by social group and rank have been noticed in other past societies (Larsen 1997). Members of the elite had an access to better quality food products, such as fresh meat and fish and white bread from fine wheat flour (Moore and Corbet 1973). This less mechanically demanding and less abrasive diet resulted in a low severity of tooth wear in the upper class individuals.

Conclusions

Differences found in the degree and pattern of teeth wear reflects differences in the composition and preparation of food among the samples. Heavy tooth wear with pronounced attrition of anterior teeth of the Stone Age sample indicates a consumption of rough, fibrous, hard-textured food products and intensive use of teeth in extramasticatory activities (e.g. softening the skin, making baskets etc.).

Decreased anterior tooth wear in the Iron Age sample indicates a consumption of more processed, softer food items and decrease in the usage of teeth as tools. However, heavy posterior teeth wear indicates an abrasiveness of the diet, which could be a result of changes in food processing practices, e.g. increase in the use of stone grinds. Similar dental wear rates and patterns in the Medieval rural sample indicate a succession of main dietary traits in the subsistence of peasants.

Low dental attrition in the Medieval nobility sample indicates a greater access of upper class individuals to highly processed refined food of better quality.

Acknowledgement

Authors wish to express their gratitude to dr. Guntis Gerhards, Institute of History of Latvia, for possibility to study Zvejnieki sample.

References

ALEXANDERSEN, V., 1988. Description of the human dentitions from the Late Mesolithic grave fields at Skateholm, southern Sweden. In: Larsson L., ed. *The Skateholm Project I. Man and Environment.* Stockholm: Almqvist and Wiksell, 106-163.

ALEXANDERSEN, V., 2003. Dental variation and change through time in Nordic populations. In: Iregren, E. and Larsson, L., eds. *A tooth for a tooth. Seminar for odontologists, osteologists and archaeologists, May 28th 1998.* University of Lund, Institute of Archaeology, Report Series No. 87, 9-36.

ANTANAITIS, I., 2001. *Rytų Baltijos regiono gyventojų ekonominė ir socialinė organizacija vėlyvajame akmens ir ankstyvajame bronzos amžiuje*. Daktaro disertacija. Vilniaus universitetas.

BENNIKE, P., 1985. *Palaeopathology of Danish Skeletons: A Comparative Study of Demography, Disease and Injury.* Copenhagen: Akademisk Forlag.

BONFIGLIOLI, B., MARIOTTI, V., FACCHINI, F., BELCASTRO, M.G. AND CONDEMI, S., 2004. Masticatory and non-masticatory dental modifications in the Epipalaeolithic Necropolis of Taforalt (Morocco). *International Journal of Osteoarchaeology*, 14 (6), 448-456.

ČESNYS, G. AND BALČIŪNIENĖ, I., 1988. *Senųjų Lietuvos gyventojų antropologija*. Vilnius: Mokslas.

ERIKSSON, G., 2006. Stable isotope analysis of human and faunal remains from Zvejnieki. In: LARSSON, L. AND ZAGORSKA, I., eds. *Back to the Origin: new research in the Mesolithic-Neolithic Zvejnieki cemetery and environment, northern Latvia*. Stockholm: Almqvist & Wiksell International, 183-215.

ESHED, V., GOPHER, A. AND HERSHKOVITZ I., 2006. Tooth wear and dental pathology at the advent of agriculture: new evidence from the Levant. *American Journal of Physical Anthropology,* 130 (2), 145-159.

HILLSON, S.W., 1996. *Dental anthropology.* Cambridge University Press.

KEENLEYSIDE, A., 2008. Dental pathology and diet at Apollonia, a Greek colony on the Black Sea. *International Journal of Osteoarchaeology*, 18 (3), 262-279.

LARSEN, C.S., 1995. Biological changes in human populations with agriculture. *Annual Review of Anthropology*, 24, 185-213.

LARSEN, C.S., 1997. *Bioarchaeology: interpreting behavior from the human skeleton.* Cambridge University Press.

LARSEN, C.S., TEAFORD, M.F. AND SANDFORD, M.K., 1998. Teeth as Tools at Tutu: Extramasticatory Behavior in Prehistoric St. Thomas, U.S. Virgin Islands. In: LUKACS, J.R., ed. *Human Dental Development, Morphology, and Pathology: A Tribute to Albert A. Dahlberg.* University of Oregon, Anthropological Papers, 54, 401-420.

LITTLETON, J. AND FROHLICH, B., 1993. Fish-Eaters and Farmers: Dental Pathology in the Arabian Gulf. *American Journal of Physical Anthropology,* 92 (4), 427-447.

LIEVERSE, A.R., LINK, D.W., BAZALIISKIY, V.I., GORIUNOVA, O.I. AND WEBER A.W., 2007. Dental health indicators of hunter-gatherer adaptation and cultural change in Siberia's Cis-Baikal. *American Journal of Physical Anthropology,* 134 (3), 323-339.

LÕUGAS, L., 2006. Animals as subsistence and bones as raw material for settlers of Prehistoric Zvejnieki. In: LARSSON, L. AND ZAGORSKA, I., eds. Back to the Origin: new research in the Mesolithic-Neolithic Zvejnieki cemetery and environment, northern Latvia. Stockholm: Almqvist & Wiksell International, 75-89.

LUBELL, D., JACKES, M., SCHWARCZ, H., KNYF, M. AND MEIKLEJOHN, C, 1994. The Mesolithic-Neolithic transition in Portugal: isotopic and dental evidence of diet. *Journal of Archaeological Science*, 21, 201-216.

MAYS, S., 1998. *The archaeology of human bones.* London: Routledge.

MERBS, C.F., 1983. *Patterns of activity-induced pathology in a Canadian Inuit population.* Archaeological Survey of Canada, Paper No. 119, Ottawa.

MOLLESON, T., 2005. The third hand: Neolithic basket makers of Abu Hureyra. In: Żądzińska, E., ed. *Current Trends in Dental Morphology Research. Refereed full papers from 13th International Symposium on Dental Morphology.* University of Łódź Press, 115-126.

MOORE, W.J. AND CORBETT, E., 1973. The distribution of dental caries in ancient British populations: II. Iron Age, Romano-British and Mediaeval periods. *Caries Research*, 7, 139-153.

PALUBECKAITĖ, Ž. AND JANKAUSKAS, R., 2006. Dental status of the Zvejnieki sample as a reflection of early ontogenesis and activities in adulthood. In: LARSSON, L. AND ZAGORSKA, I., eds. *Back to the Origin: new research in the Mesolithic-Neolithic Zvejnieki cemetery and environment, northern Latvia*. Stockholm: Almqvist & Wiksell International, 165-182.

SMITH, B.H., 1984. Patterns of molar wear in hunter-gatherers and agriculturalists. *American Journal of Physical Anthropology,* 63, 39-56.

TAUTAVIČIUS, A., 1996. *Vidurinis geležies amžius Lietuvoje (V-IX a.)*. Vilnius: Pilių tyrimo centras "Lietuvos pilys".

VARRELA, T.M., 1991. Prevalence and distribution of dental caries in late medieval population in Finland. Archives of Oral Biology, 8, 553-559.

WALKER, P.L., 1978. A quantitative analysis of dental attrition rates in the Santa Barbara Channel area. *American Journal of Physical Anthropology*, 48, 101-106.

WATSON, J.T., 2008. Changes in food processing and occlusal dental wear during the early agricultural period in Northwest Mexico. *American Journal of Physical* Anthropology, 135 (1), 92-99.

Received: 15 May 2008; Revised: 10 August 2008; Accepted: 10 September 2009

Žydrūnė Miliauskienė
Department of Anatomy, Histology and Anthropology
Faculty of Medicine, Vilnius University
Čiurlionio 21, 03101 Vilnius, Lithuania
e-mail: zydrune.miliauskiene@mf.vu.lt

Rimantas Jankauskas
Department of Anatomy, Histology and Anthropology
Faculty of Medicine, Vilnius University
Čiurlionio 21, Vilnius 03101, Lithuania
e-mail: rimantas.jankauskas@mf.vu.lt

LIETUVOS IR LATVIJOS SENŲJŲ GYVENTOJŲ DANTŲ NUSIDĖVĖJIMO YPATUMAI

Žydrūnė Miliauskienė, Rimantas Jankauskas

Santrauka

Dantų nusidėvėjimą sukelia nuolatinis dantų kramtomųjų paviršių trynimasis kramtant maistą. Nusidėvėjimo laipsnis priklauso nuo keleto veiksnių: individo amžiaus, vartojamo maisto sudėties ir konsistencijos. Pastebėta, kad dantų nusidėvėjimo stiprumo ir (arba) pobūdžio pasikeitimai atspindi žmonių mitybos pokyčius. Daugelis autorių nurodo sumažėjusį dantų nusidėvėjimo laipsnį bendruomenei pereinant nuo medžioklės ir rankiojimo prie žemdirbystės; manoma, kad žemdirbiai valgė minkštesnį, labiau mechaniškai ir termiškai apdorotą maistą. Taip pat pastebėta, kad skiriasi įvairių socialinių grupių dantų nusidėvėjimas. Visgi nusidėvėjimo kitimo tendencijos kiekvienoje populiacijoje savitos. Todėl detalus dantų nusidėvėjimo tyrimas gali padėti geriau suprasti senųjų gyventojų mitybos ypatumus.

Mūsų tikslas buvo ištirti kelių Baltijos regiono senųjų gyventojų grupių dantų kramtomuosius paviršius, siekiant išsiaiškinti, kaip žemdirbystės atsiradimas ir vėliau išryškėję socialiniai skirtumai susiję su dantų nusidėvėjimo ypatumais. Visa tyrimo medžiaga (459 suaugę individai) buvo suskirstyta į keturias grupes, atstovaujančias akmens amžiaus, geležies amžiaus, viduramžių valstiečių ir viduramžių elito bendruomenėms. Lyginant dantų nusidėvėjimą buvo atsižvelgiama į individų amžių mirties metu.

Gauti rezultatai parodė, kad visam akmens amžiaus laikotarpiui būdingas didelis dantų nusidėvėjimas. Tai reiškia, kad to meto gyventojai daugiausia maitinosi kietu, termiškai prastai apdorotu maistu. Ypač ryškus priekinių dantų nusidėvėjimas gali būti siejamas su intensyviu dantų naudojimu vietoj įrankių (išdirbant odas, pinant krepšius, gaminant lankus ir kt.). Žymesni dantų nusidėvėjimo pokyčiai atsiranda tik geležies amžiuje. Sumažėjęs priekinių dantų nusidėvėjimas gali reikšti, kad buvo vartojama daugiau minkštesnio, labiau mechaniškai ir termiškai apdoroto maisto; be to, sumažėjo dantų kaip įrankių reikšmė. Tačiau vis dar ryškus šoninių dantų nusidėvėjimas rodo, kad maiste netrūko abrazyvių dalelių, kurios galėjo atsirasti malant grūdus akmeninėmis girnomis. Viduramžių valstiečių dantų nusidėvėjimas niekuo nesiskyrė nuo geležies amžiaus gyventojų, todėl galime spėti, kad ryškių maisto produktų sudėties ar maisto gaminimo technologijų pokyčių neįvyko. Tuo tarpu viduramžių elito atstovų dantų nusidėvėjimas buvo palyginti nežymus ir beveik nepriklausė nuo individo amžiaus. Tai rodo, kad aukštesnė socialinė padėtis viduramžiais reiškė galimybę maitintis geresnės kokybės maistu.

16TH–17TH CEN. KLAIPĖDA TOWN RESIDENTS' LIFESTYLE (BY ARCHAEOLOGICAL, PALAEOBOTANICAL, AND ZOOARCHAEOLOGICAL DATA OF KURPIŲ STREET PLOTS)

IEVA MASIULIENĖ

Abstract

Archaeological excavations at one of Klaipėda Old Town's blocks near Kurpių Street provided valuable and unique materials for investigating the development of urbanism in the 16th-17th centuries, the activities, and way of life of the residents. The article presents the results of these investigations and considers some aspects of the town residents' lifestyle. Mid-16th – second half of the 17th century building construction and interior furnishings, plot layouts, and development of the block's habitation are analysed. Interpretations are offered based on the archaeological material regarding the activites and lifestyle of the plots' owners. Results of the newest palaeobotanical and zooarchaeological research are presented in the article. The latter data, along with published historical sources, suggest certain conclusions regarding 16th-17th century Klaipėda townspeople's diet.

Key words: Klaipėda Old Town, buildings, diet, trade, palaeobotany, zooarchaeology.

Introduction

The distinguishing features regarding the development of Klaipėda town's topography and urbanism through time, based on archaeological research data, written sources, and cartographic and iconographic material, are thoroughly summarized in many articles and monographs.[1] However, Klaipėda's historiography still lacks the work of specialists in which the data of every town residents' plot would be analysed using multidisciplinary methods. The literature usually accents the history of construction on the plot and the actual construction of the buildings, but does not pay enough attention to the archaeological finds, which constitute one of the major sources of information in the research of the townsfolk's trade, crafts, and way of life. Another important and problematic research theme of the city is the residents' diet, which has been little studied due to lack of material. We encounter fragmentary data about food products and drinks in the written sources. Usually the published facts are associated with the town's commerce, lists of imported and exported goods, or various orders regulating the residents' activities. The bone material so valuable to studies of the inhabitants' diet is found in the cultural layers of Old Town, but only a small part of it is identified and published. Yet another important data source regarding the townspeople's diet that is little exploited in Lithuania is the archaeobotanical material. Palaeobotanical research results of samples taken from cultural layers not only enable us to reach conclusions about the natural environment in various periods, but also provide information about the variety of local vegetation, cultivated or imported cereals, vegetables, fruit, etc..

The aim of this article is to describe the townspeople's lifestyle in the mid-16th – second half of the 17th century.[2] In this case, "lifestyle" is understood in a broader context; not only are the residents' household, diet, and activities important, but also the kind of environment and type of buildings in which they lived. The layout of the inhabitants' plots, as well as the construction of the buildings and their furnishings are analysed, based on archaeological data from the Kurpių Street block. Meanwhile, the examination of the town residents' diet is based not only on the Kurpių Street block's archaeological, palaeobotanical, and zooarchaeological data, but also on published historical sources associated with Klaipėda's economic-commercial activities. It must be stressed, that this article is oriented toward a micro-level of research of the town, so the discussed data do not necessarily reflect general lifestyle features

[1] The rich historiography of Klaipėda town and castle has been surveyed by V. Žulkus (Žulkus 2002, pp.8-11) and is therefore not reviewed separately in this article.

[2] For help, consultations, and valuable comments while writing this article, I sincerely thank Prof. Habil. Dr Vladas Žulkus, Ramunė Bračiulienė, Sandra Satkūnaitė, Mindaugas Brazauskas, Vasilijus Safronovas and Eduardas Remecas. For the opportunity to use as of yet unpublished palaeobotanical and zooarchaeological data, I gratefully acknowledge Dr Dalia Kisielienė, Dr Miglė Stančikaitė, and Prof. Dr Linas Daugnora.

Fig. 1. Klaipėda's Old town, Kurpių St. 3 excavation plot, 2007-2008 (drawing by I. Masiulienė).

of all Klaipėda's townsfolk. Moreover, only a portion of materials collected during archaeological excavations are published in this article, thus the work does not claim to be a completed investigation and will be supplemented in the future. Some of the archaeological data of the excavated block near Kurpių Street have been published and analysed in earlier publications (Masiulienė 2008, pp.341-354; Masiulienė 2009). This article aims to touch on problematic and revelant questions regarding the town residents' lifestyle, and to stimulate scientific discussion regarding the presented conclusions and assumptions.

The block's development from the mid-16th – end of the 17th century

The formation of plots. Archaeological excavations were carried out in the current plot of Kurpių Street 3's complex of buildings and yards which apparently formed already in the 18th century, and was reconstructed more than once in the 19th and 20th centuries (Fig. 1). The excavated complex covers three quarters of the historically-formed block, which borders with Kurpių, Mėsininkų, Kalvių, and Pasiuntinių Streets. The habitation of the block that was in the northwestern part of the island began in the middle of the 16th century. Because of the castle's reconstruction, the town of Klaipėda was moved to another location in the beginning of the 16th century – to the current Old Town territory. Having dug out the New Danė River as a defensive ditch at the time, a town island was formed, which encompassed the current territory approximately between the Danė River and Didžiosios Vandens Street, and between the Theatre Square and John's Hill (Fig. 1). We also find traces of economic activity in this territory from the earlier, end of the 15th – beginning of the 16th century period, but the network of streets and the blocks only began to form successively starting with the beginning to middle of the 16th century. The first plots with buildings were put up in the higher area between the current Tiltų and Turgaus Streets (Žulkus 1991, pp.45-46). Meanwhile, the northwestern part of the town was incorporated later, because that territory was in a wet lowland. Based on current archaeological, palaeobotanical, and cartographic data, as well as evaluation of historical sources, we can assume there was a rather large relict pond with bogged-up shores in the western part of the town (Masiulienė 2009). The eastern part of this pond was recorded in the second and third plots of the excavated block, while a former shore was in the first plot.[3]

Historical sources write about the filling up of the relict pond in the western part of the town's island and the formation of plots in this territory. In J. Sembritzki's published document, Duke Albrecht's 1538 privilege to the town indicates that the town residents who decided to fill up the pond and build homes here were granted the right to fish and were excused from certain taxes (Sembritzki 1926, pp.75-77). The document also writes that the buildings could be built by the laying of the first stone, which apparently meant that whichever town resident built a home first, also owned the plot (Sembritzki 1926, pp.75-77). Based on archaeological excavation data, the second plot was formed and built on first, where the pond used to be, later – the third and first plots, with the first plot built on the former pond's shore.

Old Town blocks in 16th-17th century Klaipėda usually were divided into four plots, less often into three (Žulkus 2002, p.48). The owners would mark the plot boundaries by variously constructed fences. The remains of two fences were found in the excavated block (Fig. 2). A withe fence marked one plot's southwestern boundary: 5-9 cm thick stakes were dug into the ground, and the intervals inbetween were woven with brushwood. The northeastern boundary's fence construction of the same plot was made of rough-hewn stakes or poles hammered into the ground and boards placed horizontally alongside them. The southwest-northeast length was approximately 12.5 m. Usually 16th-17th century Old Town plots were approximately 12 x 12 sq m large (Žulkus 2002, p.48). Based on the data above, it is believed that the block (its present size is about 13 x 49 sq m) was divided into four similarly-sized plots.

Buildings. Based on the conclusions of M. Brazauskas's dendrochronological research, the residential house in the second plot (Fig. 2) was built c. 1542 (Masiulienė 2008, p.351). The specific environmental surroundings had an influence not only on the buildings' construction, but also on the plots' preparation for construction. First of all, in draining and raising the place of the building, the gravel and sand layers were poured separately. So that the building would not settle, its lower part was formed from birch poles pounded into the ground as well as from the placement of variously-sized cuttings of secondary use timbers. Oak blocks (40 x 40 x 70 cm^3) were placed above them, and the entire building's perimeter was covered with a layer of imported argil used for waterproofing. The house's 20 x 20 sq cm framework beams were laid on top of the oak blocks which served as the foundation (Plate IV:1). The width of the house near Kurpių Street was about 8 m, while the length might have been about 9-10 m.[4] The building's walls were formed from struts jointed to the frame every 70-80 cm, while the intervals were filled with bricks mortared with clay. The house's northeastern and southwestern walls had stained-glass windows, as indicated by the huge amount of glass debris found near them. A large amount of window glass also was found under the annex's construction. Apparently the breakage was heaped after ripping out the residential house's non-functioning southwestern wall's window. Several fragments unique to Klaipėda's archaeological material were found in this place, two of them decorated with ornaments and the painted letters "SH," and "S" and "SP" on the other (Plate III:2). The other two glass fragments were decorated with a painted, colored botanical ornament (Plate III:4-5). Yet another stained-glass window part was round (Plate III:3). Judging from all the collected glass fragments, house stained-glass windows were made from rhomboid and triangular greenish glass parts, connected by little lead frames. Some windows might have been beautified not only with inscriptions or drawings, but also with differently-shaped glass.

We have no archaeological data about the roof construction of the house, but we can judge about the roof cover from other archaeological material found. Many lamellate tiles were found near the building and above it, in a layer formed during a fire. This type of tile spread in Klaipėda starting the 15th century and was used til the 17th century (Žulkus 1979, p.40). Various materials were used for roof coverings in the 16th-17th centuries. The poorer town residents' houses were covered with straw, reeds, and the richer ones' – with tiles (Žulkus 2002, p.61).

[3] This numeration of plots is provisional.

[4] The exact sizes of the residential house and its annex have not been determined since the house's and annex's northwestern walls continue underneath the current building's foundation, while the house's southeastern part continues in the direction of Kurpių Street.

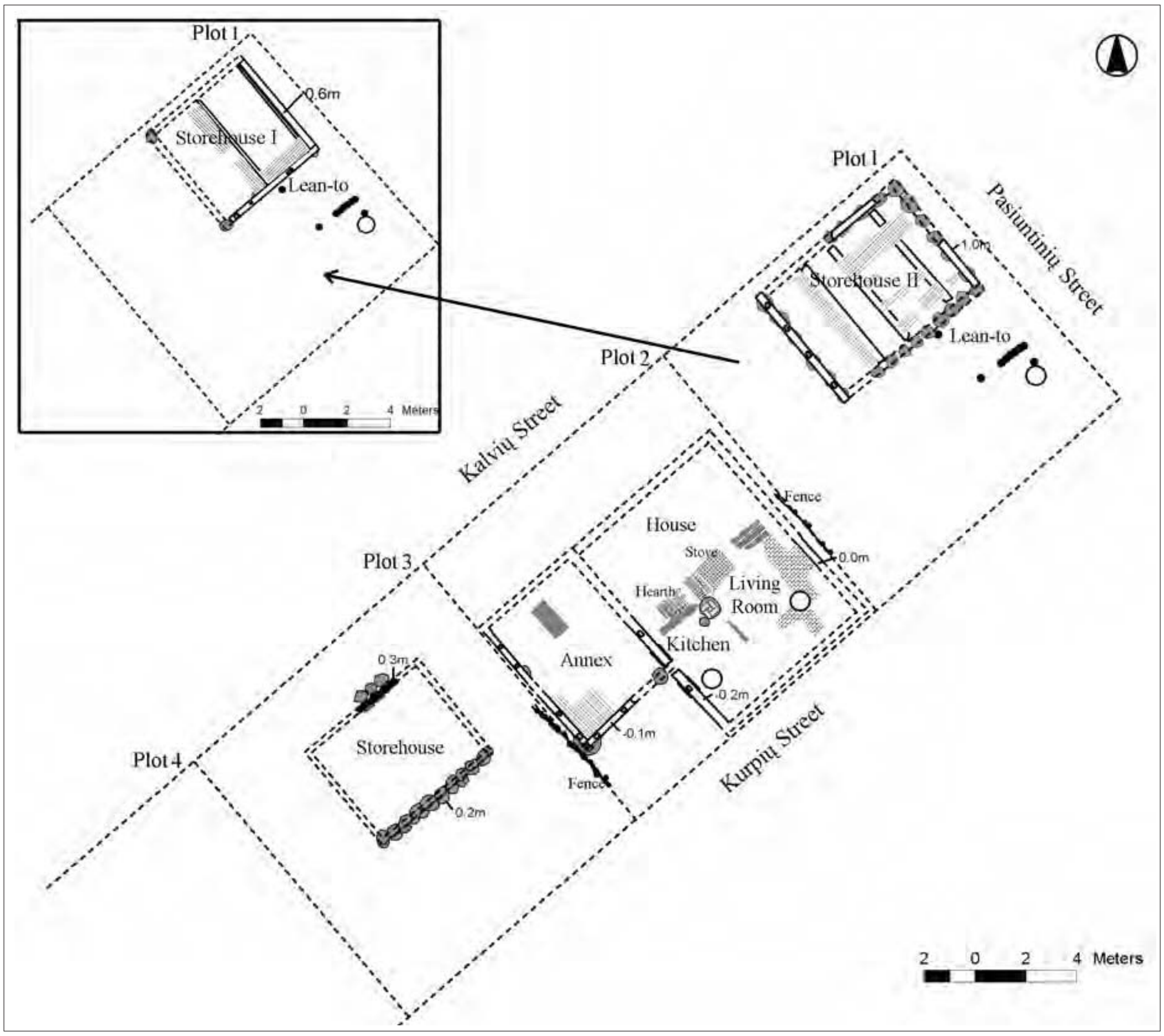


Fig. 2. Buildings put up on the block's plots in the mid-16th – second half of the 17th century. Plot 1 – Storehouse I and lean-to tentatively dated second half of the 16th – beginning of the 17th century, Storehouse II dated beginning of the 17th century – 1678; Plot 2 – Residential house with annex dated 1542/ 1554 – 1678; Plot 3 – Storehouse tentatively dated end of the 16th/ beginning of the 17th century – 1678 (drawing by I. Masiulienė).

The various interior remains of the building that were uncovered during archaeological excavations enable a view only of the first floor's interior, although the houses usually were taller. Residences in Klaipėda in the 16th-17th centuries usually had one or two rooms. The richer inhabitants' houses had even more rooms, some of which were designated workshops or little shops, others – residential. The residents would keep raw materials or goods on the second floor or in the rise (Tatoris 1994, pp.135-136), which might also have been used as a bedroom. The kitchen most often would be situated in the vestibule; remains of one such room were found during archaeological excavations near Tomo St., in a house – storehouse built in 1550 (Žulkus 2002, p.80). That building had six rooms. A kitchen fireplace was furnished in one small, approximately 1.5 x 2 sq m room; its hearth was cobbled with stone, while the other part of the room had wooden flooring. The walls of this room were built differently; two walls were wooden, the others – brick.

Another kind of layout and interior were recorded in the Kurpių Street house. Judging by the remains found, the building's first floor might have had two, maybe three rooms, which were separated by partitions. Two of the rooms were archaeologically investigated; one was a kitchen, the other – a living room. The kitchen and living room were separated by a wooden partition. Near the center of the building, on top of a stone, was a square column made of brick. The main function of this column probably was related with the interior partition and floor constructions, which would suggest that the building also had a second floor. A fragment of systematically laid bricks and half-bricks associated with the hearth was found next to the support, near the center of the building (Plate II:1). The length of the hearth's fragment was approximately 1.1 m, the width – about 0.9 m. A wide board was placed near the hearth, on the argil. The remaining room was cobbled with small field stones and brick chips; the dirt floor closer to the fireplace was tamped with clay. The animal and fish bones, hazelnuts, and household ceramic fragments collected above the floor confirm that food was prepared in the 2.5 m wide room. The width of the other room –the living room– was 4 m. In one place, the room's floor was covered with oak boards, while in another they were lined with brick. Half-bricks were ucovered, as were 28 x 28 sq cm large fragments of brick floor in some places. A glazed tile stove stood in the room, along the inner wall. We have few data to reconstruct the stove. Only a fragment of its mostly destroyed base survived, as well as a large amount of vessel tile debris that were collected near it. The stove's base was laid from two rows of bricks mortared with clay. Judging by the remains, the shape of the stove's firebox was rectangular – approximately 1.2 m long and about 1 m wide. The shapes of vessel tile stoves in the researched period were various: domed, rectangular prismatic, or truncated cone (Žulkus 2002, p.83). The vessel tiles collected from beside the stove's base, different both in shape and glaze, show that the stove was put together from various tiles. A portion of the tiles were not glazed, others were covered with brown, green, and yellowish glaze, while the bottoms were decorated with clearer or fainter concentric rings. All of these tiles are tentatively dated to the first half – middle of the 16th century.

A similar house interior is usually found in 15th-18th century Western and Central Europe's urban residential buildings. For example, in the 16th-18th century house of a potter in Lüneburg, the kitchen was established in the vestibule, and the 90 x 70 sq cm large hearth was made of brick (Ring 2001, pp.389-390). Based on archaeological data, the fireplace stood near the inner wall, beside which and on the other side of which a living room's glazed tile stove was attached. Such a type of construction, in which the fireplace and stove are connected, had advantages: first of all, only one chimney was used, while the stove, in protecting the room from smoke, would be lit from the kitchen (Ring 2001, p.389). The Kurpių Street house's fireplace and stove, which stood near the same inner wall, might also have been connected to one chimney.

The drainage system inside the residential house was typical of that period's buildings. The oak barrels on the edges of the kitchen and the room were dug in at floor level. Dendrochronological analyses of the barrels showed that the house drainage system that stood for more than a hundred years was repaired; one barrrel was dated 1597, the other – 1648 (Masiulienė 2008, p.351).

Indications of a higher quality of life not characteristic of Klaipėda buildings in that period can be discerned in the discussed construction elements of the residential house, its interior layout and furnishings. The data also suggest that this house's owner was a well-off resident of the town.

Later, in c. 1554, an annex was built onto the house (Fig. 2) (Masiulienė 2008, p.351). This annex was built on separately poured, levelled and waterproofed layers of sand and argil. The construction's oak framework timbers, 15 x 25 sq cm thick, were laid on different stones, placed in the corners and in the middle of the building. The building's walls were formed from uprights (10 x 15 sq cm), and the corners of the construction were reinforced with oblique 15 x 15 sq cm timbers. The wall's intervals between the uprights were built with bricks, and clay was used as mortar. The width of the annex's southeastern wall was approximately 5 meters, and the length of the southwestern wall was about 6 m. In places, the inside of the annex was covered with boards, while in other places it was just strewn with a layer of wood chips and wood debris. The floor in the southern corner of the building was undergoing repair – being raised. An oak floor was laid on top of a conifer wooden floor (Plate IV:2), while later on, wood chips and wood debris were poured on top of that floor. The slabs and boards laid down in the building's northwestern part, closer to Kalvių Street, may be associated with the entrance. Aside from the floor, no other constructions were found in the annex, which suggests that this building served as a storage room.

Two different buildings from two different times were found in the first plot (Fig. 2). The earlier building was constructed on a layer of levelled sand, onto which was poured a cultural layer of brown peaty soil. Many fragments of various artefacts were found in it, having found their way there as household waste. Based on the finds, this layer is dated to the middle – end of the 16th century. The corners of the building's oak frame (approximately 15 x 24 sq cm large) were placed on top of stones. The walls apparently were formed from uprights, because only grooves were observed in the frame. Since the building's walls were ripped off, we have no data about the fill between uprights. The building had a wooden floor, whose boards were placed on untrimmed, approximately 18 cm diameter timbers with cut out quarters. The size of the building was about 5 x 5.5 sq m. The interior arrangement suggests that the construction was designated for storage. The storehouse tentatively could have been built at the end of the 16th century.

At approximately the same time, a lean-to was built beside the building (Fig. 2). The construction of this small building was comprised of 20 cm diameter timbers dug into the corners and the fragment of a wall on the southeastern side, made of nine poles. The size of the construction was approximately 2.5 x 2 sq m. An intensively trampled layer with organic material (wood chips, moss, straw, etc.) was recorded both surrounding the building and inside it. This is indicative of animals being held in the lean-to. Remains of an approximately 60 cm diameter barrel dug into the sand were found beside the little animal shed, near Pasiuntinių Street.

Later, a new building, a little wider near Kalvių Street, was built on the plot. After ripping down the earlier storehouse's walls, the foundation of this building was placed on the previous frame, which was used as a special grate. The foundation stones were reinforced with mortar and bricks, and 15 x 16 sq cm large oak beams were laid on top of them. The walls were formed from uprights set into the frame every 80 cm, and the intervals were filled in with bricks, bound, possibly, with mortar. The southwestern wall had a stained-glass window, as evidenced by the many glass shards collected in one place beside it. The inside of the building was divided into two rooms of the same size, 3.5 x 5.5 sq m, separated by a partition made of horizontally reinforced boards. The size of the entire building was about 5.5 x 7 sq m. The inside of both rooms was covered with a wooden floor; remains of several barrels were found on the floors (Plate III:1). Later, the building was repaired by pouring sand onto the partially disintegrated floor and covering it with a new, conifer wood flooring. Since the dendrochronological analysis of the wood samples is not yet complete, the building could be dated by the artefacts to from the beginning of the 17th century until 1678. The remains of barrel parts leave no doubt that the building served an economic purpose and stored goods.

The remains of the building found in the third and last plot of the block are rather fragmentary, so it is difficult to draw more precise conclusions. Starting the mid-16th century, economic activity took place in the territory. Palaeobotanical research results testify that household trash was thrown out in this place before construction, although there also might have been small garden plots here (Kisielienė 2008). The owners later poured sand, which was brought over from the shore of the pond, over the wet plot. The sand has many remains of small shells, so maybe the sand was brought from the shores of the New Danė River. The foundation attributed to the building was of unmortared field stones laid in four rows in the sand, and a 16 x 24 sq cm large frame fragment placed on top of the stone foundation. Based on the preserved building remains, its approximate size was 5 x 6 sq m. We have no data regarding how the interior of the building was arranged. By the layers' stratigraphy, the building's remains tentatively could be dated from the end of the 16th or beginning of the 17th century up to 1678. In samples from the cultural layer that formed in the yard in the same period, pollen of buckwheat, rye, and hemp dominates; the pollen might have found its way here via the stored imported goods (Stančikaitė 2008). The archaeobotanical material suggests that the building was designated for storage.

The construction of all the buildings is charactersitic of that period's wooden building tradition in Klaipėda, in which the house was constructed with the help of a frame. The building type would be complicated to identify because discussions about their typology are still taking place in historiography. Researchers describe fully-framed constructions and half-timbered (timber framed; *Fachwerk* in German) constructions differently. V. Žulkus maintains that in fully-framed constructions, the squared posts were dug into the ground or set inside a framework, while half-timbered building constructions were placed on top of the foundation and diagonal timbers were used exclusively for the reinforcement of half-timbered building corners. Walls of both types of buildings were filled in with clay or bricks inbetween the struts (Žulkus 2002, p.57). M. Brazauskas, however, thinks that the frame for the fully-framed type buildings was placed on separate stones or oak blocks, and ascribes the half-timbered type to the buildings with foundations of stone or brick bound with mortar or clay; the walls would be filled in with bricks and mortar between struts. Moreover, the first floor might also have been constructed of a stone foundation and brick walls (Brazauskas 2008, p.61).

Plot zones. Both of the first plot's buildings stood near the corner of Kalvių and Pasiuntinių Streets, and a rather large farm yard with a little animal shed stood in the remaining part. The distance between the later storehouse and the second plot's residential house was approximately 4.5 m in the 17th century, the distance to Kurpių St. – about 6 m. A large part of the second plot was taken up by the residential house with the annex, and only small plots remained for little yards near the streets. Beside the annex, set back 5 m from Kurpių Street, layers of an approximately 4.5 m wide area of one little yard were found; there might have been another oblong little yard on the Kalvių Street side. The discussed first and second plots' buildings suggest that the residential house with the annex and the storehouse with the lean-to belonged to the same owner. Doubled plots also have been found on other Old Town blocks. In the middle of the 16th century, both a residential building and a farm building that belonged to one owner stood on Kurpių Street (Žulkus 2002, p.48). Apparently, the owners of such doubled plots were richer town residents. In the third plot, the building used for storage also was built near Kalvių Street, while the territory between the building and Kurpių Street was a rather large farm yard.

Construction on the examined block casts doubt on the dominant opininon in historiography til now that in the 16th-17th centuries the more important street to which house facades were oriented was Kurpių (Žulkus 2002, pp.48-49). All the buildings that were found on the block during archaeological excavations except for the residential house that covered almost the entire plot, stood near Kalvių Street, while the farm yards and small shed were near Kurpių Street. A similar building plan was recorded on blocks. On the plot near the corner of Mėsininkų and Kurpių Streets, the residential house that was built in the middle of the 16th century stood near Kepėjų Street, while the yard and storehouse were near Kurpių Street (Žulkus 2002, p.49). The residential house and workshop on another plot, which belonged to a shoemaker in the mid-16th – 18th centuries, were drawn back more than 2.7 m from Kurpių Street (Žulkus 2002, pp.48-49). An auxiliary building's remains uncovered in the plot near the corner of Vežėjų and Kurpių Streets show that from the middle to the end of the 17th century, the farm yard was near Kurpių Street (Sprainaitis 1981a, p.11). A small farm buildinig dated to the second half of the 17th century was recorded in yet another plot, Kurpių St. 1, which also stood closer to Kurpių Street (Sprainaitis 1981b, p.12). Thus, following the layout of Klaipėda's blocks, when economic zones formed near secondary streets and houses were built near the main streets, we can assume that at that time Kalvių Street was more important. One of the factors contributing to the importance of Kalvių Street and this territory's development might have been the development of the port near the New Danė. Several opinions exist about the port's place in Klaipėda in historiography, but based on archaeological research data and written sources, we can assume that the port with the scales building and warehouses in the territory near the New Danė already started to develop from the middle of the 16th century (Masiulienė 2009).

The fire of 1678, which started in the outskirts of Vitė and Krūmamiestis and later spread to Klaipėda's Old Town, had a negative impact on the block's development. All the buildings that stood on that block burned down during that fire. We do not have exact data regarding when the block was fully rebuilt, but can tentatively say that it must have occurred in the beginning of the 18th century.

Activities of the plots' landowners. The function of the buildings found on the plots as well as some palaeobotanical research data suggest that the activities of the plots' owners were connected with trade, something archaeological finds also could verify. A silver coin was found inside the residential house, inbetween the wood flooring. The coin was a 1510 Sigismund I the Old half-penny, minted in Vilnius; these coins were in circulation until the beginning of the 17th century (Plate III:6).[5] Two more, copper and silver coins were found in the first plot; these were the Free City of Riga's 1571 and 157(5?) shillings (Plate III:7-8). A fabric roll's lead stamp was found in the same layer; one side of the stamp had the imprint of the maker's mark (so far unidentified), the other side – the letter "F," which meant a defective fabric. The find is dated to the middle – end of the 16th century. A small brass scales plate was found not far from that same period's layers. Several finds associated with that period's luxury wares also need to be mentioned. Three brass pins dated to the middle – end of the 16th century were found in the earliest, brown peaty soil layer near the annex and in the first plot. The pins were for holding a hairstyle or fastening on a cap or hood. Part of a plate of unknown function, but made from horn with an engraved image of a standing woman (Plate IV:4), were found in the same layer, in a corner of the annex. Judging by the engraving's preserved fragment, it is thought that the woman is depicted wearing Renaissance clothing. This is undoubtedly an imported product, only right now it is difficult to say what kind of product this was a part of – perhaps an element of decor of a small box. A book cover's brass binding, whose surface was covered with protuberant geometric and botanical ornaments (Plate IV:3), was found in the same cultural layer in the third plot. Several more brass book cover fastener parts were found in the middle – end of the 16th century's and 17th century's cultural layers of the first plot.

All the named finds are unique to Klaipėda's archaeological material and confirm the assumption that the plots' owners belonged to the richer class of townsfolk, while their activities could have been associated with trade.

The town residents' diet in the mid-16th to end of the 17th century

Concrete data regarding the Klaipėda townspeople's dietary habits in the mid-16th to end of the 17th century are not abundant; even more so, the kinds of dishes that were prepared are unknown. For this reason, the problem of the town residents' diet is examined in a multi-disciplinary fashion, analysing various groups of data that enable but an image of the food products consumed at that time: meat, fish, vegetables, fruits, drinks,

[5] E. Remecas of the Lithuanian National Museum identified the coins.

etc. The zooarchaeological and palaeobotanical data of the Kurpių Street block are directly associated with Klaipėda residents' diet. The second and third plots' bone material or zooarchaeological data (Diagram 1)[6] are used in this article. Palaeobotanical research results of some of the samples from the third plot's cultural layers also are presented (Table 2)[7]. Published historical sources associated with Klaipėda's economic-commercial activities (Sembritzki 1926; Willoweit 1969; Groth 1995) indirectly testify about the food and drink consumed by Klaipėda's inhabitants. Duke Albrecht's scales right granted in 1538 (Sembritzki 1926, p.75) gave the impulse for Klaipėda's commerce. However, at all times the trade initiative belonged to Western Europe's ports, while Klaipėda usually was the intermediate marketplace in which goods were divided or presented. On the other hand, it is worth noting that by the Stowage right that was granted in 1639 by the King of the Polish-Lithuanian Commonwealth, Wladislaus IV, merchants from other port towns first would have to offer the local merchants the luxury, widely used, and food goods they brought in to Klaipėda and only after that could they export them elsewhere (Tatoris 1994, p.256). The main 17th-18th century imports consisted of salt and colonial wares, especially tobacco and drinks (Groth 2001, p.15). Various goods are recorded in Klaipėda's port's 1664-1722 customs books, which are conserved in Berlin in the *Geheimes Staatsarchiv Preussischer Kulturbesitz* (Groth 1995). Data regarding food and drink goods imported into the Klaipėda port in 1664-1678 are systematized and presented in this article (Table 1). That not all the goods recorded in the customs books could have been bought and used by Klaipėda's residents must be considered. On the other hand, the lists show what kind of food and drink products were possible to acquire in Klaipėda at the time.

Meat and meat products. Zooarchaeological analysis enabled the identification of 501 of the 988 bones and bone fragments, as well as several of the domesticated animal, bird, and wild game species (Diagram 1). The research showed that the inhabitants mostly consumed the meat of cattle; of all the identified bones, 315 of them – much more than half – belonged to cattle, including calves. Significantly less bones of other domesticated animals – pigs, goats, and sheep – were found. Noteworthy is that some of the animal bones had clear chop or cut marks, which appeared upon dividing the meat into smaller pieces. Several domestic birds also were identified during the analysis: chickens, geese, and ducks. Moreover, remains of bird eggshells were found in the first plot's yard.

For their needs, the townsfolk apparently would breed some of the animals, usually sheep, goats, pigs, and domestic birds, on their own. Small farm sheds are found in the plots' yards. Remains of a small animal shed also were recorded in the excavated plot near Pasiuntinių and Kurpių Streets. The inhabitants would pasture their animals in the nearby meadows. Historical sources of the end of the 16th century mention cattle pastures on the right shore of the New Danė (Sembritzki 1926, p.101).

The animals might have been slaughtered by butchers who founded a guild in 1627 (Sembritzki 1926, p.166). The valuation of butchers' services were recorded in 1681 in the newly ratified statutes regarding Klaipėda town's prices, servants, clothing, weddings, children's baptisms, and funerals; the regulations were prepared according to the country's and town's earlier statutes of 1666. The new document indicated that butchers would receive 15 farthings for slaughtering a pig and making the sausages, while for the slaughter of a calf or sheep, they would receive 6 and 4 farthings, respectively (Sembritzki 1926, p.146).

Small amounts of meat products – sausages, hams, fat/bacon – would be imported from other Baltic Sea port towns. However, more meat was exported than imported. Salted meat, fat, geese, and animal intestines were exported from Klaipėda's port in the 17th century (Willoweit 1969, p.844; Sembritzki 1926, p.159; Groth 1995, pp.11-13).

Some of the wild animal bone fragments that were found in and near the residential house show that a part of the townspeople's rations consists of game meat. Bone parts of red deer, elk, roe deer, hare, and possibly boar were found in the cultural layers (Diagram 1). At that time one of the exported wares consisted of furs. In addition to the animals on the lists of exports in the second half of the 17th century, elk, red deer, and hare hides also are mentioned (Sembritzki 1926, p.159; Groth 1995, pp.11-13). Other wild animal bones were collected during the excavations in Klaipėda's castle area, such as European bison, aurochs, beaver, bear, fox, as well as seal (or porpoises) (Žulkus 2002, p.91).

Fish and fish products.. Over a dozen fish bone fragments were found during excavations inside and near the residential house, in the layers that formed in the middle – end of the 16th century. Of all the collected fish bones, only two species of fish were identifiable: several pike bones and a large sea fish's "spine" (Daugnora 2008). Other types of fish remains were

[6] Analysis of the bone material from the first plot currently is incomplete.

[7] The table presents some of the macroremain data identified from the third plot. Palaeobotanical analysis of samples from the first and second plots currently is being conducted.

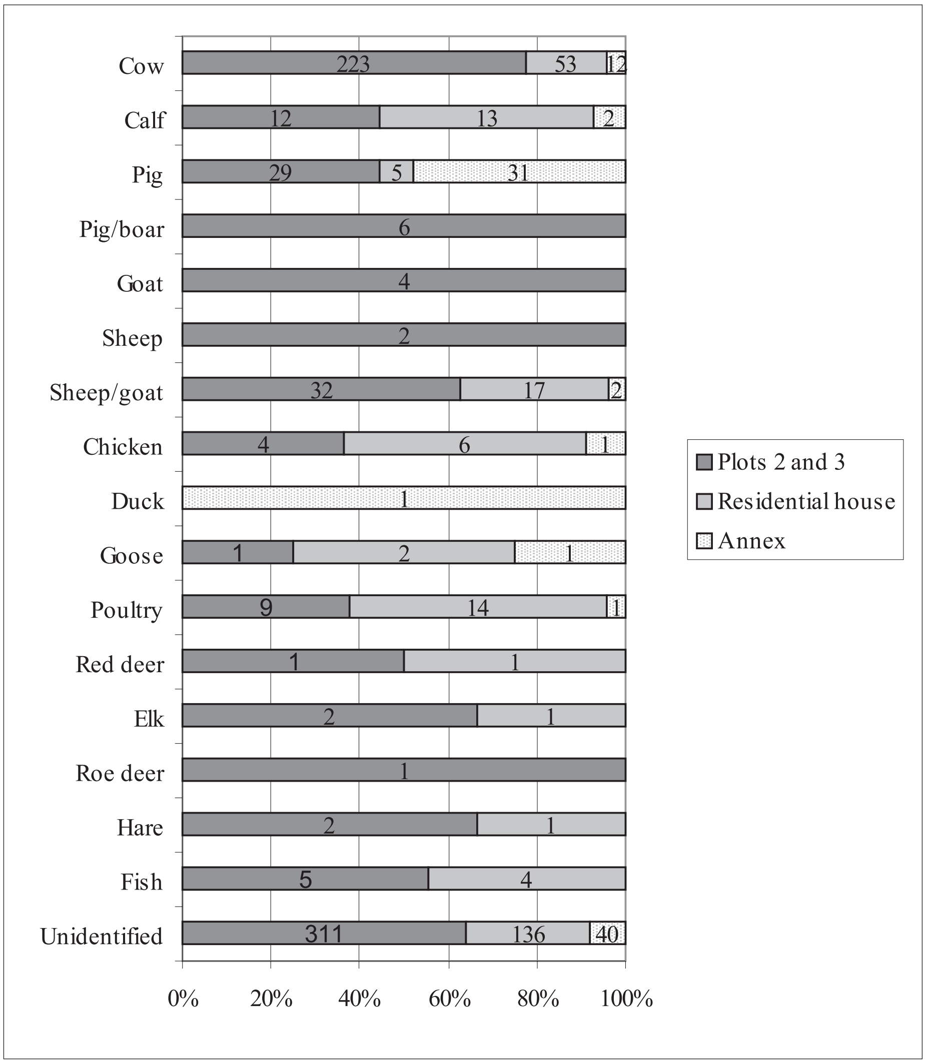


Diagram 1. Zooarchaeological data (number of bones and bone fragments): cultural layers of Plots 2 and 3, dated middle – end of the 16th century; residential house layer, formed before and during the 1678 fire; annex layer, dated mid-16th – second half of the 17th century (analysed by L. Daugnora, prepared by I. Masiulienė).

found in the 14th-16th century cultural layers of Klaipėda's castle area: bones of pike, zander, and a large sturgeon (Žulkus 2002, p.91).

Based on the earlier mentioned document of 1538, the owners of those plots that formed in the area of the pond were granted permission to fish (Sembritzki 1926, pp.75-77). This would be confirmed by two fish-hooks found in the excavated block, inside the annex and in the first plot's yard. One of the fishhooks was exceptionally large and might have been intended for sea fishing. J. Sembritzki also explains other ways of fishing, for example, sturgeon and salmon were caught by nets in the sea, cod – by traps (Sembritzki 1926, p.78). Fragments of clay net sinkers were found near the residential house in the former yards' layers.

The residents sold a portion of the fish they caught in the open market, straight from the boats, or by exporting them. According to the lists or inventories of 1644, 1666-1673, and 1675-1678, a large percent of the exported fish consisted of cod; lampreys also are mentioned (Groth 1995, pp.11-13; Willoweit 1969, pp.847-848). A large amount of various fish was brought to Klaipėda from neighbouring and Western European port towns. A fish import from Bergen is recorded in lists dated 1602-1612 (Willoweit 1969, p.844), and cod and herring – in 1644 (Willoweit 1969, pp.845-846). Based on Klaipėda's customs books, rather many variously prepared herring were imported. Other fish mentioned on lists would be caught in the Curonian Bay and Baltic Sea as well – cod, salmon, crucian carp, flounder, sheatfish. In the second half of the 17th century, crabs were brought in several times to Klaipėda from Lübeck and Amsterdam.

Crops, grain, and flour products. No macroremains of crops were identified in the analysed samples from the cultural layers, but the spore-pollen analysis showed that in the third plot, in the layers formed beside the storehouse, pollen of rye, hemp, and buckwheat dominated (Stančikaitė 2008). Historical sources indicate

Table 1. Inventory of food and drink products imported to Klaipėda's port in 1664-1678 (according to A. Groth, prepared by I. Masiulienė).

Item	Gdańsk	Gotland	Heiligenaa	Kalmar	Kolobrzeg	Liepaja	Lübek	Sackenhusen	Sackenstrand	Amsterdam	Harlingen	Warnes	Vlieland	Terscheling	St. Martin	Kopenhag	Sondenborg	Edam	Niederlandy	France	Hamburg	Palanga	Kurlandia	Enkhuizen	Rotterdam	Oldenburg	Windawa	Königsberg	Sweden	Ostende	Baye de Borgneuf	Pilawa
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
Meat and meat products																																
Sausage							x																									
Ham							x																									
Fat/ Bacon					x			x																								
Meat						x		x																								
Intestines (animal)						x																										
Fish and fish products, Crustacea																																
Crucian carp (Polish "karas")							x																									
Salmon								x																								
Cod			x		x	x		x																								
Cod (jerked)				x			x																									
Flounder			x			x	x																			x						
Herring	x	x			x	x	x			x				x	x	x								x	x	x						x
Herring (jerked)																					x											
Herring (smoked)			x			x																										
Sheatfish										x																						
Fish (Bergen)							x																									
Crab							x																									
Crops, grain, and flour products																																
Oats						x		x																								
Oatmeal					x																											
Buckwheat					x																											
Buckwheat groats								x																								
Barley	x					x		x																								
Barley (Spanish)														x							x											
Barley flour																							x									
Flour	x					x																										
Rape	x																															
Rice							x			x	x	x	x	x							x											
Rye			x			x																								x		
Rye flour	x				x				x																							
Millet groats	x																															
Bread					x																											
Honey cakes										x	x	x		x																		
Cookies										x		x				x																
Vegetables																																
Cucumbers							x																									
Cabbage										x																						

Onions						x				x	x					x									x							
Peas					x	x	x																									
Horseradish	x																															
Fruits and berries																																
Oranges							x			x				x					x													
Orange peels										x																						
Lemons (Polish “cytryny”)	x						x			x			x	x					x													
Lemons (Polish “limony”)	x					x	x			x		x		x							x											
Lemon peels							x																									
Candied fruit or peels							x			x																						
Dates							x																									
Figs	x				x		x			x	x	x	x								x											
Raisins	x						x			x	x	x	x	x							x											
Pears					x		x																									
Apples	x				x		x			x																						
Plums	x					x	x			x		x									x											
Cherries					x																											
Cherries (dried)					x																											
Spices																																
Anise						x	x			x						x																
Cinnamon	x				x		x			x																						
Cloves							x			x																						
Ginger							x			x	x	x		x		x					x											
Cardamom	x																															
Caraway							x			x																						
Bay leaves					x					x																						
Nutmeg	x						x			x																						
Pepper	x				x		x			x		x		x		x					x											
Spices	x						x			x		x		x																		
Crocus	x									x						x																
Other food products																																
Salt (Hamburgian)							x																									
Salt (Spanish)	x				x		x			x				x																		
Salt (Kolobrzegian)					x																											
Salt (Lüneburgian)	x						x														x											
Salt (French)	x		x		x	x	x			x	x		x	x	x	x		x	x	x	x							x			x	
Sugar	x				x		x			x	x	x	x	x		x					x											
Powdered sugar							x			x						x																
Honey				x	x	x	x			x																						
Syrup							x			x											x											
Marmelade										x																						
Chestnuts										x		x																				
Walnuts	x						x			x		x		x	x	x				x												
Almonds							x			x		x		x		x					x											
Black walnuts (“oak tubercles”)										x																						

Capers					x		x			x																						
Olives	x						x			x		x		x							x											
Rapeseed oil							x																									
Linseed oil			x				x																									
Codliver oil						x	x					x																				
Tallow						x																	x						x			
Cheese	x				x		x			x	x	x		x		x								x	x							
Butter						x																	x						x			
Hops	x				x	x	x			x									x													
Malt (dried)					x	x	x																							x		
Drinks																																
Ale	x		x			x	x	x	x														x									
Vodka	x	x					x	x		x				x		x					x										x	x
Wine (Polish "alikant")										x											x											
Wine (Spanish)	x	x				x	x			x		x	x	x							x											
Wine (Polish "mal-mazja")										x																						
Wine (spar-kling)							x			x				x		x					x											
Wine (Polish "Petercy-ment")						x	x			x		x				x					x											
Wine (French)	x	x			x		x			x		x	x	x	x	x			x	x	x											x
Wine (Rhine)	x						x			x				x		x					x											
Wine (vermouth)										x																						
Wine (red)							x																									

that one of the main export goods in the 17th century consisted of various grains (barley, oats, rye, and wheat), which were purchased not only from the surrounding area, but also from Samogitia (Sembritzki 1926, pp.159-160; Groth 1995, pp.11-13). Some crop grains like rye, barley, oats, and buckwheat would be imported mostly from Prussia and Northern German towns. Rye, not grown in these lands, would be bought in via boat to Klaipėda mostly from ports in the Netherlands.

Bakers were the first in Klaipėda to establish a guild in 1585; somewhat later, in 1639, the guild split into two: the Bakers' and the Confectioners' guilds (Sembritzki 1926, p.166). Alongside the excavated plot is Kepėjų (Bakers') Street, near which plots began being inhabited from the beginning – middle of the 16th century. The name of the street apparently originates from the bakers who used to work and live here. Bread and other products would also be baked by the town residents themselves; some sold their baked goods from their homes. The disgruntled members of the guild complained to the town's authorities in 1663 and as a consequence, private individuals were forbidden to sell bread, except for the peasants, who were permitted to sell their own baked bread only on Saturdays until 9 AM (Sembritzki 1926, p.166). Some baked goods would be brought in from elsewhere in the second half of the 17th centruy; the lists mention cookies and honey cakes from Holand and the Netherlands. Once, bread also was imported from Kołobrzeg.

Vegetables. Macropalaeobotanical research showed that before building the storehouse on the third plot in the middle – end of the 16th century, there might have been small garden plots there (Kisielienė 2008). No macroremains of vegetables were found in the samples, however, a large amount of garden weed remains were established – mostly white and many-seeded goosefoot (*Chenopodium album, Chenopodium cf. polyspermum*) (Table 2). A seed of a plant in the squash genus (*Cucurbita*) was found in the first plot, in the cultural layer near the 17th century storehouse. Meanwhile, we find data in the historical sources of cabbage grown in Klaipėda in the beginning of the 16th century. The data mention Wilhelm von Melen (or Mielen), who acquired a house near the Danė River in 1504, together with a plot for a bathhouse near the relict pond and a cabbage garden on a little island (Sembritzki 1926, p.74). Cabbage and sauerkraut are mentioned in the inventories of exported

Table 2. Some palaeobotanical sample data from Plot 3's cultural layers (analysed by D. Kisielienė)

Cultivated and collected plants		**E13 (12)**	**E12(15)**	**E12(16)**
Ficus carica L.	common fig		2	
Corylus avellana L. (fragments)	European hazel	9 fr	5 fr	1 fr
Rubus idaeus L.	garden raspberry	4	1	1
Fragaria vesca L.	wild strawberry	2	6	1
Crop and flax field weeds				
*Fallopia convolvulus (*L.) A.Love	climbing buckwheat	4	1	
Viola cf. *arvensis* Murr.	field pansy			1
Centaurea cyanus L.	cornflower		1	
Millet field and garden weeds, ruderal plants				
Urtica dioica L.	common nettle	3	4	4+1fr
Urtica urens L.	small nettle		1	2+1fr
Polygonum aviculare L.	common knotweed	2	1	5
Persicaria minor (Huds.) Opiz	small persicaria	1		
Persicaria lapathifolia (L.) Gray	dock-leaved smartweed	41+6fr	15	1
Persicaria hidropiper (L.) Spach	smartweed	1	1	
Rumex acetosella L.	common sorrel	10+3fr	18	14
Rumex crispus L.	curled dock		6	
Chenopodium album L.	white goosefoot	21	>500	39
Chenopodium cf. *polyspermum* L.	many-seeded goosefoot	7	331	25
*Stellaria media (*L.) Vill	common chickweed	2		3
Ranunculus repens L.	creeping buttercup	4		2
Potentilla anserina L.	silverweed	1	1	
Mentha arvensis L.	field mint	1		
Lapsana communis L.	common nipplewort	1		
Thlaspi arvense L.	common pennycress	2 fr		

and imported goods in the second half of the 17th century (Groth 1995, pp.11-13). Other vegetables would be brought in to Klaipėda in that period – sources mention cucumbers, brought in from Lübeck, and onions, usually from the Netherlands. Klaipėda's inventory of exported goods in 1671 mentions turnips (Sembritzki 1926, p.159).

Fruits and berries. Fig-tree seeds (*Ficus carica*) were found in the samples from layers dated to the middle – end of the 16th century near the annex (sample E12(15)) as well as in the annex itself (D11(17)) (Kisielienė 2008). The fig can undoubtedly be associated with the commerce of the time; this is confirmed by the later 1664-1678 inventories of goods imported to Klaipėda. Most figs would be imported from other ports in Prussia and the Netherlands. Earlier, seeds of this plant had been found in the territory of Vilnius's presidential mansion, in 14th century cultural layers (Stančikaitė *et al* 2008, p.249). Raspberry (*Rubus idaeus* L.*)* and strawberry (*Fragaria vesca* L.) macroremains were found in samples E13(12) and E12(15). These plants are associated with wooded plots and glades, but they also could have grown successfully near ponds or alongside houses (Kisielienė 2008). We find information in the written sources about other species of fruit that the townsfolk consumed: pears and apples. Their mention is connected with the regulation of Klaipėda's commerce. In 1613, the town's magistrate, Transaction Court, and Merchants' Guild permitted the artisans to engage only in small trade in apples, pears, and nuts (Sembritzki 1926, p.96). The merchants would deliver some of the fruits and berries to Klaipėda from Western European ports. Oranges mostly were brought in from ports in the Netherlands and Lübeck. Lemons (A. Groth indicates the Polish *cytryny* and *limony*) would be brought in from other towns in Prussia and the Netherlands. Apples, pears, plums, and cherries usually were delivered from Northern Germany and some Prussian ports.

Spices. Herbal spices which could have grown nearby in meadows and along the edges of the forests undoubtedly were used to flavour dishes. Macroremains of field mint (*Mentha arvensis*) and sorrels (*Rumex acetosella, Rumex crispus*) were identified in some of the third plot's samples (Kisielienė 2008).

Particularly various spices would be imported to Klaipėda from other ports. Lists of goods from the second half of the 17th century record ginger, peppers, crocus, cloves, anise, cinnamon, caraway, etc.. Most varieties of spices were delivered from Amsterdam and Lübeck. Pharmacists with permits and some town residents traded in the spices imported to Klaipėda. At the end of the 17th century, four inhabitants in the town sold spices (Sembritzki 1926, p.170). In the privilege granted Jacob Jung in 1677, he was permitted to sell not only medicine in the pharmacy, but also spices (Sembritzki 1926, pp.142-143).

Other foodstuffs. One of the most important products used in cooking food – salt – was the main imported good in the 16th-17th centuries. Several varieties of salt (Hamburgian, Kołobrzegian, Lüneburgian, French, Spanish) were imported in large quantities from many Western and Central European ports of the time.

Sugar, powdered sugar, honey, and syrup were used to sweeten drinks and dishes. These products usually were brought in from ports in Northern Germany and the Netherlands.

Regarding dairy products, it must be mentioned that Klaipėda's residents only exported butter in the 17th century (Willoweit 1969, p.844; Groth 1995, pp.11-13), while the main imported product consisted of cheeses, usually brought in by boat from ports in the Netherlands.

During the course of archaeological excavations, many shells of hazelnuts and walnuts were collected from all the plots' yards as well as from some of the buildings. Hazelnuts were one of the exported goods in the second half of the 17th century (Sembritzki 1926, p.159; Groth 1995, pp.11-13). Walnuts would be brought into Klaipėda by way of the sea; they usually were imported from certain ports in Prussia, Northern Germany, the Netherlands, and France. Acorn shells also were found in some of the earliest excavated plot's cultural layers. Inventories of imported goods dated to the end of the 17th century record black walnuts, still called *oak tubercles* (*ąžuolo gumbeliai*), brought in from Amsterdam. An abundance of goodies and delicacies were imported from Western Europe in the second half of the 17th century: marmelades, candied (crystallized) fruit, orange and lemon peels, almonds, chestnuts, raisins, olives, capers. Imported rapeseed oil and linseed oil could have been used in food preparation.

Drinks. Based on historical sources, Klaipėda's residents consumed many and various alcoholic drinks. Klaipėda's government would even issue decrees that regulated how many drinks the residents were allowed to consume and when. For example, in 1613 it was decreed that long-lasting weddings with immoderate eating and drinking and other disorder were limited to one day (Sembritzki 1926, p.107), while according to the 1666 regulations, one could drink only one or two barrels of beer during an engagement or wedding (Sembritzki 1926, p.148). The townspeople would themselves make alcoholic drinks like ale, vodka, or mead, but limits and prohibitions on selling and buying these drinks would be decreed often enough. A decison to prohibit artisans to resell ale and mead was accepted in 1603 (Sembritzki 1926, p.91). The hops and dried malt that were used in the production of ale would be delivered by merchants from other port towns. Klaipėda's townsfolk would export a portion of the ale. The inventories of exported goods that date to the second half of the 17th century mention locally brewed Klaipėda ale (Groth 1995, pp.11-13). It must be noted that the larger part of alcoholic drinks were brought in from elsewhere. Various kinds of wine would be delivered to Klaipėda's port in the 17th century: sparkling, vermouth, Rhine, Spanish, French. Some ale would be brought in from Gdansk, Liepaja, and some German towns, but the quantities were not large. Meanwhile, vodka would be delivered from many of that time's Western European towns.

In summarizing the dietary data, it can be said that a ration of the Klaipėda townspeople's food was made up not only of locally grown products, but also of imported goods. In the 16th-17th centuries, the residents were able to purchase the imported goods in the market which operated in the center of the town, on today's Turgaus (Market) Street. Even little shops with petty wares are mentioned within the market in 1613; the shops could be set up only during the annual market (Sembritzki 1926, p.94). Often inhabitants would sell food products or drink from their homes, while some goods also could be bought in the pharmacies. Separate little shops also could be set up in the residents' homes. A collection of articles called *Wett-Articull der Churfurstl. Stadt Memmel* was published in Königsberg in 1667. In one of the articles, article 48, the activity of the merchants is clearly defined: if the merchant makes ale, then he cannot undertake petty trading; if the merchant has a petty wares shop, then he cannot make ale; and finally, the seller of petty wares or small goods merchant can make ale, but cannot deal in wholesale (Sembritzki 1926, pp.151-152). The same rules also regulated foreigners' trade. They indicated that during the annual market, merchants from other towns were allowed to sell ale, mead, wine, and vodka for eight days, but when the market was not open, they could sell only apples, pears, nuts, onions, and other vegetables, and deal in petty trade for eight days, as well as sell the goods by delivering them to homes once the term ended (Sembritzki 1926, p.151). Thus, Klaipėda's trade was strictly regulated by constantly issued or supplemented statutes.

Dishes and table utensils. Research into the town residents' diet is closely connected with dishware used in the household, as its function can show not only what kind of dishes were used to prepare, store, and eat food, but also how those foods were prepared. Initial analysis of the excavated territory's artefacts enables a general discussion of the dishes the residents used, distinguishing their variety. Food would be braised or cooked in ceramic pots, in three-legged pots, and in three-legged pans. In the tradition of their manufacture and in their forms, these dishes are undistinguished from other ceramic materials in Klaipėda in the 16th-17th centuries. Items that were baked in an oxidated environment and covered in clear or green glaze dominate. Worth discussing separately are the pot cover fragments collected from the middle – end of the 16th century's cultural layers of the first plot; these fragments are distinguished by their decor. The surfaces and knobs of ten different pot covers were decorated with a various stamp ornament (Plate IV:5). Several similarly decorated pot lid fragments also were found in other Klaipėda Old Town plots near Turgaus, Didžiosios Vandens, and Tomo Streets (Masiulienė 2001, p.33). Wooden barrels and vats were used to store drinks and other food products. The latter's parts and cover were found in the mid-16th–17th century's cultural layers. Remains of eight barrel bottoms were found in the first plot's building dated to the 17th century, in which wares were stored. Barrels were one of the main containers in which various goods were transported. Symbols were impressed into some of the barrel bottoms – apparently the manufacturer's trade mark. The drinks would be poured out from the barrels via taps. An ale barrel's little brass tap was found near the house. The tap was similar to one found in a house's basement in a plot near Tiltų Street (Žulkus 2002, pp.78-79).

The main table utensil in European countries in the Middle Ages was the knife, with which the food only was initially cut; the people would eat with their hands (Steponavičienė 2007, p.195). Meanwhile, spoons and forks spread somewhat later. In the 16th-17th century cultural layers on Klaipėda's Old Town, wooden spoons are found more often than metal ones (Žulkus 2002, p.92). A copper and lead alloy spoon with a decorated handle tip was found in the drainage system of the excavated residential house on Kurpių Street; another spoon's decorated handle was found in the yard (Fig. 3). Fragments of several knives and their blades or handles were found in the investigated territory (Fig. 4). Some of the iron knives' handles were made of wood, others were bone, and the tip of one knife was decorated with a zoomorphic ornament cast from brass. Based on the customs books, in the second half of the 17th century, most knives would be imported to

Fig. 3. Leaden spoon, covered with copper alloy, mid-16th century – 1678; and spoon's handle, decorated with crown at tip, middle – end of the 16th century (photograph by R. Bračiulienė).

Fig. 4. Knives along with their blades and handles, middle – end of the 16th century (photograph by R. Bračiulienė).

Klaipėda from Lübeck, and one time each from Kalmar and Liepaja; meanwhile, the lists do not mention either spoons nor forks (Groth 1995, pp.17-116). Food would be set on the table in plates or bowls; several dozen fragments of these dishes were found during excavations. A portion of them were manufactured by local artisans, while some earthenware plates were imported. Based on 1664-1678 lists of wares, ceramic plates were brought in from Gdansk a couple times (Groth 1995, pp.17-116). Klaipėda's archaeological ceramic material testifies that in the 16th-17th centuries, plates would be imported from towns in the Netherlands, Holand, and Northern Germany (Šakinytė 1998, pp.74-75). A few fragments of wooden bowls were found in the cultural layers. In the second half of the 17th century, ceramic and wooden bowls would be supplied from ports in Gdansk, Harlingen, Amsterdam, and Hamburg (Groth 1995, pp.17-116). Drinks would be poured into jugs. A stone paste jug fragment with a decorative, embossed man's head was found in the second plot's yard and dated to the second half of the 16th century. Several wineglass fragments were found in the first plot's yard beside the 17th century storehouse. The fragments belonged to Romer type wineglasses, whose distinguishing feature is small, adhered glass bubbles. Glasses would be brought into Klaipėda's port from Gdansk, Kołobrzeg, and Lübeck (Groth 1995, pp.17-116).

The discussed data show that the excavated plot's townsfolk prepared food in dishes made by local potters, while some of the table utensils and dishes they used were imported from port towns in Western and Central Europe.

Conclusions

Archaeological, palaeobotanical, and zooarchaeological research of the block near Kurpių Street, along with historical data, enable a generalization regarding the main aspects of Klaipėda residents' way of life in the mid-16th – second half of the 17th century.

Specific environmental surroundings and economic factors had an influence on the development of construction on the block. The second plot was built on in the first stage, in the middle of the 16th century, while the other two plots were built on in the second stage, at approximately the end of the 16th – beginning of the 17th century.

The construction of the buildings is characteristic of the tradition of wooden building construction that dominated in Klaipėda town at the time. Some of the residential house's exterior elements suggest an architecturally exceptional building to Klaipėda at that time. The two story house had at least three rooms on the first floor. The residential house's kitchen hearth and living room's stove were connected to one chimney. Such an interior is characteristic of buildings in 16th-18th century Western and Central European towns. On the other hand, the data suggest a higher quality of life in Klaipėda at that time.

The orientation of the buildings and layout of the plots suggest that in the 16th-17th centuries, the more important street was present day Kalvių Street and not Kurpių. The formation of a port near the New Danė River starting the mid-16th century was important to the development of the block; the port needed an infrastructure in order to function. Buildings whose function was to store goods stood on all the investigated block's plots.

The archaeological and palaeobotanical material confirm the plots' owners' links with trade. The archaeological finds also suggest that the proprietors who lived on the second plot belonged to a wealthier group of town residents.

Both locally produced and imported food products and drinks were used in the townspeople's diet. The inhabitants kept various animals and fowl on their plots, and grew vegetables in their gardens. Many townsfolk also made alcoholic drinks in their homes. It was possible to purchase drinks, vegetables, fruits, baked goods, and other food products in the town's market or in the residents' houses and little shops. A wide assortment of goods would reach Klaipėda from Prussia, Northern Germany, and other Western European towns. Klaipėda's commercial ties in the 16th-17th centuries undoubtedly had an influence on the townspeople's way of life.

Translated by Indre Antanaitis-Jacobs

References

Manuscripts

DAUGNORA, L., 2007. Sklypo Kurpių g. 3, Klaipėdoje, zooarcheologinės medžiagos analizė (L. Daugnoros asmeninis archyvas)

KISIELIENĖ, D., 2008. Sklypo Kurpių g. 3, Klaipėdoje, augalų makroliekanų analizė (D. Kisielienės asmeninis archyvas)

MASIULIENĖ, I., 2001. Klaipėdos buitinė keramika XV–XVIII a. Magistrinis darbas (rankraštis). Klaipėda.

SPRAINAITIS, R**.**, 1981a. Klaipėdos senamiesčio pastatai Žvejų g. 3 ir Pergalės (dab. Tiltų) g. 6. Archeologinės priežiūros ir fiksacijos 1980–1981 m. ataskaita. *In*: Archive of Lithuanian Institute of History, Fund 1, file 910.

SPAINAITIS, R., 1981b. Kurpių g. 1 Klaipėdoje. Archeologinės priežiūros ir fiksacijos ataskaita. *In*: Archive of Lithuanian Institute of History, Fund 1, file 828.

STANČIKAITĖ, M., 2008. Gyventojų veiklos pėdsakai sklypo Kurpių g. 3 nuosėdų pjūviuose sporų-žiedadulkių tyrimų duomenimis (M. Stančikaitės asmeninis archyvas)

ŠAKINYTĖ, I., 1998. Majolika Lietuvoje XVI–XIX amžiuje. Bakalaurinis darbas (rankraštis). Klaipėda.

Literature

BRAZAUSKAS, M., 2008. XVI–XVIII amžių Klaipėdos pastatų tipai ir chronologija. *In: Nauji požiūriai į Klaipėdos miesto ir krašto praeitį. Acta Historica Universitatis Klaipedensis, XVII.* Klaipėda: Klaipėdos universiteto leidykla, 51-62.

GROTH, A., 1995. *Żegluga i handel morski Kłajpedy w latach 1664-1722. Statystyka obrotu towarowego*. Gdańsk.

GROTH, A., 2001. Klaipėdos uostas XVII–XVIII a. *In: Klaipėdos ir Karaliaučiaus kraštų XVI–XX a. istorijos problemos, Acta Historica Universitatis Klaipedensis, VIII.* Klaipėda: Klaipėdos universiteto leidykla, 5-16.

MASIULIENĖ, I., 2008. Tyrinėjimai Kurpių g. 3, Klaipėdos senojo miesto teritorijoje. *In: Archeologiniai tyrinėjimai Lietuvoje 2007 metais*. Vilnius: Lietuvos archeologijos draugija, 341-354.

MASIULIENĖ, I., 2009. Klaipėdos senamiesčio šiaurės vakarinės dalies raida XVI–XVII amžiais (in press). *In: Lietuvos archeologija, 35.* Vilnius.
RING, E., 2001. Bauen und Wohnen in Lüneburg vom 13. bis 16. Jahrhundert. Ein Überblick. *In: Lübecker Kolloquium zur Stadtarchäologie im Hanseraum III: Der Hausbau.* Lübeck: Schmidt-Römhild, 387-401.
STEPONAVIČIENĖ, D., 2007. *Lietuvos valdovo dvaro prabanga XIII a. viduryje – XVI a. pradžioje.* Vilnius: Versus aureus.
STANČIKAITĖ, M., KISIELIENĖ, D., MAŽEIKA, J., BLAŽEVIČIUS, P., 2008. Environmental conditions and human interference during the 6th and 13th–15th centuries A.D. at Vilnius Lower Castle, east Lithuania. *In: Veget Hist Archaeobot, 17 (Suppl 1).* Springer-Verlag, 239-250.
TATORIS, J., 1994. *Senoji Klaipėda, Urbanistinė raida ir architektūra iki 1939 metų.* Vilnius: Mokslo ir enciklopedijų leidykla.
SEMBRITZKI, J., 1926. *Geschichte der Königlich Preussischen See- und Handelsstadt Memel.* Memel.
WILLOWEIT, G., 1969. *Die Wirtschaftsgeschichte des Memellandes. I-II.* Marburg/Lahn.
ŽULKUS, V., 1979. XV–XIX amžių Klaipėdos statybinė keramika. *In: Architektūros paminklai, 5.* Vilnius, 37-43.
ŽULKUS, V., 1991. Klaipėdos senojo miesto raidos modelis. Vilnius: Spauda.
ŽULKUS, V., 2002. *Viduramžių Klaipėda, Miestas ir pilis, Archeologija ir istorija.* Vilnius: Žara.

Received: 1August 2009; Revised 3 September 2009;
Accepted: 5 October 2009

Ieva Masiulienė
Institute of Baltic Sea Region History and Archaeology
Klaipėda University, Herkaus Manto g. 84
LT-92294 Klaipėda
LITHUANIA
ieva.masiuliene@gmail.com

XVI–XVII A. KLAIPĖDOS MIESTIEČIŲ GYVENSENA (KURPIŲ GATVĖS SKLYPŲ ARCHEOLOGINIŲ, PALEOBOTANINIŲ IR ZOOARCHEOLOGINIŲ TYRIMŲ DUOMENIMIS)

Ieva Masiulienė

Santrauka

Vertingos ir unikalios medžiagos miestiečių gyvensenai XVI a. viduryje – XVII a. pabaigoje tirti suteikė pastarųjų metų archeologiniai tyrinėjimai kvartale prie Kurpių gatvės. Šiame straipsnyje gyvensenos sąvoka suprantama platesniame kontekste, todėl apibendrinami kvartalo sklypų formavimosi, užstatymo ir pastatų konstrukcijų bei įrengimo duomenys. Kompleksiškai analizuojami Kurpių gatvės zooarcheologinė, paleobotaninė, archeologinė medžiaga ir publikuoti istoriniai šaltiniai, susiję su Klaipėdos ūkine-ekonomine veikla, leidžia daryti tam tikras išvadas apie miestiečių mitybą.

Kvartalo sklypų formavimuisi ir užstatymui įtakos turėjo gamtinė aplinka ir ekonominiai veiksniai. Pirmame etape, XVI a. viduryje, vyksta antrojo sklypo įsisavinimas, antrame etape, apie XVI a. pabaigą – XVII a. pradžią, užstatomi pirmasis ir trečiasis sklypai.

Pastatų konstrukcijos būdingos tuo metu Klaipėdos mieste vyravusiai medinių pastatų statybos tradicijai. Kai kurie gyvenamojo namo eksterjero elementai leidžia kalbėti apie architektūriškai išskirtinį pastatą to laikotarpio Klaipėdoje. Dviaukščio namo pirmame aukšte buvo mažiausiai trys patalpos. Gyvenamojo namo virtuvės židinys ir kambario krosnis buvo prijungti prie vieno kamino. Toks namo interjeras būdingas XVI–XVIII a. Vakarų ir Vidurio Europos miestų pastatams. Antra vertus, iš gyvenamojo namo konstrukcijų, vidaus suplanavimo bei įrengimo galima spręsti apie aukštesnės gyvenimo kokybės požymius, nebūdingus to meto Klaipėdos pastatams.

Pastatų orientavimas ir sklypų suplanavimas liudija, kad XVI–XVII a. svarbesnė buvo dabartinė Kalvių gatvė, o ne Kurpių. Didelę reikšmę kvartalo vystymuisi turėjo nuo XVI a. vidurio prie Naujosios Danės besikuriantis uostas, kuriam funkcionuoti buvo reikalinga infrastruktūra. Prekėms sandėliuoti skirti pastatai stovėjo visuose tyrinėto kvartalo sklypuose.

Archeologinė ir paleobotaninė medžiaga patvirtina sklypų savininkų sąsajas su prekyba. Taip pat archeologiniai radiniai rodo, kad antrajame sklype gyvenę savininkai priklausė turtingesnių miestiečių grupei.

Miestiečių mitybai buvo vartojami vietinių gamintojų ir importuoti maisto produktai bei gėrimai. Gyventojai savo sklypuose laikė įvairius gyvulius, paukščius, o daržuose užsiaugindavo daržovių. Dažnas miestietis savo namuose pasigamindavo ir alkoholinių gėrimų. Miesto turguje arba miestiečių namuose ir parduotuvėlėse buvo galima įsigyti gėrimų, daržovių, vaisių, kepinių ir kitų maisto produktų. Platus prekių asortimentas Klaipėdą pasiekdavo iš Prūsijos, Šiaurės Vokietijos ir kitų Vakarų Europos miestų. Neabejotinai Klaipėdos prekybiniai ryšiai XVI–XVII a. turėjo įtakos miestiečių gyvensenai.

AN INSIGHT INTO THE BIOARCHAEOLOGY OF THE MEDIEVAL INHABITANTS OF VESELAVA

VITA RUDOVICA, ARTURS VIKSNA, GUNITA ZARIŅA, ILZE MELNE

Abstract

In the course of archaeological excavation in 2004, 2006 and 2007 at the 13th–17th century cemetery of Veselava, in Cēsis District, Latvia, 941 burials were excavated. The osteological material permitted an insight into the palaeodemography and palaeodiet of the medieval inhabitants of Veselava. Demographic research shows that the population was characterised by high mortality among juveniles, aged 15–20, and among women aged 15–35. Among males, the highest mortality was observed at age 30–40, mortality remaining high in the age range of 40–50. As a result, adult life expectancy, e^0_{20}, is 5.1 years shorter for females than for males.

Palaeodietary analysis, utilising inductively coupled plasma atomic mass spectrometry (ICP-MS), was undertaken on 40 individuals, determining the concentration of seven elements in the bone. In order to assess the natural background level of these elements, 20 soil analyses were also undertaken.

The elemental content of male and female bone is similar, although the mean level of Zn and Cu in bone is slightly higher for males, which might indicate higher meat consumption. On the other hand, Sr and Mn values are higher for females, indicating a high proportion of plant foods in the diet.

It is thought that the 13th–17th century inhabitants of Veselava often had a meagre diet, and that plant food consumption was higher among women.

Keywords: Latvia, medieval, rural population, palaeodemography, palaeodiet.

Introduction

Bone is a complex tissue consisting of inorganic calcium phosphates precipitated in an organic collagen matrix. Its composition varies considerably with age and type of bone. Whole cortical bone is approximately 69% inorganic, 22% organic and 9% water (Triffitt 1980). The highly insoluble hydroxyapatite is the dominant calcium phosphate phase in bone mineral.

Bone is one of the few materials that are consistently recovered from archaeological and palaeontological sites; its chemical composition has the potential to provide invaluable information about ancient human and faunal diet and health status. Diet is the key to understanding many aspects of the development of human culture. Changes in dietary regimes came together with the change in the manner of food procurement. Gathering, hunting and, after domestication, cattle breeding and finally agriculture: each stage of the development of the dietary process also brought social stratification that led to a preferred diet for certain individuals. The improvement of analytical methods has made it possible to employ trace elements found in bone remains for the reconstruction of diet. Human diet is converted into the language of elements; not the separate components of diet, but the sources of elements are determined (Smrčka 2005). Gilbert (1985) used Zn, Cu, Mg, Mn and Sr to reconstruct the palaeodiet. He expected zinc and copper to be related to the supply of animal protein, whilst Sr, Mg and Mn could indicate the supply of vegetal food.

The influence of changes in the environment on the degradation of archaeological material needs to be established. Laboratory experiments addressing ionic exchange between soil solution and bone tissue should be tailored for each archaeological or palaeontological site. Solutions prepared with equivalent concentrations of each ion present in the soil solution can then be equilibrated with various bone tissues (Pate *et al.* 1989).

Measurement of trace element mass concentrations in soils is the first step in evaluating their potential health or ecological hazard. Various digestion methods are used to determine the mass concentration of trace elements in solid matrices, including different combinations of concentrated acids (Gaudino *et al.* 2007).

ICP-MS allows rapid multi-element determination of samples. Despite the excellent detection limits obtained with ICP-MS, limitations and problems in the determination of many trace elements in bone might be expected due to potential spectral interferences, mostly from major elements in bones (Ca and P) (Djingova *et al.* 2003). Analysis of these specimens is difficult due to the low concentration of the elements of interest, compared with the high concentration of the matrix elements. Sample preparation is an important step in the analysis of bone. Microwave digestion in sealed containers followed by ICP-MS is, nowadays, one of the most versatile methods for the analysis of samples. Microwave digestion provides a rapid and efficient method, and it also possesses the advantage of reducing volatilisation loss and contamination. The disadvantage of the microwave digestion method is that it is more expensive and requires some experience. Procedures using a low volume of acids or dilute acid solutions generally require H_2O_2 as an auxiliary oxidant agent to decrease solid residue and residual carbon content (Georgia *et al.* 2002). Compared to other studies (Florian *et al.* 1998) the small reagent volume (4 mL) reduced the risk of contamination and allowed less dilution after the digestion, resulting in better detection limits.

Therefore, the aim of the present paper is to determinate the trace elements in archaeological bones for reconstruction of palaeodiet using ICP-MS.

Study site

The medieval cemetery of Veselava is located in Veselava Parish of Cēsis District, Latvia, about 300 m north of Veselava Manor. The cemetery was registered by the Board of Monuments already in 1928. At that time, human bone and bronze ornaments were found in the course of agricultural work. Information was obtained that an oak tree had once grown on the hill here, with a bell in the tree and an icon of the Mother of God in a hollow in the tree. The human bone had been found mainly in the vicinity of the oak.

The monument was registered anew by Vladislavs Urtāns in 1958. The only written evidence of the cemetery is to be found in a 1688 church inspection report for the Livland region. The report states that the dead were being buried at a site where a chapel of Ignatius had once stood.

The excavation of Veselava medieval cemetery, undertaken by the National History Museum of Latvia, was connected with road improvement work, and lasted three seasons. In 2004, the excavation was directed by Jānis Ciglis. A total of 30 burials were excavated and the approximate limits of the cemetery determined. In 2006, excavation work continued under the direction of Ilze Melne, uncovering 235 burials. After removal of the old road surface, it turned out that the archive information and the archaeologists' calculations were misleading, since there were more burials under the road to be rebuilt. In 2007, the work was continued and completed, excavating a further 676 burials.

All the burials in the zone affected by the roadwork were excavated: under the road and in the proposed areas of the roadsides, ditches and bus stop. A total area of about 1244 m² was excavated, corresponding to almost half the area of the cemetery. At the eastern and western ends, the limits of the cemetery were reached, so we know that it was 75 m long. The width, in a north-south direction, was about 50 m.

A total of 941 burials have been excavated. Most were in supine position in accordance with Christian tradition, with heads to the west, but there were exceptions as well, oriented to the east or south. Most commonly, the arms had been placed by the sides, on the hips or across the middle, with the legs extended. There were exceptional cases, where the dead had been buried with legs crossed, in flexed position on the side, or even on the stomach. Most individuals were buried singly, although there were cases of two, three and even as many as six individuals in a single grave. The presence of iron nails and traces of wood in the cemetery indicate that the dead had been buried in plank coffins. Two disturbed cremations with no grave goods were also found in the cemetery.

A total of 524 burials, or 56%, had grave goods. These are mainly items of iron or bronze, with fewer objects of glass, stone or tin, as well as cowrie shells, and fragments of textiles and leather goods. Characteristic medieval objects were found: bead necklaces, brooches, finger-rings, pendants, knives, belt buckles and coins.

The coins found on the burials and in the grave fill have helped to date individual burials and determine the overall period of use of the cemetery. The oldest coin is a coin pendant: a silver coin of Dietrich, Archbishop of Paderborn, Westphalia (1208–1212). Also important among the earliest coins is a pfennig of Nicholas, Bishop of Riga (1229–1253). More common are hohlpfennigs of Hamburg, Mecklenburg, Lübeck, Tallinn and Tartu – bracteates dated to the period from the second half of the 13th to the first half of the 15th century. A second major group of coins, indicating a later period of use of the cemetery, consists of shillings minted by John II Casimir in Poland or Lithuania in the 1650s–60s (1648–1668). Thus, the cemetery was in use for a period of almost 500 years: from the mid-13th to the late 17th century.

The osteological material recovered in the course of the excavation (Plate II:1) provided an insight into the palaeodemography and palaeodiet of the inhabitants of Veselava.

Palaeodemography

Age and sex were determined for 877 individuals, using conventional morphological methods (Ferembach *et al.* 1980, Buikstra and Ubelaker 1994, Scheuer *et al.* 2004). The methodology allowed age determination up to 60 years. Sex was determined for individuals over the age of 15. Demographic analysis was performed using standard life tables (Acsádi and Nemeskéri 1970). Under-representation of children below the age of four was compensated according to methods proposed by Rösing and Jankauskas (1997): increasing their proportion to 45 % of the total sample. Population reproductive indices – potential gross reproductive rate (R_{pot}), net reproductive rate (R_0) and mean potential number of children per female (C) – have been calculated according to Hennenberg (1976), assuming a total fertility value of 7.45. Total mortality is calculated after the formula of Acsádi and Nemeskéri (1970).

Population structure is reconstructed after the scheme of Siven (1991).

Of the individuals buried at Veselava, 30 % were children aged up to 14: children up to the age of 1 year comprised 1.2 %, and children aged 1–4 made up only 7.8 % (Table 1). The number of children aged 5–14 is high in proportion to the number of adults (0.4). In most populations this figure is in the range of 0.2–0.3 (Bocquet-Appel, Masset 1977). According to historical demography data, child mortality up to the age of 1 year constitutes up to 25 % of total annual mortality, with 40–55% of mortality in the age group up to 4 years. In order to compensate for children not represented, the number of children aged 0–4 was increased to 45 % of the total number of individuals. This allows the errors in palaeodemographic calculations resulting from non-represented children to be reduced. Thus, average newborn life expectancy is reduced after compensation from 25.0 years to 18.7 years, which is a more objective figure (Table 1). Total mortality in the population was high: 53.5 per thousand.

Three mortality maxima can be distinguished for the inhabitants of Veselava:

1) the first consists of mortality among the children aged 0–4 years, for which compensation has been made in the calculations,

2) the second appears in the age range of 15–19, and is not characteristic of a balanced population. Increased mortality in this period may indicate epidemics or harsh social conditions,

3) the third maximum appears in the age range of 30–40, the period that sees the highest mortality among females and males (Fig. 1). The proportion of individuals surviving longer than 50 years is small: 5.4%.

Table 1. Summarised demographic data on the Veselava burials

Index	
Number of burials	877
Proportion of subadults d_{0-19}, %	46.0
Proportion of subadults d_{0-19}, % after correction of D_{0-4} to 45 %	60.6
Juvenitility index (D_{5-14}/ D_{20+})	0.40
Index of masculinisation (Males/ Females)	0.87
Average newborn life expectancy (e^0_0), years	25.0
Average newborn life expectancy (e^0_0), years*	18.7
Average male life expectancy (e^0_{20}), years	19.0
Average female life expectancy (e^0_{20}), years	13.9
Potential gross reproductive rate, R_{pot}	0.550
Number of children per female (C)	4.1
Net reproduction rate, R_0	1.05
Total mortality M $\%_0$	53.5

* After correction of D_{0-4} to 45 %

As regards the adult burials, it should first be mentioned that, based on the osteological material that could be sexed, the number of female burials is slightly in excess of the number of males (the ratio of males to females is 0.87). This may be connected with high mortality among young women, in the age group 15–35 (Fig. 2). This age group constitutes 67.8% of all female burials in the cemetery, which testifies to particularly high mortality during the most active reproductive period. Because of the high mortality among young women, the mean number of children per woman (including those who had no children) is 4.1, and female life expectancy at age 20, e^0_{20}, was only 13.9 years. Among males, the highest mortality is in the age group 30–40, with mortality remaining high in the age group 40–50 (Fig. 2).

In contrast to females, males do not show increased mortality in the age groups 15–30, and 13.6 % of males survive longer than age 50. Life expectancy among males at age 20, e^0_{20}, is 19.0 years. Accordingly, survivorship among males aged 25–50 is 18.8 % higher than among females (Fig. 3).

Comparing adult life expectancy among the inhabitants of Veselava with the figures for Latvia and Lithuania in the 14th–18th century, we see that the figures for Veselava are low (Fig. 4). Total mortality was high: 53.5 per thousand.

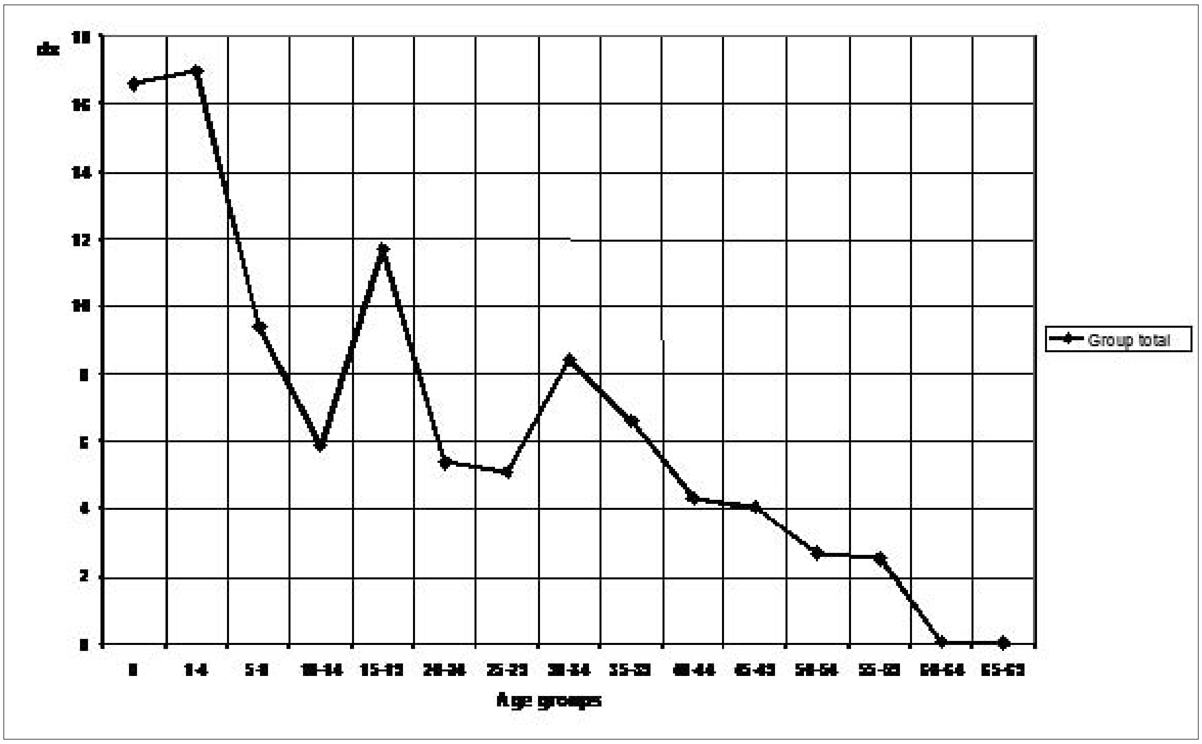


Fig. 1. Age structure of total mortality among the individuals subject to study, after compensation for children aged 0–4 years.

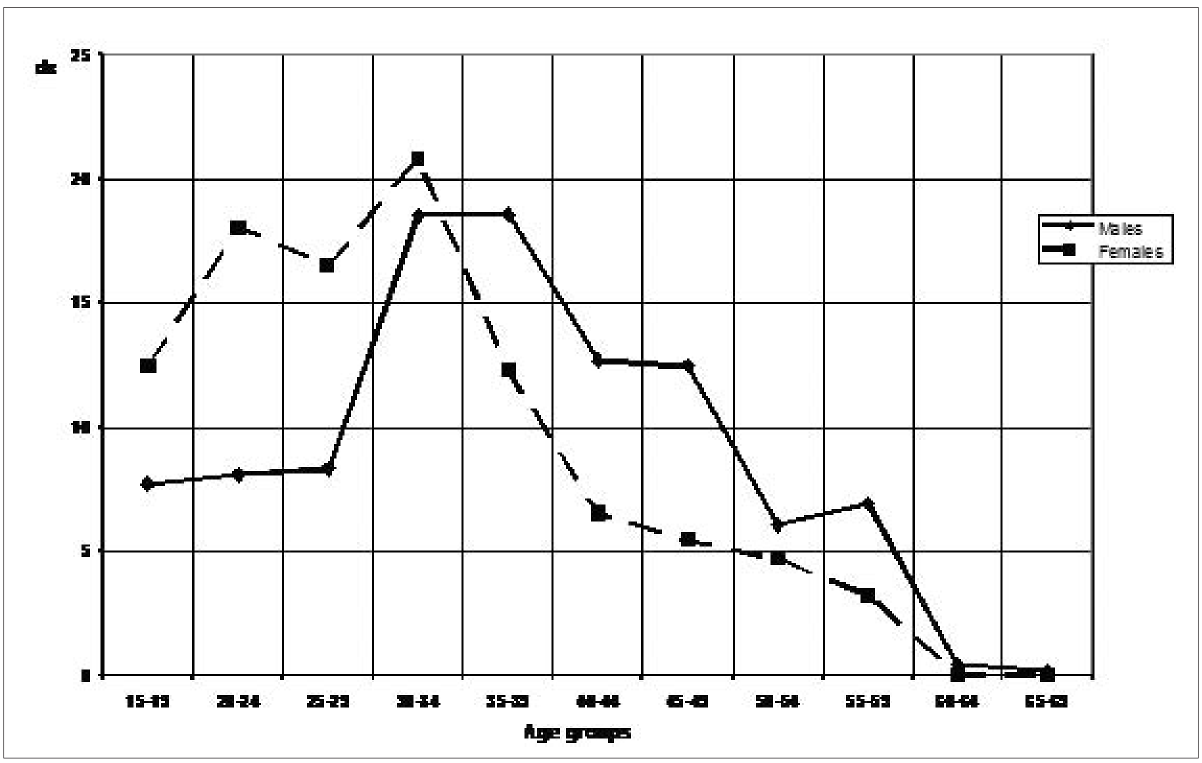


Fig. 2. Age structure of male and female mortality.

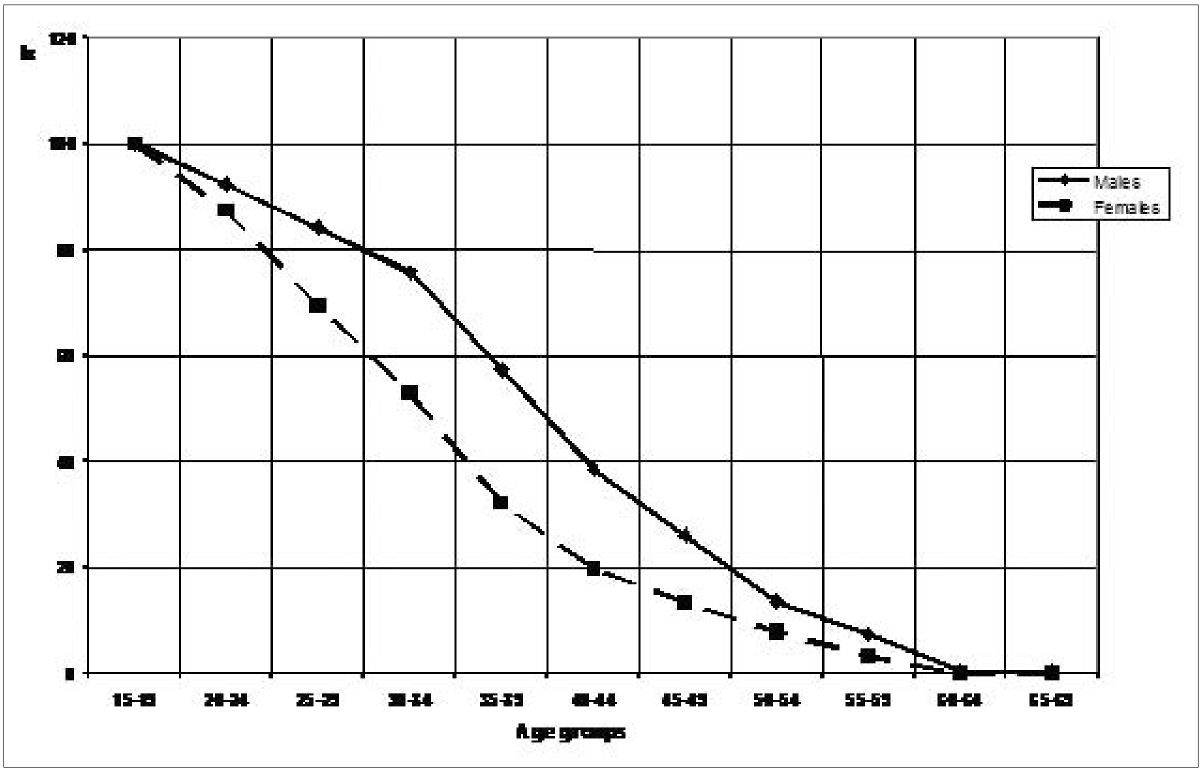


Fig. 3. Male and female survivorship in particular age ranges.

Calculation of the population structure for the inhabitants of Veselava indicates that 21% were children up to the age of 4; 31 % were children aged 5–14; 12% were juveniles aged 15–19; 34.3% were in the age range of 20–50, and only 1.5% were older than 50. Overall, the population was young, since children and juveniles up to the age of 20 made up 64% of the total population (Fig. 5). At the age of 25, there is a predominance of females in the population, but because of high female mortality, males predominate from age 30 upwards (Fig. 6).

The palaeodemographic statistics for the inhabitants of Veselava indicate that socio-economic and epidemiological conditions were adverse, something that significantly influenced mortality among young juveniles and young women.

Experimental

Instrumentation

Measurements were performed using a Perkin Elmer ELAN DRC-e ICP-MS spectrometer with cross-flow nebulizer. External calibration was performed using Merck multi-element stock solutions. Four calibration standard solutions (5; 15; 50 100 ppb) were used for calibration of the instrument. The calibration curve was linear over the whole range of the measured concentrations ($r \geq 0.9999$). The optimum conditions of spectrometer are presented in Table 2.

Table 2. ICP-MS spectrometer optimal measurement conditions

Measurement conditions	
Argon plasma gas flow	15 L min^{-1}
Auxiliary gas flow	1.2 L min^{-1}
Nebulizer gas flow	0.99 L min^{-1}
ICP – RF power	1270 W
Pulse stage voltage	750 W
Lens voltage	8.1 V
Integration time	2000 ms
Dwell time	50 ms
Number of runs	5

An Anton Paar 300 microwave oven digestion system was used. The control temperature was programmed to 125 °C and maximum microwave power (600 W) was applied from the beginning, decreasing later till 350 W. If the temperature of one of the eight vessels exceeded the programmed value, the power was regulated automatically and the temperature held constant for the remaining digestion time (approx. 20 minutes). Each digestion run included seven samples and one blank. The volume of acids in the vessels varied from 6 to 50 mL.

Samples and sample preparation

This study represents an attempt to analyse the paleodiet of the 14th–17th century population of Latvia, using as an example 28 male and 12 female inhuma-

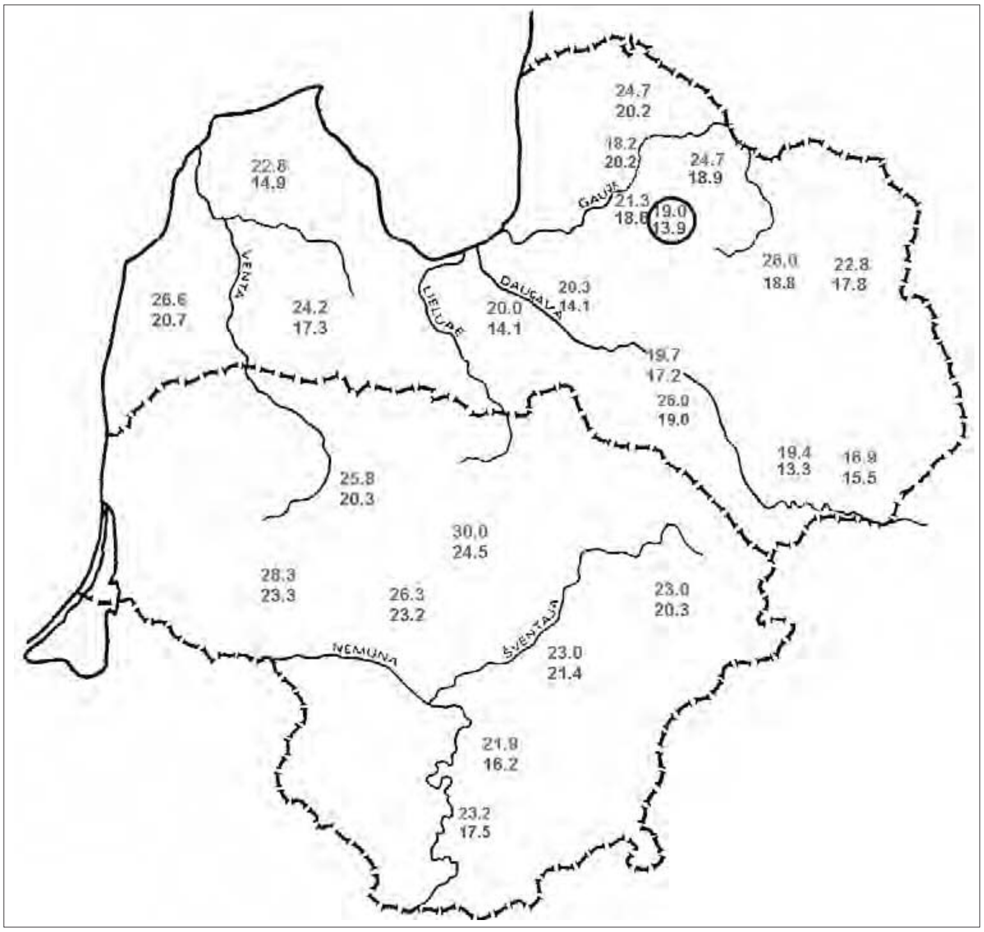


Fig. 4. Life expectancy at age 20, e^0_{20}, among males (upper figure) and females (lower figure) in Latvia and Lithuania in the 14th–18th century (incorporating data from *Česnys, Balčiūniene 1988, Jankauskas 1995*).

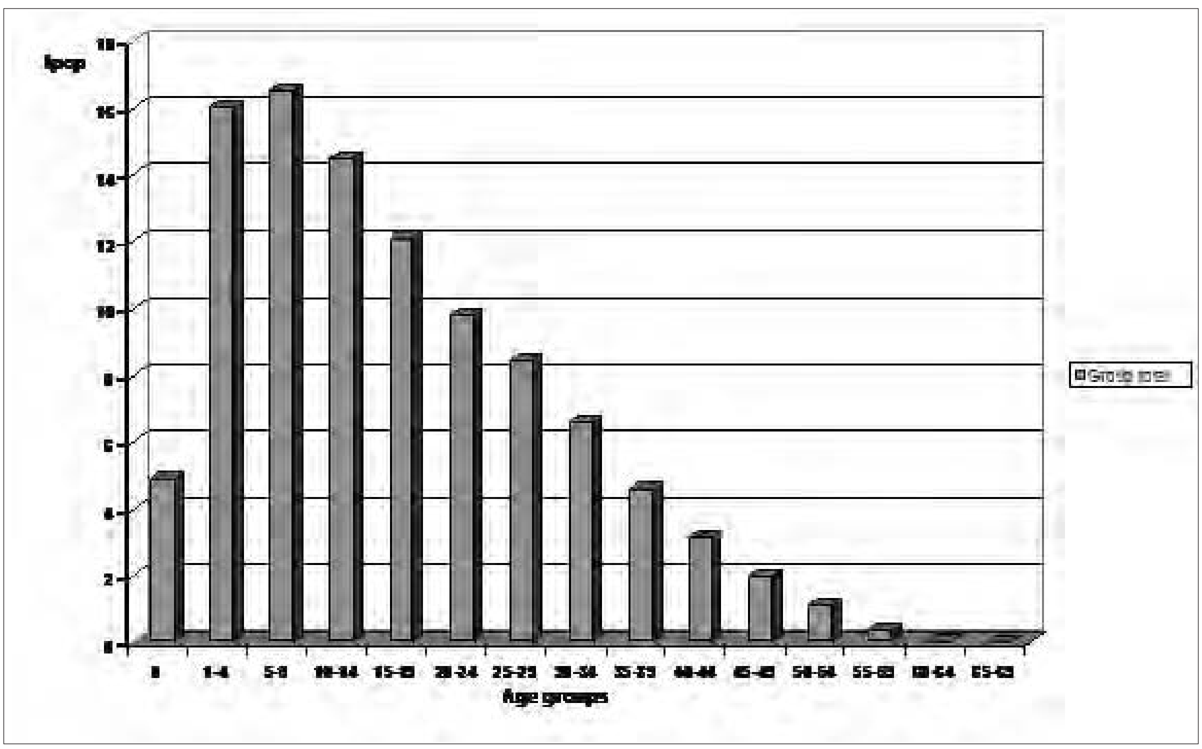


Fig. 5. Hypothetical overall population structure of the individuals buried at Veselava after compensation for children aged 0–4.

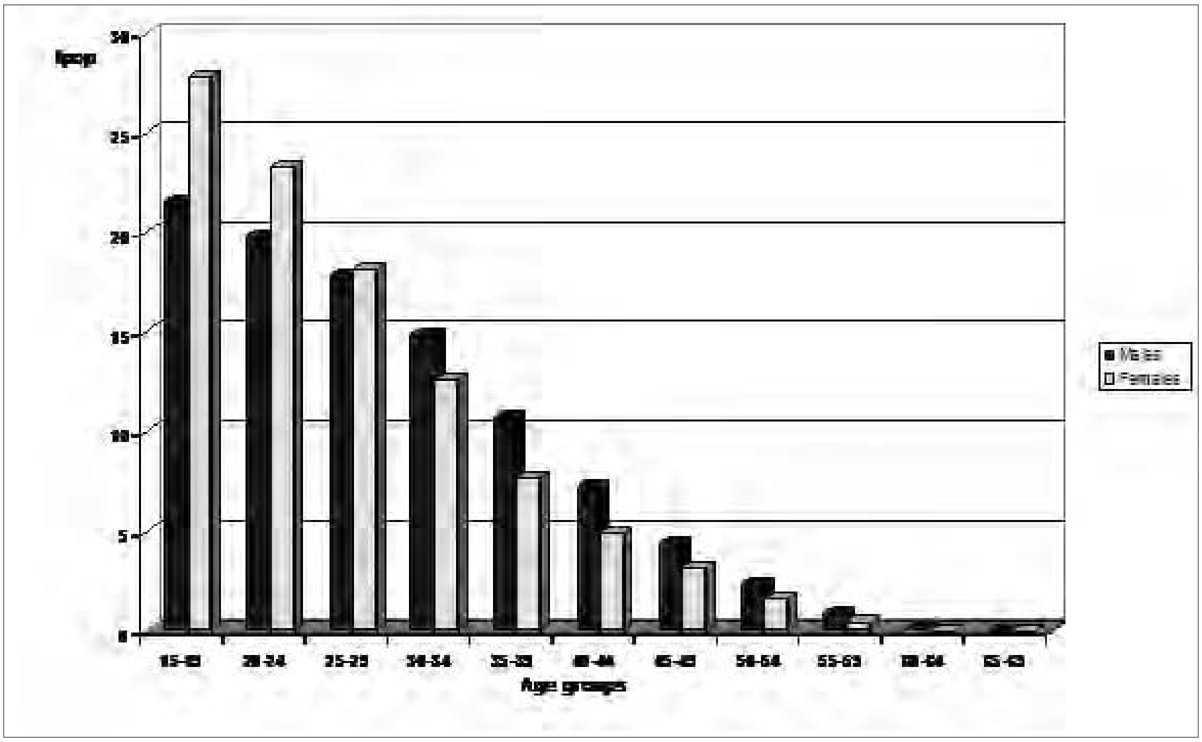


Fig. 6. Hypothetical population structure of the adult individuals buried at Veselava.

tions from Veselava cemetery. Additionally, soil samples were analysed.

The bones were rinsed with deionised water. Samples were taken from the major part of the cancellous bone from the femoral head using a drill. Homogenisation and grinding was performed using a Retsch ball miles MM 301. A 6-minute grinding mill program was used, at 30 Hz frequency. The samples were dried in an oven at 105 ^{0}C for 2 hours. When preparing the samples for chemical analysis, 0.3 g of dried bone powder with precision 0.0001 g was weighed. The samples were placed in a PTFE pressure vessel and a mixture of 4mL HNO_3 (Merck, suprapur) and 2mL H_2O_2 (Merck, suprapur) was added. The closed vessels were placed in the microwave oven-assisted sample digestion system and heated for 40 min (maximum temperature: T = 125 ^{0}C, maximum pressure: 35–40 bar). After cooling, the digested samples were diluted to 25.0 mL with deionised water. The obtained solutions were diluted 10 and 50 times with deionised water before the analysis by ICP-MS instrument.

Quality control and method validation were performed by analysis of NIST-SRM 1486 (animal meal) standard reference material.

Twenty soil samples were collected at the cemetery site. Sampling was performed in June 2007. The soil samples were weighed and stored in cardboard boxes, and then dried in an oven with a fan at 50 ^{0}C until constant weight was reached, after which they were sieved through a 1 mm mesh.

10.00 g of the air-dried soil was transferred into a 50 mL beaker, and 50 mL of water added. The pH was measured after equilibration in an end-over-end 16 h.

20.00 g of dried soil was transferred into an Erlenmeyer flask and 100 mL 0.5 M HNO_3 added. The extract was shaken for 30 minutes with shaker and later filtered into a polyethylene flask (Ranst *et al.* 1999).

After digestion, the metal content (Al, Cr, Mn, Fe, Ni, Cu, Zn, Cd and Pb) in the soil samples was determined with ICP-AES.

Results and discussion

Soil acidification, the presence of soot and soluble salts, the medium-grained sandy soil, and 'open' structures seem to be the main factors accelerating deterioration. The degree of metal mobility was related to soil pH and soil texture. The soil type in the study area was mainly sandy, and the cemetery constitutes an open structure. Most of the bone samples from the excavated area were very poorly preserved.

On the site as a whole, soil pH values ranged from 7.15 to 8.12. Table 3 presents element availability to the soil solution. Al, Fe and Mn are relative abundant elements in the sands, but are highly insoluble. Cation exchange capacity is very low. The sandy soil is low in organic matter.

Table 3. The mean concentration values (µg g^{-1}) of elements available to the soil solution in the analysed soil samples; n=20.

Element	Mean	SD
Al	1186	335
Cr	0.55	0.14
Mn	34	12
Fe	706	284
Ni	0.33	0.18
Cu	2.4	1.7
Zn	4.4	1.9
Cd	0.03	0.01
Pb	1.2	0.8

The small percentage of each element available to the soil solution indicates that it would have had a small influence on the archaeological bone mineral and can be related as background level.

The high content of Ca and P can effect the determination of elements using ICP-MS. The sample preparation method and analysis method with ICP-MS was validated by SRM. The results from the analyses of NIST-SRM-1486 (animal bone) are presented in Table 4. The obtained results illustrate the applicability of the proposed method for determination of Mn, Cu, Zn, Sr, Cd and Pb in bone samples. All analysed results are in a good agreement with certified results.

Table 4. ICP-MS analysis results of the bone powder standard reference material (NIST SRM -1486) after acid microwave digestion; n = 6.

Element	Concentration µg g^{-1}	
	Analysed	Certified
Mn	1.16±0.03	1
Cu	0.72±0.11	0.8
Zn	138±16	147±16
Sr	266±7	264±7
Cd	0.0029±0.0004	0.003
Pb	1.34±0.14	1.34±0.01

The elemental content was analysed in 40 archaeological human bone samples to find any significant differences between the sexes in terms of elemental content. The obtained results are shown in Table 5.

Table 5. The content of elements in archaeological bone samples analysed by ICP-MS (µg g^{-1}); n=40.

Elements	Female		Male	
	Mean	SD	Mean	SD
Mn	149	75	120	64
Cu	1.70	0.47	1.79	0.51
Zn	106	21	119	24
Sr	85	19	79	13
Ba	28.2	9.6	25.9	9.7
Cd	0.1	0.05	0.1	0.04
Pb	2.3	1.4	2.4	1.2

Strontium, manganese, and calcium are usually found in higher quantities in plant resources. Zinc and copper show higher concentrations in animal foods. Other elements, such as Cd and Pb, describe anthropogenic activities and environmental pollution.

Strontium enters the food chain at the level of plants. Higher strontium levels reflect a higher portion of vegetal food in the diet. It is found that strontium content effect lactation period in female life (Mays 2003), but in the current research, the variation of strontium content was not significant in female and male bone samples.

Manganese ions can be accumulated from the soil solution and enrich the bones. The comparison of the results of analysed soil and bone samples shows that the level of manganese content is approximately 4 times higher in the inhabitant bones than in the soil solution. In our opinion, this could not affect the manganese content in bones. The strontium and manganese content was slightly higher in female than male bones.

Barium has a strong affinity to PO_4^{3-} and is bound in the bones more strongly than Ca. The content of Ba also characterises the quantity of plant foods in diet.

The Zn content in the bones does not change so rapidly over time, and it is not affected by the soil solution. So, Zn and Sr can serve as approximate indicators of the proportional presence of vegetal and animal albumens in the diet. A slightly higher mean level of zinc was found in male bones.

There is more Cu in the bones of carnivores than in those of herbivores. The analysis of Cu content showed an increased level in male bone samples.

Looking at all of the elements mentioned (Sr, Mn, Ba, Cu and Zn) we can see that the content of Sr and Mn is higher in the analysed female bone samples, while the content of Zn and Cu is slightly higher in male bone samples.

Cadmium and lead are toxic elements. Sources of Cd include industrial fertilizers, fly ash from fossil fuels and metal processing plants. Lead sources are non-natural: lead may derive from vessels made of hard tin, pottery with lead glaze or lead tubes. The mean lead and cadmium contents in bone and soil samples showed the same levels. In the studied area, the Pb and Cd are at background level.

Conclusions

Rekonstruojant Veselavos The content of Sr, Mn, Ba, Cu, Zn, Pb and Cd in archaeological bones has been investigated, using inductively coupled plasma atomic mass spectrometry, and evaluated in order to reconstruct the palaeodiet. The method of preparing archaeological bone samples allows the accurate determination of studied elements. Digestion with a small amount of HNO_3 acid decreases the possibility of spectral overlap, and added H_2O_2 completely destroys organic matter.

Soil solution analyses will provide essential data to test various models concerning the chemical composition of secondary minerals and ionic substitution phases in fossil bone. Soil samples should be taken from various positions around each skeleton during excavation.

Analysed 40 archaeological human bone samples did not show significant differences between the sexes in terms of elemental content, but still some small tendencies were observed. It is thought that the 13th–17th century inhabitants of Veselava often had a meagre diet.

Acknowledgements

V. Rudovica is grateful for financial support from the European Social Fund (ESF).

References:

ACSÁDI, G. AND NEMESKÉRI, J., 1970. *History of Human Life Span and Mortality*. Budapest: Akademiai Kiado.

BOCQUET-APPEL, J.P. AND MASSET, C., 1977. Estimateurs en paléodémographie. *L'Homme*, 17 (4), 65–90.

BUIKSTRA, J.E. AND UBELAKER, D.H., 1994. Standards for data collection from human skeletal remains. *Arkansa: Arkansas Archeological Survey Research Series* No.44.

ČESNYS, G., BALČIŪNIENE, I., 1988. *Senųjų Lietuvos gyventojų antropologija.* Vilnius: Mokslas.

DJINGOVA, R., ZLATEVA, B., KULEFF, I., 2004. On the possibilities of ICP-MS for analysis of archaeological bones for reconstruction of paleodiet. *Talanta*, 63, 785-789.

FEREMBACH, D., SCHWIDETZKY, I., STLOUKAL, M., 1980. Recomendations for Age and Sex Diagnoses of Skeletons. *Journal of Human Evolution*, 9, 517-549.

FLORIAN, D., BARNES, R.M., KNAPP, G., 1998. Comparison of microwave-assisted leaching techniques for the determination of heavy metals in sediments, soils, and sludges. *Fresenius Journal of Analytical Chemistry*, 362(7), 558 – 565.

GAUDINO, S., GALAS, C., BELLI, M., BARBIZZI, S., ZORZI, P., JACIMOVIC, R., JERAN, Z., PATI, A., SANSONE, U., 2007. The role of different soil sample digestion methods on trace elements analysis: a comparison of ICP-MS and INAA measurement results. *Accreditation and Quality Assurance*, 12, 84–93.

GEORGIA, C.L., ARAUJO, M.H., GONZALEZ, M.H., FERREIRA, A.G., NOGUEIRA, A.R., NOBREGA J.A., 2002. Effect of acid concentration on closed-vessel microwave-assisted digestion of plant materials. *Spectrochima Acta*, 57(B), 2121-2132.

GILBERT, R.I., 1985. Stress, Paleonutrition and Trace Elements. *In:* Gilbert, R.I. and Milke, J.H. eds. *The Analysis of Prehistoric Diets.* Orlando: Academic Press, 339–357.

HENNEBERG, M., 1976. Reproductive possibilities and estimations of the biological dynamics of earlier human populations. *In :* Ward, R.H. and Weiss, K.M. ed. *The Demographic Evolution of Human Populations.* London: Academic Press, 41-48.

JANKAUSKAS, R., 1995. Vėlyvųjų viduramžių Alytaus antropoekologija (XIV – XVII a. senkapio duomenimis). *Lietuvos archeologija*, 11, 34–46.

MAYS, S., 2003. Bone strontium: calcium ratios and duration of breastfeeding in a Mediaeval skeletal population. *Journal of Archaeological Science*, 30, 731–741.

PATE, D.F., HUTTON, J.T., NORRISH, K., 1989. Ionic exchange between soil solution and bone: toward a predictive model. *Geochemistry*, 4, 303-316.

RANST, E.V., VERLOO, M., DEMEYER A., PAUWELS J.M., 1999. Manual for the Soil Chemistry and Fertility Laboratory. *Ghent University: Faculty Agricultural and Applied Biological Scienses.*

RÖSING, F.W. and JANKAUSKAS, R., 1997. Infant deficit in pre-modern burial sites. *In: The 8th Tartu international anthropological conference, 12–16 October Tartu*. Estonia: Tartu, 50-52.

SCHEUER, L. and BLACK, S., 2004. *The Juvenile skeleton*. Amsterdam: Elsevier Academic Press.

SIVENS, C.H., 1991. On Reconstruction the (Once) Living Population from Osteological Age Data. *International Journal of Anthropology,* 6, 2, 111 - 118.

SMRČKA, V., 2005. *Trace elements in bone tissue*. Charles University in Prague: The Karolinum Press.

TRIFITT, J. T., 1980. The organic matrix of bone tissue. *Fundamental and Clinical Bone Physiology,* 45 – 82.

Received: 25 April 2008; Revised: 20 October 2008;
Accepted: 20 September 2009

Dr. Vita Rudovica,
Department of Analytical Chemistry, University of Latvia
Kr. Valdemara iela 48, LV-1013 Riga
Latvia
e-mail: wita@navigator.lv

Assoc. prof. dr. Arturs Viksna
Department of Analytical Chemistry, University of Latvia
Kr.Valdemāra iela 48
LV-1013 Rīga
Latvia
e-mail: arturs.viksna@lu.lv.

Dr. Gunita Zariņa
Institute of Latvian History at the University of Latvia
Akademijas laukums 1
LV-1524 Riga Latvia
e-mail: lvi@lza.lv

Ilze Melne
Nacional History Museum, Archaeology Department
Pils laukums 3
LV-1050 Rīga
Latvia
e-mail: arheol@history-museum.lv

VIDURAMŽIŲ VESALAVOS GYVENTOJŲ SAMPRATA BIOARCHEOLOGINIU POŽIŪRIU

Vita Rudovica, Arturs Viksna,
Gunita Zariņa, Ilze Melne

Santrauka

Veselavos viduramžių kapinynas yra Cėsio rajone Latvijoje, apie 300 m į šiaurę nuo Veselavos dvarvietės. Šis kapinynas buvo aptiktas 1928 m. Veselavos kapinyną tyrinėjo Latvijos nacionalinio istorijos muziejaus archeologai Jānis Ciglis (2004 m.), Ilze Melne (2006–2007 m.). Iš viso buvo ištirti 676 palaidojimai. Rekonstruojant Veselavos kapinyne palaidotų gyventojų vartotą maisto racioną, buvo naudotas induktyvusis jungtinis plazminis atomus tiriantis spektrometras. Juo mirusiųjų kauluose buvo aptikta Sr, Mn, Ba, Cu, Zn, Pb ir Cd. Archeologinės medžiagos (kaulų) pavyzdžių paruošimas sudarė sąlygas tiksliai nustatyti nagrinėjamus elementus. Maisto virškinimas su mažu azoto rūgšties kiekiu sumažino spektrinių užsidengimų galimybę, o naudotas vandenilio peroksidas visai sunaikino organinę medžiagą.

Dirvos tirpdymo analizės suteikė pagrindinius bandinių duomenis skirtingų modelių rūpimai cheminei sudėčiai nustatyti, atmetant šalutinius mineralus ir jonizacijos kaitos fazes fosiliniuose kauluose. Dirvožemio mėginiai kasinėjimų metu buvo imami iš įvairių vietų šalia kiekvieno skeleto. Ištyrus 40-ies žmonių skeletų pavyzdžius, nepastebėta ženklaus cheminių elementų skirtumų lyčių požiūriu, tačiau visgi keletas smulkių nukrypimų užfiksuota. Tyrimų metu nustatyta, kad Veselavos gyventojai XIII–XVII a. dažnai maitinosi skurdžiai.

Vertė Algirdas Girininkas

Dailidės' fibula. Werner's class I J

NEW RESEARCH WORKS
IN THE EAST BALTIC REGION

A NOTE ON THE "SLAVIC" BOW FIBULAE OF WERNER'S CLASS I J

FLORIN CURTA

Abstract

A bronze fibula from Dailidės near Joniškis in eastern Lithuania is compared with its analogies found in Mazuria (the Olsztyn group), the Carpathian Basin, the Middle Dnieper region and southeastern Romania. The chronology of the group is established to the late sixth and early seventh century. The series may have originated in Mazuria and spread to other regions in the context of gift-giving exchange between regional elites.

Keywords: bow fibula, East Lithuanian Barrow Culture, female dress, Avars, Olsztyn group, Slavs.

More than thirteen years ago, in a paper on the cultural and trade relations of early medieval Lithuania, Adolfas Tautavičius published a bronze fibula said to be from Dailidės near Joniškis in eastern Lithuania (Tautavičius, 1972, p. 145 pl. 2/26).[1] Although nothing else is known about the whereabouts of the discovery, its good state of preservation suggests that the fibula in question may have been part of a burial assemblage, perhaps a cremation in one of the cemeteries of the so-called East Lithuanian Barrow Culture, which are known from that region of Lithuania.[2] The size and ornamentation of the fibula, including the typically linear decoration (Fig. 1.1) make it relatively easy to assign to Werner's class I J (Werner, 1950, pp. 154-155).[3] In addition to the Dailidės fibula, nine other specimens are currently known for this class, four of which have been found in the Baltic region. Werner called this and other classes of bow fibulae "Slavic," because he thought that they had been worn singly, not in pairs, a supposedly typical feature of the "ethnic costume" of Slavic women.[4] Moreover, Werner believed that "Slavic" fibulae were typically associated with cremations, the supposedly standard burial rite of the early Slavs, not with inhumations (Werner, 1950, p. 172). However, the "Slavic" fibulae from cemeteries excavated before World War II in Eastern Prussia (a region now divided between northeastern Poland and the Kaliningrad *oblast*' of Russia) were found in assemblages, which had nothing to do with what both Werner and subsequent generations of archaeologists would have recognized as typically "Slavic." Werner realized that his theory of the Slavic migration responsible for the distribution of "Slavic" bow fibulae in Eastern Europe would not work with specimens from the Baltic region. He proposed instead that in that, and only in that, case, bow fibulae be interpreted as a result of long-distance trade between the Baltic coast and the Danube region, along the so-called Amber Trail (Werner, 1950, p.167; Werner 1984).[5] Like many others in the 1950s, Werner

1 The fibula was found at some point before World War II and is now in the Vytautas the Great War Museum in Kaunas (inv. 1836). I am grateful to Audronė Bliujienė for having kindly procured a photograph of the fibula and allowed for its publication.

2 The closest to the presumed find spot is the cemetery of Degsnė-Labotiškės, for which see Tautavičius, 1970-1971. For the East Lithuanian Barrow Culture, see Tautavičius 1959. Fifty years after the publication of Tautavičius's paper, a new, updated survey of the problems raised by the East Lithuanian Barrow Culture is much needed. In the meantime, see Vaitkevičius, 2005.

3 Out of four specimens known to Werner, only one had been discovered in the Baltic region (Kielary). Werner also included in his class I J a fibula from an unknown location in Hungary, which in fact belongs to his class I K. The number of finds of I J fibulae from the Baltic region increased after Herbert Kühn published two specimens from Tumiany (Kühn, 1956, p. 101)). For variant 2 of his class P (fibulae with diamond-shaped foot-plate), Liudmil Vagalinski (Vagalinski, 1994, pp. 280 and 295; see also Vagalinski, 2003) linked the specimens known to Werner and Kühn to the fibulae from Óföldeák and Sărata Monteoru (he relied for the latter on oral information, although the fibula had by then been published by Fiedler, 1992, p. 83 fig. 11/9). The same number of specimens was known to Christina Katsougiannopoulou (Katsougiannopoulou, 1999, pp. 58-59), while Dan Gh. Teodor (Teodor, 1992) offers no discussion of such fibulae. No author dealing with fibulae of Werner's class I J seems to have been aware of the existence of the Dailidės specimen.

4 For the role of the "ethnic costume" in the German archaeology of the early Middle Ages, both before and after World War II, see the pertinent remarks of Fehr, 2000. The influence of the German school of archaeology is certainly responsible for the widespread acceptance in Eastern Europe of such ideas as those espoused by Joachim Werner. To this day, the idea of an "ethnic" (almost "national") costume to be used for ethnic attribution of the archaeological evidence has very rarely, if ever, been questioned by Lithuanian or Latvian archaeologists. See, for example, Zariņa, 1959 and 1980; Vaškevičiutė 1992; Kazakevičius 1994.

5 By contrast, Werner advanced a fundamentally different model of interpretation for other classes of fibulae found in the Baltic region. According to him (Werner, 1961, pp.

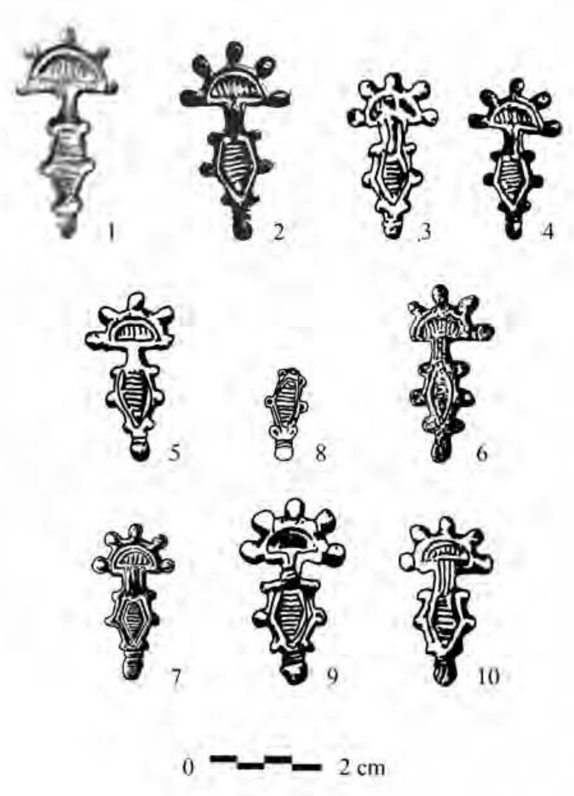


Fig. 1. Fibulae of Werner's class I J. Numbers refer to the list of finds in Annex 1. Drawings by author (3-6, 9, 10), all others after Simoni, 1980, fig. 2; Fiedler, 1992, p. 83 fig. 11.9; Korzukhina, 1996, p. 618 pl. 28.8. The photograph of the Dailidės fibula is published courtesy of the Vytautas the Great War Museum in Kaunas.

strongly believed that mortuary practices were a direct indication of status hierarchy (see Bartel, 1982; Bertaius, 2005). He therefore interpreted bow fibulae from the Baltic region as marking the status of the rich "amber lords" of the North (Werner, 1984). Until recently, Werner's ideas were fully embraced by many archaeologists, who never bothered to question his assumptions.[6]

My purpose in this paper is to re-examine the idea of explaining the distribution of "Slavic" bow fibulae in Eastern Europe in terms of migration, on the basis of the evidence of fibulae of Werner's class I J. Were brooches found in the Baltic region truly obtained from the Slavs in the Danube region by means of trade with amber? Conversely, was the presence of such brooches in the Danube region the result of emigration from territories farther to the north and northeast? In order to answer those questions, one needs to consider first the distribution of ornamental patterns and the chronology of the archaeological assemblages in which specimens of Werner's class I J were found. Only one fragmentary specimen is known, and all known fibulae of that class are remarkably similar to each other in terms of the general layout and decoration. With the exception of the Dailidės fibula, the size of most specimens varies around five centimeters (the shortest being the fibula from Pastyrs'ke, with 4.5 cm, the longest after Dailidės being the brooch from grave 56 in Tumiany, with 5.5 cm). Fibulae found at considerable distance from each other, such as Novi Banovci (Serbia) and Kielary (Poland) are not only of the same size, but also similar in many other details, such as the terminal lobe (Fig. 1.3 and 5).[7] The Dailidės fibula does not have any such parallel, as no analogy exists within Werner's class I J for its narrow bow or for the lack of a frame for the linear decoration of the foot-plate, which is otherwise distinctly visible even on specimens supposedly deformed by fire, such as that from grave 1321 in Sărata Monteoru. The same appears to be true for the Óföldeák brooch, the foot-plate knobs of which are conspicuously more prominent than those of any other fibula in the class. Despite such differences in detail, all members of Werner's I J class share the following characteristics: a semicircular head-plate covered with a vertically arranged linear motif; five knobs, all of equal size and shape; a ribbed bow; a diamond-shaped foot-plate with a horizontally arranged linear motif and three pairs of more or less prominent knobs; a terminal lobe with no decoration.[8] Defined in such a way, Werner's class I J is not different in terms of proportions and location of the ornament from class I F, for which clear links can be identified to the late fifth- or early sixth-century metalwork in the Lower and Middle Danube region (Curta and Dupoi, 1994-1995, pp. 222, 231 figs. 12-13, and 232 fig. 14; Curta, 2008, p. 468).[9] Given that the two classes have also similar distributions in Eastern Europe (Figs. 2-3), it

317-318), luxurious gilded silver, "Frankish" brooches found outside their production centers in northwestern Europe did not signal trade, but matrimonial alliances, gift giving, and the like. Although not supported by any shred of evidence, Werner's idea of an early medieval Amber Trail is remarkably resistant: it has recently been adopted by both Russian and American scholars (Kulakov, 1994a, pp. 117-118; McCormick, 2001, pp. 78 and 370). For a critique of such views, see Curta, 2007.

6 But see Curta, 2004 and 2005. For Werner's ideas taken at face value, see Okulicz-Kozaryn, 1997; Kowalski, 2000, p. 235.

7 On the other hand, the Negotin and the Novi Banovci fibulae, both found in northern Serbia are also very similar to each other.

8 Despite the fact that Werner's class I J belongs to his group of "Slavic" bow fibulae with terminal lobes in the form of a *human* mask.

9 For fibulae of both classes (I F and I J), the ratio between the length and the width of the diamond-shaped foot-plate, with its three pairs of knobs, is remarkably similar. Moreover, some of the smallest fibulae of Werner's class I F – such as that from grave 501 in Kielary – are of the same size as some of the largest fibulae of Werner's class I J.

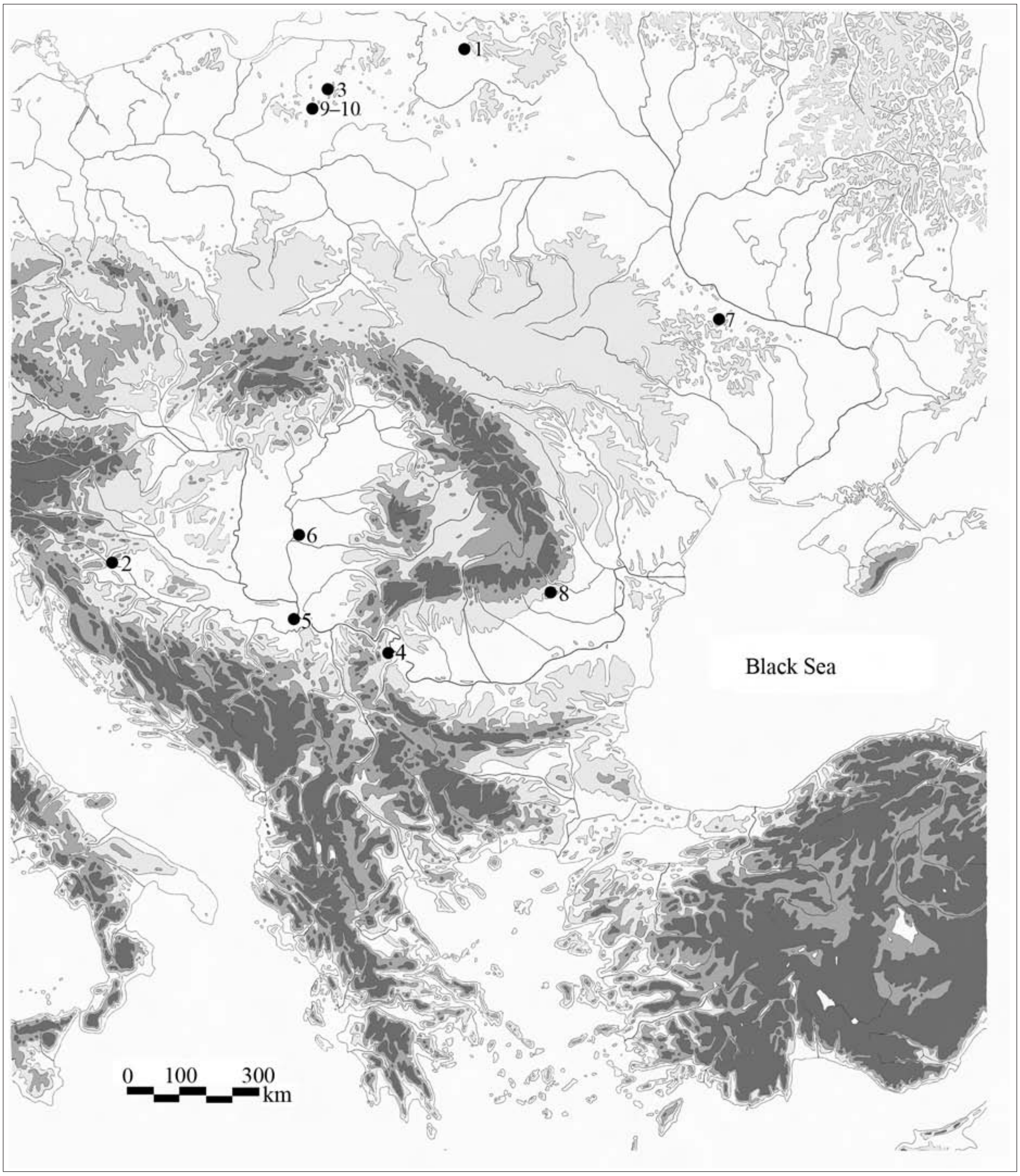


Fig. 2. The distribution of fibulae of Werner's class I J in Eastern Europe. Numbers refer to the list of finds in Annex 1.

is quite possible that fibulae of Werner's class I J were imitations of I F fibulae, with a simple linear ornament replacing the scrollwork decoration. But where did that linear ornament originate? At a first glimpse, the closest analogy is the chip-carved, linear ornament on the fifth-century brooches of the Cluj-Someşeni-Ţaga or Hács-Bendékpuszta series (Protase, 2003; Harhoiu, 1990, p. 186; Kiss, 1995, pp. 297 and 299; 298 fig. 12.4; 300 fig. 13.1, 2, 8, 9). However, and leaving aside the chronological problems raised by such analogies, none of the fifth-century brooches offers quite the same visual contrast between the vertical arrangement of the linear decoration of the head-plate and the horizontal arrangement on the foot-plate. The same ornamental principle may be found also on imitations of fibulae of the Csongrád class produced in the early sixth century in Mazuria (Hilberg, 2003, pp. 301-302; 302 fig. 7 lower row).[10] Can the "Slavic" bow fibulae of Werner's class I J be of the same date?

[10] Another imitation of a fibula of the Csongrád class is known from the Middle Dnieper region (Parczewski, 1991, p. 121 fig. 3.4 and pl. 2.3). The parallel has been first noted by Katsougiannopoulou, 1999, p. 59. On the other hand, a similar principle was applied to the linear decoration of

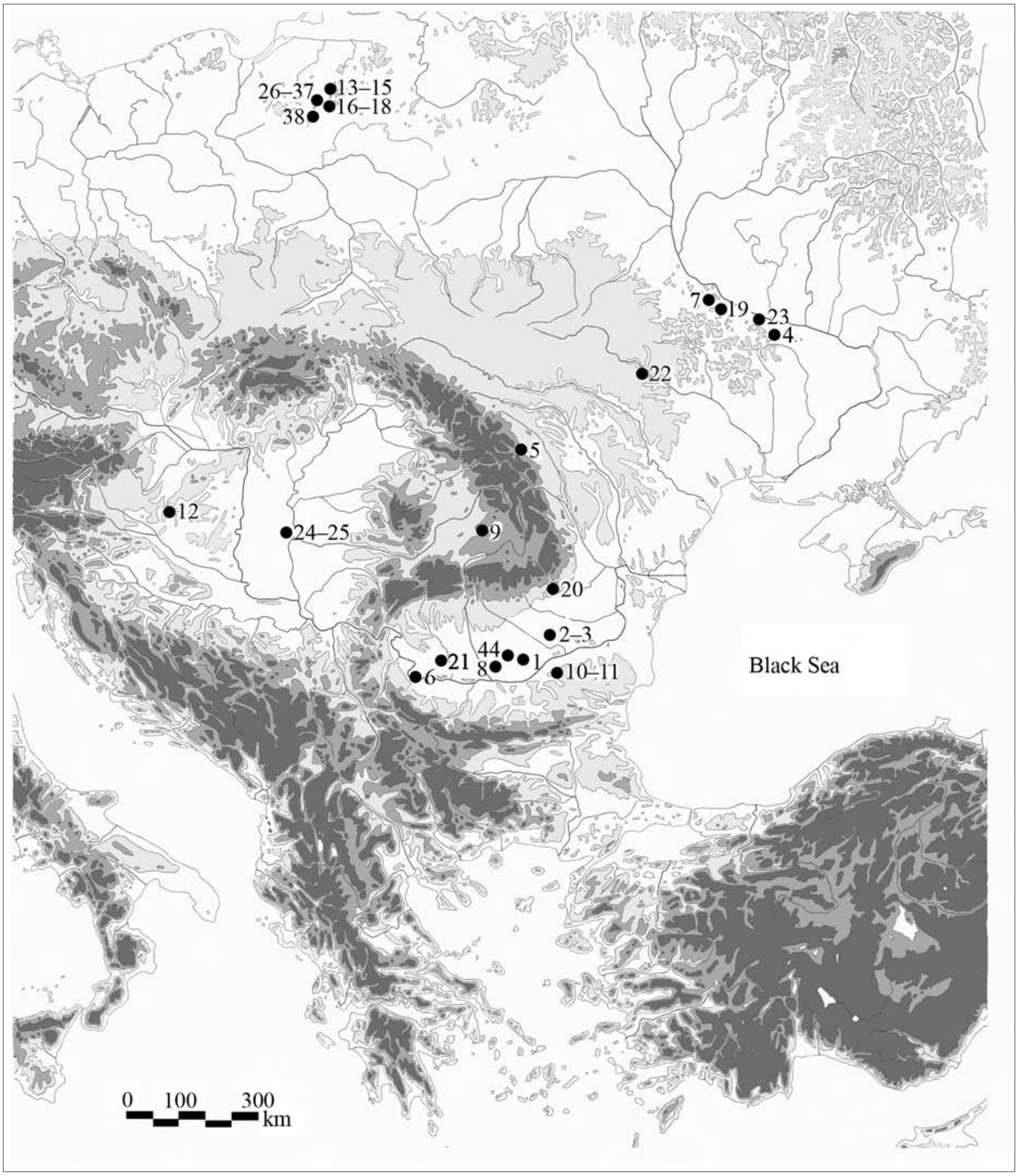


Fig. 3. The distribution of fibulae of Werner's class I F in Eastern Europe. Numbers refer to the list of finds in Annex 2.

Only three of the ten specimens known so far have been found in burial assemblages, and of those only two may be used for a discussion of chronology. The Óföldeák fibula was found in an inhumation grave together with twelve glass beads (Fig. 4). Three of them have an eye-shaped ornamental pattern, with wart-like applications. Those are beads of Pásztor's class I F (Pásztor, 1995, pp. 87 with Table 1 and 92 with Diagram 3), which is abundantly represented in Early Avar assemblages in Hungary. Of all those assemblages with such beads, two have also produced coins, the latest of which was struck for Emperor Phocas (602-610).[11] Together with that coin was also a segmented bead of Pásztor's class T, very similar to that from Óföldeák

the "Slavic" bow fibulae of Werner's class I D from Plenița and Negulești (Teodor, 1992, pp. 138 and 145 fig. 4.1, 2).

[11] Grave 7 in Tác (forged solidus, 582/3): Fülöp, 1987; Somogyi, 1997, pp. 89-90. Grave 116 in Jutas (follis struck for Phocas over an older coin of Emperor Maurice): Rhé and Fettich, 1931, p. 25 and pl. 3; Garam, 1992, p. 141 and pls. 30-31; Somogyi, 1997, pp. 47-48. A gold coin struck for Phocas is also known from the environs of Óföldeák, perhaps from the same cemetery on the Lelei Street in which the grave with the I J fibula was found (Somogyi, 1997, pp. 69-70; Szentpéteri, 2002, pp. 270-271).

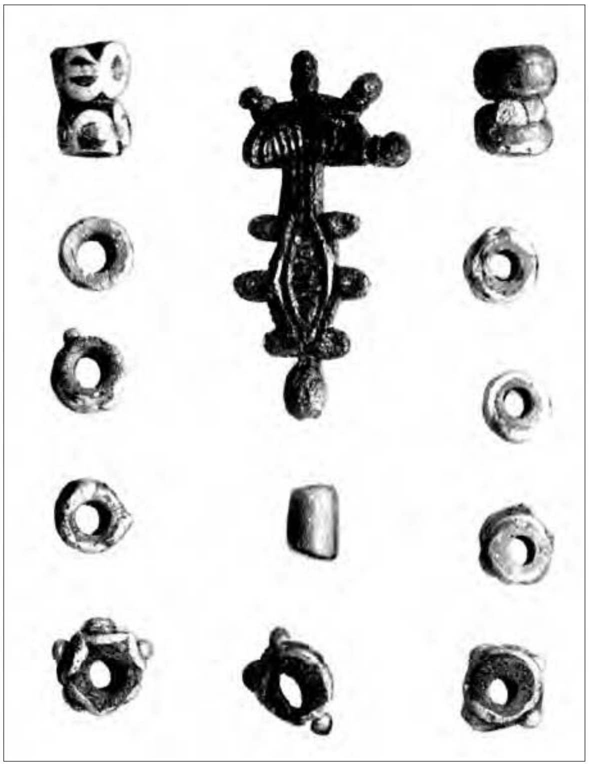


Fig. 4. Óföldeák: bow fibula and glass beads. After Csallány, 1961, pl. 259.1.

(Fig. 4, upper right corner).Finally, three simple beads from Óföldeák (Fig. 4, second and fourth on the left, and third on the right) belong to Pásztor's class S, the dating of which is secured by specimens found together with coins struck for Emperor Heraclius (610-641).[12] The beads from Óföldeák thus point to a date for that assemblage, which may be placed within the first two decades of the seventh century. This is not contradicted by the evidence from grave 56 in Tumiany (Fig. 5). The copper-alloy belt buckle found together with the I J fibula has no analogies in Mazuria. However, judging from the published drawing (Kulakov, 1989, p. 252 fig. 36.3), this appears to be a much older piece recycled for a new buckle, as the fragment of the plate attached to the buckle loop is most certainly of a later date. Silver or copper-alloy loops with a scrollwork decoration and characteristic, undecorated "beds" for the tongues often accompany lavishly decorated buckles with diamond-shaped plates produced in the Carpathian Basin around AD 500. Similar in size and decoration to the Tumiany buckle is the loop of a buckle found in Gyula (Hungary) with an intricate animal-style ornament, most typical for the late fifth or early sixth century (Csallány, 1941, p. 132 and pl. 39.2; Nagy, 2007, pp. 85 and 173 pl. 39). Like the Tumiany

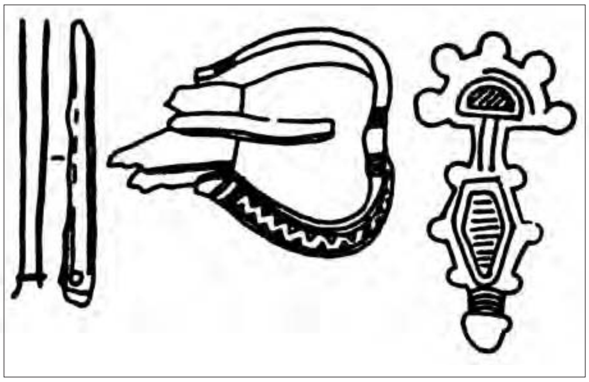


Fig. 5. Tumiany, grave 56: strap end, belt buckle, and bow fibula. After Kulakov, 1989, p. 252 fig. 36.3.

buckle, the Gyula specimen is a hybrid, most likely recycling an older plate and loop. Unfortunately, nothing is known about the circumstances in which the buckle was found. If any conclusion may be drawn from this analogy, it is that an early sixth century date for the production of the Tumiany buckle loop does not necessarily apply as well to the assemblage in which the buckle was found. Without contextual information, it is impossible to tell how much later after being produced was the loop re-used for the buckle, which eventually was deposited in grave 56.

Nonetheless, there may be indirect evidence that the I J fibula found its way in that grave together with the buckle during the second half of the sixth century or around AD 600, at the latest. As already mentioned, the only other group of fibulae using the linear ornament so typical for the I J class in the same manner (vertical arrangement on the head-plate and horizontal arrangement on the footplate) are imitations of Csongrád-type fibulae produced in Mazuria (Fig. 6). One such imitation was found in grave 629 in Miętkie together with a bronze buckle with rectangular plate and rectangular loop (Kulakov, 1989, pp. 182 and 233, fig. 17.2). Similar buckles are known from Tumiany (grave 13; Kulakov, 1989, p.187), but also from a cremation grave in Elbląg, which also produced a spear-shaped strap end (Kulakov, 1990, p. 97 pl. 3.15), of a type dated in Tumiany to the middle or second half of the sixth century (Kowalski, 1991, p.76; Kowalski, 2000, p.214). The buckle in grave 13 of the Tumiany cemetery was associated with a silvered bronze, rectangular brooch. Such brooches appear in other graves of that same cemetery in association with spear-shaped strap ends (grave 30a: Kulakov, 1989, pp.189 and 243 fig. 27.3), trapeze-shaped pendants (grave 64: Kulakov, 1989, pp.192 and 254 fig. 28.3), or spectacle-like pendants (grave 103: Kulakov 1989, pp. 195 and 262 fig. 46.1[13]), all of

[12] Krstur: Milleker, 1893, p. 305 with figs. 47-48; Somogyi, 1997, p. 58. Grave 5 in Szegvár-Sapoldal: Lőrinczy, 1994, p. 328; Somogyi, 1997, pp. 85-87. Grave 132 in Linz-Zizlau: Ladenbauer-Orel, 1960, pp. 55-56 with pls. 13.132 and 24.

[13] The same combination is documented for grave 109 from the Miętkie cemetery (Kulakov, 1989, pp. 183 and 234 fig. 18.2).

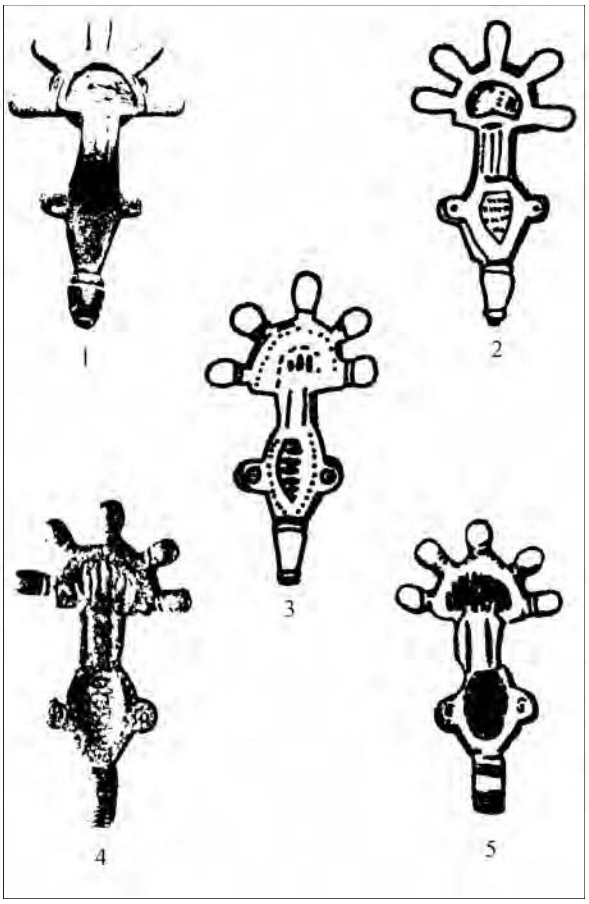


Fig. 6. Mazurian imitations of Csongrád-type fibulae: 1 – Kielary, grave 31; 2 – Miętkie, grave 455; 3 – Miętkie, grave 629; 4 – unknown location in Eastern Prussia; 5 – unknown location in the Middle Dnieper region. After Kühn, 1981, pls. 39.244 and 62.404; Kulakov, 1989, p.229 fig. 13.3 and 233 fig. 17.2; Parczewski, 1991, 121 fig. 3.4.

which have been attributed by Jacek Kowalski to the earliest of the two chronological phases he claims to have found in the Tumiany cemetery (Kowalski, 2000, p. 214). I have shown elsewhere that a careful examination by statistical means of the burial assemblages from that cemetery proves Kowalski's idea of two phases to be wrong (Curta, 2006, pp.440-442 and 446). The Tumiany cemetery may have begun shortly before the middle of the sixth century and was abandoned at some point during or shortly after the first quarter of the seventh century. Neither the rectangular brooches, nor the buckles with rectangular plate and rectangular loop can be attributed to the latest burial phase, because of the association with grave goods most typical for the second half of the sixth century, especially spectacle- and trapeze-shaped pendants and spear-shaped strap ends. This further suggests that the local imitations of the Csongrád-type fibulae may also be of the same date. If so, it is at least possible that they coincided in time with fibulae of Werner's class I J with a similar linear ornament. Should a blanket dating to the late sixth century be accepted for the three Mazurian brooches of that class, then the lingering question is whether or not they served as source of inspiration for the manufacture of other fibulae found outside Mazuria. In other words, can one speak of a dissemination of brooch forms and design details? The great similarity between the fibulae from Novi Banovci and Tumiany (stray find) suggests that specimens found in the Carpathian Basin may have been produced in Mazuria or imitations of Mazurian originals. The slight chronological difference between the Tumiany (if the proposed dating is correct) and the Óföldeák fibulae substantiates the idea of I J brooches originating from the Baltic region. Most imitations of the Csongrád-type fibulae with linear ornament similar to that of the I J fibulae have been found in Mazurian assemblages.

Although the Dailidės fibula was most likely produced locally, it may well have imitated a Mazurian original. This is most remarkable, given that relations between the Olsztyn group in Mazuria and communities of the East Lithuanian Barrow Culture have so far not received sufficient scholarly attention, especially when compared with the much more studied relations between western Lithuania and Sambia (Žulkus 1991; Kulakov 1994b). Judging from the existing evidence, Mazuria may have been the intermediary through which the cultural influence from the Middle and Lower Danube region reached Eastern Lithuania. This may indeed be the case for the silver belt buckle found in a female burial in Ziboliškė near Švenčionys, in the vicinity of the Lithuanian-Belarus border, which is said to have a good analogy in Transylvania (Bliujienė, 2006, p. 147).[14] In terms of decorative elements, the "Slavic" bow fibula of Werner's class I D found on the other side of the border in a settlement excavated in Mikol'tsy, on the shore of Lake Narach, near Myadel' (Zverugo, 2005, pp. 104 and 121 fig. 68.2) is linked to specimens from Budapest and Bačko Petrovo Selo (Serbia), but also from Tumiany (Curta, 2006, pp. 427 fig. 3 and 428 fig. 4). The Dailidės and Mikol'tsy fibulae are unique finds in that they are both similar to specimens from Mazuria, but not to those from the neighboring regions in Belarus and Latvia. Werner's classes I D and I J are not represented among the "Slavic" bow fibulae found during the excavation of the early medieval stronghold in Nikadzimava near Horki, in eastern Belarus (Sedin 1994). Conversely, no analogies exist in Mazuria for the large fibula of Werner's class II B (Sedin, 1997,

[14] This may also be true for the foot-plate of a gilded, copper-alloy fibula from a male cremation burial in the Sudota 1 burial mound cemetery near Švenčionys. Although its scrollwork decoration suggests that the fibula in question may have been produced in the Middle Danube region, it may have been obtained through some intermediary in Mazuria. See Bliujienė, 2006, pp. 134 and 137 fig. 9.

p. 285 fig. 2.6).[15] Nor are there any analogies in Mazuria for the northernmost finds of "Slavic" bow fibulae in Eastern Europe, the two specimens of Werner's class II D found in Boķi (Latvia; Ciglis, 2001, pp. 53 and 58 fig. 7.2) and Jägala Jõessu near Tallinn (Korzukhina, 1996, pp. 414 and 686 pl. 96.4) or the I D brooch from Strīķi (Latvia; Atgāzis, 2001, p. 286 fig. 199/2).[16] Finally, no fibulae of Werner's class I B appear in Mazurian assemblages, which may be compared to those from Linkuhnen (now in Kaliningrad) and Schreitlauken (now in Sovetsk), on the border between Lithuania and the Kaliningrad *oblast'* of Russia (Kühn, 1981, pp. 209 and 317; pls. 50.319 and 75.502).[17] The evidence thus strongly suggests the existence of separate, mutually exclusive networks for the distribution of different types of bow fibulae in the Baltic region. The Olsztyn group in Mazuria may have mediated the contacts of the Danube region with communities of the East Lithuanian Barrow Culture, but not with those in the neighboring territories in western Lithuania or eastern Belarus. How can this privileged relation be explained?

It has been noted that the dissemination of a brooch form or of ornamental details may indicate one of three types of movement: of brooches (through gift-giving or trade), with or without their owner; of models of brooches, including templates for the reproduction of ornamental patterns; and of craftsmen carrying manufactured brooches of models (Leigh, 1991, p. 117; Hines, 1997, p. 213). Until recently, prevailing views about the organization of production in the early Middle Ages favored the third type of movement. However, the discovery of soapstone mold for bow fibulae in a sunken-featured building at Bernashivka near Mohyliv-Podil'skyi in Ukraine, together with other molds, smelting implements, and domestic pottery suggests a different model of interpretation, which allows for the possibility of a local production using a technology (the "lost-wax" procedure) capable of producing similar, but never identical fibulae (Vynokur 1997; see also Curta, 2006, p. 450).[18] Moreover, the absence of exact replication of any known fibula is a strong indication that each brooch or pair of brooches was produced as required, probably for one occasion at a time. That fibulae such as those from Novi Banovci and Tumiany look alike is an indication of imitation, but also of the movement of fibula designs across a vast area of Eastern Europe, on a north-south direction. Whether or not this may also indicate movement of people, it is hardly evidence for outright migration. Nor can there be any question of itinerant craftsmen. Between the Carpathian Basin to the south and the Baltic region to the north, there is a vast corridor completely devoid of fibula finds. This large area was however not devoid of settlements, yet no fibula of Werner's class I J was found on any of the many sites of the so-called Prague culture of southern Belarus, western Ukraine, or southern Poland (Gavritukhin 2003; Terpilovs'kyi 2005). Some have interpreted the general distribution of "Slavic" bow fibulae as a deliberate rejection of neighboring cultural models (Barford 2004). If so, then bow fibulae are not the only example of such a focused distribution. Both before and after 600, amber traveled southward as a form of gift exchange between elites in the Baltic region and those in the Avar qaganate or in the Middle Dnieper region (Curta 2007). The "amber lords" of the North did not exchange fibulae for amber; instead, they sent both to the south in exchange for regional alliances. In other words, instead of "index fossils" for migration, fibulae of Werner's class I J indicate long-distance contacts between East European elites.

I have argued elsewhere that despite the notorious danger associated with "reading" gender in burial assemblages as a direct reflection of social practices (Härke 2000), bow fibulae were not just part of the female dress, but also emblems of high social status (Curta 2005). "Slavic" bow fibulae may have marked aristocratic, married women in death, if not also in life. Brooches belonged to the outermost layer of clothing and were thus easily visible, perhaps the most visible of all dress accessories, a particular sort of badge. If that was a badge of social identity, then bow fibulae may have been exchanged between elites as gift-giving, possibly associated with matrimonial alliances. It has been noted that female cremation burials of the late fifth- and early sixth-century East Lithuanian Barrow Culture were relatively poor and included a standard "grave good kit" of one to four spindle whorls, an awl, a knife, and a sickle (Bliujienė, 2006, p. 137). Although little is known about how that "grave good kit" changed, if at all, during the late sixth or early seventh century, a burial marked with a I J fibula such as that from Dailidės was clearly exceptional. The status of the woman buried with such a brooch (if indeed the Dailidės fibula was part of a burial assemblages, and

[15] However, a fragmentary brooch is known from Tumiany, which belongs to the same class (Werner's II C) as two other fibulae found in Nikadzimava (Kühn, 1981, pp.102-103 and pl. 24.150; Sedin, 1997, p. 285 fig. 2.6).

[16] While no less than fourteen I D fibulae are known from Mazurian assemblages, none of them is similar to the Strīķi brooch (Curta, 2006, p. 427 fig. 3).

[17] However, two sites in the Kaliningrad oblast', Löbertshoff (now in Polessk) and Warengen (now Primorsk) have produced fibulae of Werner's class I C, with good analogies in the Mazurian cemeteries of Kosewo and Tumiany. See Curta, in print.

[18] Although no mold for the casting of bow fibulae has been found in Mikol'tsy, the site produced numerous smelting implements, including crucibles and ladles (Zverugo, 2005, pp. 109 and 131 fig. 78).

if that grave was that of a woman) may have derived from her or her husband's relations with the elites in Mazuria, themselves connected with the distant elites in the Carpathian Basin. That such a status may not have been simply ascribed to the woman at death results from the fact that bow fibulae, such as that from Mikol'tsy, have also been found on settlement sites, an indication that such dress accessories were used as badges of social identity not only in death, but also in life. At a time of shifting alliances and changing social and political relations within communities of the East Lithuanian Barrow Culture, producing and wearing a "Slavic" bow fibula may have been a strategy for creating a new sense of identity for social elites.

Summary

More than thirteen years ago, Adolfas Tautavičius published a bronze fibula from Dailidės near Joniškis in eastern Lithuania. Although nothing else is known about the whereabouts of the discovery, its good state of preservation suggests that the fibula in question may have been part of a burial assemblage, perhaps a cremation in one of the cemeteries of the so-called East Lithuanian Barrow Culture, which are known from that region of Lithuania. This is a specimen of Werner's class I J. In addition to the Dailidės fibula, nine other fibulae are currently known for this class, four of which have been found in the Baltic region. Werner called this and other classes of bow fibulae "Slavic," but the evidence does not support his idea of explaining the distribution of such fibulae in Eastern Europe in terms of migration. Nonetheless, fibulae of Werner's class I J found at considerable distance from each other (e.g., Novi Banovci and Kielary) are very similar. However, the Dailidės fibula appears so far to be a unique piece within its own class, in terms of both size and ornamentation. Using proportions and location of the ornament as criteria, fibulae of Werner's class I J do not differ much from brooches of Werner's class I F, for which clear links can be identified to the late fifth- or early sixth-century metalwork in the Lower and Middle Danube region Given that the two classes have also similar distributions in Eastern Europe, it is quite possible that fibulae of Werner's class I J were imitations of I F fibulae, with a simple linear ornament replacing the scrollwork decoration. On the other hand, a very similar ornament may be found also on imitations of fibulae of the Csongrád class produced in the early sixth century in Mazuria.

On the basis of the associated glass beads, the fibula from Óföldeák may be dated to the Early Avar period, perhaps to the first two decades of the seventh century. Fibulae from Kielary and Tumiany may be slightly earlier (late sixth century), if any value may be placed on their sharing the same ornamental principle with imitations of Csongrád-type fibulae, one of which, at least, may be dated to the late sixth century. If Werner's class I J originated in Mazuria, then the Dailidės fibula, although of local production, may well have imitated a Mazurian original. Relations between the Olsztyn group in Mazuria and communities of the East Lithuanian Barrow Culture are poorly understood, although they must have been responsible for other similar phenomena, such as the silver belt buckle from Ziboliškė near Švenčionys, or the "Slavic" bow fibula of Werner's class I D found in Mikol'tsy near Myadel'. By contrast, no analogies exist in Mazuria for the fibulae from the neighboring regions in Belarus (Nikadzimava), Latvia (Boķi and Strīķi), Estonia (Jägala Jõessu), and the Kaliningrad *oblast'* of Russia (Linkuhnen and Schreitlauken). The Dailidės fibula may indicate gift-giving exchange between the elites in the region of the East Lithuanian Barrow Culture and in Mazuria, the latter also connected with the distant elites in the Carpathian Basin.

References

ATGĀZIS, M., 2001. Vidējais dzelzs laikmets (400.-800. g.). *In*: GRADONIS, J., ed. *Latvijas senākā vēsture 9. g.t.pr. Kr.-1200. g.*. Riga: Latvijas vēstures institūta apgāds, 232-289.

BARTEL, B., 1982. A historical review of ethnological and archaeological analyses of mortuary practice. *Journal of Anthropological Archaeology,* 1, 32-58.

BERTAŠIUS, M., 2005. The archaeology of group: from situational construct to ethnic group. *In:* LANG, V., ed. *Culture and Material Culture. Papers from the First Theoretical Seminar of the Baltic Archaeologists (BASE) Held at the University of Tartu, Estonia, October 17th-19th, 2003*. Tartu/Riga/Vilnius: University of Tartu/University of Latvia/University of Vilnius, 29-38.

BLIUJIENĖ, A., 2006. Watershed between Eastern and Western Lithuania during the early and late Migration period. *Archaeologia Lituana* 7, 123-143.

BOBRINSKII, A. A., 1901. *Kurgany i sluchainye arkheologicheskie nakhodki bliz mestechka Smely*. Vol. 3. St. Petersburg: Balashev.

BRUN MID, J., 1905. Starine ranijega srednjega vijeka iz Hrvatske i Slavonije. *Vjesnik Hrvatskoga arheolokoga dru tva,* 8, 208-220.

CIGLIS, J., 2001. Some notes on the chronology of Latgallian and Selonian artefacts in the Middle Iron Age. *Archaeologia Lituana,* 2, 48-64.

CONSTANTINIU, M., 1966. Elemente romano-bizantine în cultura materială a populației autohtone din partea centrală a Munteniei în secolele VI-VII. *Studii şi cercetări de istorie veche,* 17 (4), 665-678.

CONSTANTINIU, M., AND PANAIT, P. I., 1965. O aşezare feudală timpurie la Băneasa-sat. *Cercetări arheologice în Bucureşti,* 2, 98-140.

CSALLÁNY, D., 1941. A szentes-nagyhegyi gepida sírlelet (1939) és régészeti kapcsolatai. *Archaeologiai Értesitő* 2, 127-161.

CSALLÁNY, D., 1961. *Archäologische Denkmäler der Gepiden im Mitteldonaubecken*. Budapest:Akadémiai kiadó.
CURTA, F., 2004. Werner's class I H of Slavic bow fibulae revisited. *Archaeologia Bulgarica* 8 (1), 59-78.
CURTA, F., 2005. Female dress and Slavic bow fibulae in Greece. *Hesperia* 74 (1), 101-146.
CURTA, F., 2006. *Slavic* bow fibulae? Werner's class I D revisited. *Acta Archaeologica Academiae Scientiarum Hungaricae* 57, 423-474.
CURTA, F., 2007. The Amber Trail in early medieval Eastern Europe. *In:* LIFSHITZ, F., AND CHAZELLE, C., eds. *Paradigms and Methods in Early Medieval Studies*, New York: Palgrave MacMillan, 61-79.
CURTA, F., 2008. Once again on bow fibulae of the 'Pietroasele type' (Werner's class I F). *Acta Archaeologica Academiae Scientiarum Hungaricae* 59, 465-492.
CURTA, F., In print. Some remarks on bow fibulae of Werner's class I C. *Slavia antiqua*
CURTA, F., AND DUPOI, V., 1994-1995. Über die Bügelfibel aus Pietroasele und ihre Verwandten. *Dacia* 38-39, 217-238.
DOLINESCU-FERCHE, S., 1974. *Aşezări din secolele III şi VI e.n. în sud-vestul Munteniei. Cercetările de la Dulceanca*. Bucharest : Editura Academiei Republicii Socialiste România.
DOLINESCU-FERCHE, S., 1992. Habitats du VI-e et VII-e siècles de notre ère à Dulceanca IV. *Dacia* 36, 125-177.
DOLINESCU-FERCHE, S., AND CONSTANTINIU, M., 1981. Un établissement du VI-e siècle à Bucarest. *Dacia* 25, 289-329.
DOLINESCU-FERCHE, S., AND VOEVOZEANU, P., 1969. O fibulă digitată descoperită la Vîrtoape. *Revista Muzeelor* 6 (4), 354-355.
FEHR, H., 2000. Hans Zeiss, Joachim Werner und die archäologischen Forschungen zur Merowingerzeit. *In:* STEUER, H., ed. *Eine hervorragend nationale Wissenschaft. Deutsche Prähistoriker zwischen 1900 und 1995*. Berlin/New York: Wlater de Gruyter, 311-415.
FIEDLER, U., 1992. *Studien zu Gräberfeldern des 6. bis 9. Jahrhunderts an der unteren Donau*. Bonn: Rudolf Habelt.
FÜLÖP, GY., 1987. Ujabb bizánci éremlelet Tácról. *Alba Regia* 23, 127-136.
GARAM, É., 1992. Die münzdatierten Gräber der Awarenzeit. *In:* Daim, F., ed. *Awarenforschungen*. Vienna: Institut für Ur- und Frühgeschichte der Universität Wien, 135-250.
GAVRITUKHIN, I., O., 2003. Khronologiia prazhskoi kul'tury Belorusskogo Poles'ia. *Histarychna-arkhealagichny Zbornik* 18, 123-138.
HARHOIU, R., 1990. Chronologische Fragen der Völkerwanderungszeit in Rumänien. *Dacia* 34, 169-208.
HÄRKE, H., 2000. Die Darstellung von Geschlechtergrenzen im frühmittelalterlichen Grabritual: Normalität oder Problem? *In:* POHL, W., AND REIMITZ, H., eds. *Grenze und Differenz im frühen Mittelalter*, Vienna: Verlag der Österreichischen Akademie der Wissenschaften, p. 180-196.
HEYDECK, J., 1895. Das Gräberfeld von Daumen und Rückblick auf einer deutsch-nationalen Kunst. *Sitzungsberichte der Altertumsgesellschaft Prussia* 49-50, 65-94.
HILBERG, V., 2003. Die westbaltischen Stämme und die überregionale Kulturaustausch in der Ostseeregion zur Merowingerzeit. *Bodendenkmalpflege in Mecklenburg-Vorpommern: Jahrbuch* 51, 295-319.
HINES, J., 1997. *A New Corpus of Anglo-Saxon Great Square-Headed Brooches*. Woodbridge/Rochester: Boydell Press/Society of Antiquaries of London.
Kalitinskii, A., 1928. K voprosu o nekotorykh formakh dvuplastinchatykh fibul iz Rossii. *Seminarium Kondakovianum* 2, 277-308.
KATSOUGIANNOPOULOU, C., 1999. *Studien zu ost- und südosteuropäischen Bügelfibeln*. Dissertation, (PhD). University of Bonn.
KAZAKEVIČIUS, V., 1994. Das Gräberfeld von Plinkaigalis als Quelle der baltischen ethnischen Geschichte in Litauen. *In:* STJERNQUIST, B., ed. *Prehistoric Graves as a Source of Information. Symposium at Kastlösa, Öland, May 21-23, 1992*, Stockholm: Kungl. Vitterhets Historie och Antikvitets Akademien, 111-128.
KHAVLIUK, P. I., 1974. Ranneslavianskie poseleniia v basseine Iuzhnogo Buga. *In:* Tret'iakov, P. N., ed. *Rannesrednevekovye vostochnoslavianskie drevnosti*, Leningrad: Nauka, 181-215.
KISS, A., 1995., Das germanische Gräberfeld von Hács-Béndekpuszta (Westungarn) aus dem 5.-6. Jahrhundert. *Acta Antiqua Academiae Scientiarum Hungaricae* 36, 275-342.
KORZUKHINA, G. F., 1996. Klady i sluchainye nakhodki veshchei kruga drevnostei antov v srednem Podneprov'e. Katalog pamiatnikov. *Materialy po arkheologii, istorii i etnografii Tavrii* 5, 352-435 and 586-705.
KOWALSKI, J., 1991. Z badań nad chronologią okresu wędrówek ludów na ziemiach zachodniobałtyskich (faza E). *In:* OKULICZ, J., ed. *Archeologia bałtyska. Materiały z konferencji Olsztyn, 24-25 kwietnia 1988 roku*, Olsztyn: Ośrodek badań naukowych im. Wojciecha Kętrzyńskiego w Olsztyne, 67-85.
KOWALSKI, J., 2000. Chronologia grupy elbląskiej i olsztyńskiej kręgu zachodniobałtyjskiego (V-VII w.). Zarys problematyki. *Barbaricum* 6, 203-266.
KUDLAČEK, J., 1964. Zur Frage des Reiches der Goten und ihres Aufenthaltes im mittleren Dneprgebiet (Uber die Genesis der Bügelfibeln der Anten). *Študijné zvesti* 14, 5-43.
KÜHN, H., 1956. Das Problem der masurgermanischen Fibeln in Ostpreussen. *In:* Kleemann, O., ed. *Documenta archaeologica Wolfgang La Baume dedicata 8.II.1955.* Bonn: L. Rohrscheid, 79-108.
KÜHN, H., 1981. *Die germanischen Bügelfibeln der Völkerwanderungszeit im Mitteldeutschland*. Graz: Akademische Druck- und Verlagsanstalt.
KULAKOV, V. I., 1989. Mogil'niki zapadnoi chasti Mazurskogo poozer'ia konca V-nachala VIII vv. (po materialom raskopok 1878-1938 gg.). *Barbaricum* 1, 148-276.
KULAKOV, V. I., 1994a. *Prussy, V-XIII vv.* Moscow: Geoeko.
KULAKOV, V. I., 1994b. Vakarų lietuvių V-XII a. radiniai prūsų žemėse. In: Nikžentaitis, A., and Žulkus, V., eds. *Klaipėdos miesto ir regiono archeologijos ir istorijos problemos.* Klaipėda: Klaipėdos Universiteto, 107-124.
Ladenbauer-Orel, H., 1960. *Linz-Zizlau. Das baierische Gräberfeld and Traunmündung*. Vienna/Munich: A. Schroll.
Leigh, D., 1991. Aspects of early brooch design and production. In: Southworth, E., ed. *Anglo-Saxon Cemeteries. A Reappraisal. Proceedings of a Conference Held at Liverpool Museum 1986*, Wolfeboro Falls: Alan Sutton, 107-124.
LŐRINCZY, G., 1994. Megjegyzések a kora avarkori temetkezési szokásokhoz (A fülkesíros temetkezés). In: LŐRINCZY, G., ed. *A kőkortól a középkorig: Tanulmányok Trogmayer Ottó 60. születésnapjára*. Szeged: Csongrád Megyei Muzeumok Igazgatósága, 311-335.

MADARAS, L., 1995. *The Szeged-Fehértó A and B Cemeteries*. Debrecen/Budapest: Kapitalis.
MCCORMICK, M. 2001. *Origins of the European Economy. Communications and Commerce, A.D. 300-900*. Cambridge: Cambridge University Press.
MIKHAILOV, S., 1961. Rannosrednovekovni fibuli v Bălgariia. *Izvestiia na Arkheologicheskiia Institut* 24, 37-60.
MILLEKER, B., 1893. Szerb-Keresztúri őstelep (Torontál m.). *Archaeologiai Értesitő* 13, 300-305.
MITREA, I., 2001. *Comunităţi săteşti la est de Carpaţi în epoca migraţiilor. Aşezarea de la Davideni din secolele V-VIII*. Piatra Neamţ: Muzeul de Istorie.
NAGY, M., 2007. *Állatábrolások és az I. germán állatstílus a Közép-Duna-vidéken*. Budapest : Magyar Nemzeti Múzeum.
NESTOR, I., 1961. L'établissement des Slaves en Roumanie à la lumière de quelques découvertes archéologiques récentes. *Dacia* 5, 429-448.
NICOLAESCU-PLOPŞOR, C. S., 1945-1947. Notes archéologiques. *Dacia* 11-12, 309-311.
OKULICZ-KOZARYN, L., 1997. *Dzieje Prusów*. Wrocław: Fundacja na Rzecz Nauki Polskiej.
PARCZEWSKI, M., 1991. Metalowe zabytki naddnieprzańskie z VI-VIII w. w zbiorach Krakowskiego Muzeum Archeologicznego. *Archaeoslavica* 1, 115-126.
PÁSZTOR, A., 1995. A kora és közép avar kori gyöngyök és a bizánci éremleletes sírok kronológiai kapcsolata. *Somogyi megyei múzeumok közleményei* 11, 69-92.
PISAROVA, V., 1997. Nova nakhodka nakiti i kultovi predmeti ot VII v. ot raiona na Kubrat. *Problemi na prabălgarskata istoriia i kultura* 3, 283-295.
POPESCU, D., 1941-1945. Fibeln aus dem Nationalmuseum für Altertümer in Bucureşti. *Dacia* 9-10, 485-505.
PROTASE, D., 2003. *Ţaga. Două aşezări din perioada finală a etnogenezei românilor (sec. IV-VI şi sec. VII-VIII)*. Cluj-Napoca: Editura Nereamia.
PRYKHODNIUK, O. M., 1980. *Arkheologichni pam'iatky seredn'ogo Prydniprov'ia VI-IX st. n. e.* Kiev: Naukova dumka.
RASHEV, R., 2000. *Prabălgarite prez V-VII vek*. Sofia: Faber.
RHÉ, GY., AND FETTICH N., 1931. *Jutas und Öskü. Zwei Gräberfelder aus der Völkerwanderungszeit in Ungarn*. Prague: Seminarium Kondakovianum.
SEDIN, A. A., 1994. Pal'chatyia fibuly z Nikadzimava. *In:* SEDIN, A. A., ed. *Arkhealogyia i strazhytnaia gystoryia Magyleushchyny y sumezhnykh terytoryi (Materyialy kanferencyi 22 krasavyka 1993 g.)*. Magileu: Magileusky ablasny kraiaznauchy muzei, 128-132.
SEDIN, A. A., 1997. Nikodimovskoe gorodishche rannego srednevekov'ia v vostochnoi Belorussii. In: Sedov, V. V., ed. *Etnogenez i etnokul'turnye kontakty slavian.* Moscow: Institut Arkheologii RAN, 279-289.
SIMONI, K., 1981. Zagreb i okolica u ranom srednjem vijeku. In: *Arheoloska istrazivanja u Zagrebu i njegovoj okolici*, Zagreb: Hrvatsko Arheološko društvo, 155-168.
SOMOGYI, P., 1997. *Byzantinische Fundmünzen der Awarenzeit*. Innsbruck: Universitätsverlag Wagner.
SPIRU, I., 1970. Fibule descoperite în judeţul Teleorman. *Revista Muzeelor* 7 (6), 531.
SZÉKELY, Z., 1971a. Raport preliminar asupra rezultatelor săpăturilor efectuate la aşezările din sec. VII-IX e.n. de la Filiaş şi Poian. In: *Sesiunea de comunicări ştiinţifice a Muzeelor de istorie, decembrie 1964*, Bucharest : n. p., p. 144-156.
SZÉKELY, Z., 1971a. Slavii şi populaţia băştinaşă din sud-estul Transilvaniei. *Aluta* 3, 129-139.
SZÉKELY, Z., 1974-1975. Aşezări din secolele VI-IX e. n. în sud-estul Transilvaniei. *Aluta* 6-7, 35-78
SZENTPÉTERI, J., 2002. *Awarische Denkmäler der Awarenzeit in Mitteleuropa*. Budapest: Publicationes Instituti Archaeologici Academiae Scientiarum Hungaricae.
TĂNASE, D., AND MARE, M., 2001. Piese de port şi de podoabă din secolele III-VII în colecţia Pongrácz. Catalog. *Analele Banatului* 9, 181-206.
TAUTAVIČIUS, A., 1959. Vostochnolitovskie kurgany. *In:* TARAKANOVA, S. A., AND TERENT'EVA, L. N., eds., *Voprosy etnicheskoi istorii narodov Pribaltiki po dannym arkheologii, etnografii i antropologii.* Moscow: Izdatel'stvo Akademii Nauk SSSR, 390-395.
TAUTAVIČIUS, A., 1970-1971. Degsnės-Labotiškių pilkapių (Molėtų raj.) kasinėjimai 1970 m. *Archeologiniai ir etnografiniai tyrinėjimai Lietuvoje*, 48-50.
TAUTAVIČIUS, A., 1972. Prekybiniai-kultūriniai ryšiai V-VIII amžiais. *In:* Michelbertas, M., ed. *Lietuvos gyventojų prekybiniai ryšiai Lietuvoje II-XII a.* Vilnius: Istorijos Institutas, 126-148 and 276-278.
TEODOR, D. GH., 1992. Fibule 'digitate' din secolele VI-VII în spaţiul carpato-dunăreano-pontic. *Arheologia Moldovei* 15, 119-152.
TEODORESCU, V., 1972. Centre meşteşugăreşti din sec. V/VI-VII în Bucureşti. *Bucureşti. Materiale de istorie şi muzeografie* 9, 73-99.
TERPILOVS'KYY, R. V., 2005. Nasledie kievskoi kul'tury v V-VI vv. In: KACZANOWSKI, P., AND PARCZEWSKI, M., eds. *Archeologia o początkach Słowian. Materiały z konferencji, Kraków, 19-21 listopada 2001*. Cracow: Instytut Archeologii Uniwersytetu Jagiellońskiego, 387-402.
TOROPU, O., 1976. *Romanitatea tîrzie şi străromânii în Dacia traiană subcarpatică*. Craiova: Scrisul Românesc.
TUDOR, D., 1964. Săpăturile lui Gr. G. Tocilescu în castrul roman de la Răcari (raion Filiaşi, reg. Oltenia). *Apulum* 5, 254.
VAGALINSKI, L., 1994. Zur Frage der ethnischen Herkunft der späten Strahlenfibeln (Finger- oder Bügelfibeln) aus dem Donau-Karpaten-Becken (M. 6.-7. Jh.). *Zeitschrift für Archäologie* 28, 261-305.
VAGALINSKI, L., 2003. Za taka narechenite slavianski lăchevi fibuli v Karpato-Dunavskiia basein (vtora polovina na VI-VII v.). *In:* ANGELOVA, S., GOCHEVA, Z., AND STEFANOVA, T., eds. *Sbornik v pamet na d-r Petăr Gorbanov*. Sofia: Universitetsko izdatelstvo „Sv. Kliment Okhridski", 336-383.
VAITKEVIČIUS, V., 2005. Interpreting the East Lithuanian barrow culture. *In:* LANG, V., ed. *Culture and Material Culture. Papers from the First Theoretical Seminar of the Baltic Archaeologists (BASE) Held at the University of Tartu, Estonia, October 17th-19th, 2003*. Tartu/Riga/Vilnius: University of Tartu/University of Latvia/University of Vilnius, 71-86.
VAŠKEVIČIUTĖ, I., 1992. Burial practices in one of the Baltic tribes - Semigallians. In: Hårdh, B., and Wyszomirska-Werbart, B., eds. *Contacts Across the Baltic Sea During the Late Iron Age (5th-12th Centuries). Baltic Sea Conference, Lund October 25-27, 1991*. Lund: Institute of Archaeology and Historical Museum, 89-98.
VINSKI, Z., 1954. Gibt es frühslawische Keramik aus der Zeit der südslawischen Landnahme? *Archaeologia Iugoslavica* 1, 71-82.
VINSKI, Z., 1958. O nalazima 6. i 7. stoljeća u Jugoslaviji s posebnim obzirom na arheološku ostavštinu iz vremena

prvog avarskoga kaganata. *Opuscula Archaeologica* 3, 16-67.
VYNOKUR, I. S., 1997. *Slov'ians'ki iuveliry Podnistrov'ia. Za materialamy doslidzhen' Bernashivs'kogo kompleksu seredyny I tys. n.e.* Kam'ianets' Podil's'kyy: Oium.
WERNER, J., 1950. Slawische Bügelfibeln des 7. Jahrhunderts. In: BEHRENS, G., ed. *Reinecke Festschrift zum 75. Geburtstag von Paul Reinecke am 25. September 1947*. Mainz: E. Schneider, 150-172.
WERNER, J., 1960. Neues zur Frage der slawischen Bügelfibeln aus süd-osteuropäischen Ländern. *Germania* 38, 114-120.
WERNER, J., 1961. *Katalog der Sammlung Diergardt (völkerwanderungszeitlicher Schmuck)*. Vol. 1. Berlin: Mann.
WERNER, J., 1984. Zu den Bügelfibeln aus den völkerwanderungszeitlichen Brandgräberfeldern Masuriens. *Germania* 62 (1), 74-77.
ZARIŅA, A., 1959. Odezhda latgalov po materialam arkheologicheskikh raskopok poslednikh let. *In:* MOORA, H., ed. *Trudy Pribaltiiskoi obăedinennoi kompleksnoi ekspedicii*. Moscow: Izdatel'stvo Akademii Nauk SSSR, 510-522.
ZARIŅA, A., 1980. Odezhda naseleniia Vostochnoi Latvii v XI-XII vv. i nekotorye ee skhodnye cherty s odezhdoi slavian. In: CHROPOVSKÝ, B., ed. *Rapports du III-e Congrès international d'archéologie slave. Bratislava 7-14 septembre 1975*. Vol. 2.Bratislava: VEDA, 503-513.
ŽULKUS, V., 1991. Die Prussen und ihre Nachbarn im 1. Jahrtausend nach Christi Geburt. In: ŽULKUS, V., TIMMANN, H.-H., AND TIMMANN, W., eds. *Prussen, Kuren und Masuren. Drei Beiträge zur Landeskunde Ostpreussens*, Hamburg: Landsmannschaft Ostpreussen, 4-14.
ZVERUGO, IA., G. 2005. *Belaruskae Paville u zhaleznym veku i rannim siaredneviakoui*. Minsk: Instytut gistoryi NAN Belarusi.

Received: 15 April 2009; Revised: 10 May 2009;
Accepted: 13 September 2009

Florin Curta
Department of History
202 Flint Hall University of Florida
P.O. Box 117320
Gainesville, FL 32611-7320
USA
fcurta@ufl.edu
http://www.clas.ufl.edu/users/fcurta

Annex 1: fibulae of Werner's class I J

1. Dailidės near Joniškis (Molėtai district, Lithuania); stray find; copper-alloy; L=6.25; Tautavičius, 1972, pp. 145 and 146 fig. 16.
2. Donji Stenjevec, in Zagreb (Croatia); stray find; copper-alloy; Vinski, 1954, p. 79 and pl. 50; Werner, 1960, p. 118; Kudlaček, 1964, p. 42 pl. 5.2; Vinski, 1958, p. 28 and pl. 17.9; Simoni, 1981, p.156 and fig. 2.
3. Kielary (former Kellaren, Olsztyn district, Poland); stray find; copper-alloy; L=5.0; Werner, 1950, p.154 and pl. 30.46; Kühn, 1956, p. 101 and pl. 38.8,3; Kühn, 1981, p. 185 and pl. 42.265.
4. Negotin (Serbia); stray find; copper-alloy; L=5.0; Csallány, 1961, p. 356 and pl. 213.7.
5. Novi Banovci (Zemun district, Serbia); stray find; copper-alloy; L=5.0; Brunšmid, 1905, pp. 217-218 and 213 fig. 32.8; Csallány, 1961, p. 240 and pl. 213.3; Kühn, 1956, p. 101 and pl. 27.8,2; Vinski, 1958, p. 28 and pl. 17.8.
6. Óföldeák (Csongrád district, Hungary); found in an inhumation burial, together with 12 glass beads with eye-shaped inlays ("Augenperlen"); copper-alloy; L=5.1; Csallány, 1961, p. 38 and pls. 191.16 and 259.1.
7. Pastyrs'ke (Cherkasy district, Ukraine); copper-alloy; L=4.5; Kalitinskii, 1928, p. 290 and pl. 36.49; Werner, 1950, p. 154 and pl. 30.45; Kühn, 1956, p. 101 and pl. 37.8,1; Korzukhina, 1996, pp. 378 and 618 pl. 28.8.
8. Sărata Monteoru (Buzău district, Romania); found in the cremation burial no. 1321; copper-alloy; L=2.8; Nestor, 1961, p. 446; Fiedler, 1992, pp. 81 and 83 fig. 11.9.
9. Tumiany (former Daumen, Olsztyn district, Poland); found in the cremation burial no. 56, together with a copper-alloy belt buckle with chip carved decoration; copper-alloy; L=5.5; Kühn, 1956, p. 101 and pl. 27.8,4; Kühn, 1981, pp. 106-107 and pl. 19.116; Kulakov, 1989, pp. 191 and 252 fig. 36.3.
10. Tumiany (former Daumen, Olsztyn district, Poland); stray find; copper-alloy; L=5.0; Kühn, 1956, p.101 and pl. 27.7,5; Kühn, 1981, p. 110 and pl. 21.132.

Annex 2: fibulae of Werner's class I F

1. Adămeşti, in Alexandria (Romania); stray find; copper-alloy; L=8.1; Spiru, 1970, p. 531 and fig. 1; Teodor, 1992, pp. 138 and 148 fig. 7.8.
2. Bucharest-Băneasa (Romania); settlement find; silver, fragment; L=3.3; Constantiniu, 1965, pp. 77-78 and 92 fig. 18; Constantiniu, 1966, p. 667 fig. 2.2; Teodor, 1992, pp. 138 (where the fibula is of copper-alloy, L=4) and 149 fig. 8.5.
3. Bucharest-Soldat Ghivan Street (Romania); found in the sunken-floored-floored building no. 12, together with wheel- and hand-made pottery; copper-alloy, fragment; L=3.25; Constantiniu, 1966, p. 667 fig. 2.1; Dolinescu-Ferche and Constantiniu, 1981, pp. 324 and 323 fig. 20; Teodorescu, 1972, p. 79 fig. 3; Teodor, 1992, pp. 138 (where L=3.8) and 149 fig. 8.8.
4. Chyhyryn (Cherkasy district, Ukraine); stray find; silver; Prykhodniuk, 1980, pp. 140 and 70 fig. 48.
5. Davideni (Neamț district, Romania); settlement find; copper-alloy; L=8.6; Mitrea, 2001, pp. 162-163 and 329 fig. 68.3.
6. Desa (Dolj district, Ukraine); stray find; copper-alloy; L=6.6; Popescu, 1941-1944, pp. 505 and 504 fig. 11/121; Nicolaescu-Plopşor, 1945-1947, pp. 310-311; Werner, 1950, p. 155 and fig. 3; Teodor, 1992, pp. 138 (where L=6.7) and 148 fig. 7.3.
7. Dudari (Kaniv district, Ukraine); stray find; copper-alloy; Korzukhina, 1996, pp. 354 and 684 pl. 94.11.
8. Dulceanca (Teleorman district, Romania); settlement find; fragment; Dolinescu-Ferche, 1992, p. 152.
9. Filiaş (Harghita district, Romania); found in the sunken-floored building no. 20, together with a copper-alloy earring with twisted end; copper-alloy, fragment; L=3.9; Székely, 1971a, pp. 147-148 and 156 fig. 5.1; Székely, 1971b, pp. 131 and 133 fig. 3.2-2a; Székely, 1974-1975, p. 39 and pl. 9/10 and 10a; Teodor, 1992, pp. 138 and 149 fig. 8.6.

10. Kamenovo (Razgrad district, Bulgaria); found in a hoard, together with three other bow fibulae (Werner's classes I C and I F), four human-shaped figurines, a cast, perforated strap end, and two bronze appliqués; copper-alloy; Pisarova, 1997, pp. 286-287 and 294 fig. 1.9; Rashev, 2000, p. 189 pl. 83/.2.
11. Kamenovo (Razgrad district, Bulgaria); found in a hoard together with three other bow fibulae (Werner's classes I C and I F), four human-shaped figurines, a cast, perforated strap end, and two bronze appliqués; copper-alloy, fragment; Pisarova, 1997, pp. 287 and 294 fig. 1.6; Rashev, 2000, p. 189 pl. 83.15.
12. Keszthely-Dobogó (Zala district, Hungary); stray find; copper-alloy; L=6.8; Werner, 1950, p. 154 and pl. 30.33.
13. Kosewo (former Alt-Kossewen, Mrągowo district, Poland); found in the cremation burial no. 501; copper-alloy; L=5.6; Kühn, 1956, p. 95 and pl. 24.12; Kühn, 1981, p. 59 and pl. 3.18; Kulakov, 1989, pp. 183, 216 fig. 4a and 236 fig. 20.4.
14. Kosewo (former Alt-Kossewen, Mrągowo district, Poland); found in the cremation burial no. 553b, together with an identical fibula; copper-alloy; L=6.4; Kühn, 1956, p. 95 and pl. 24.7; Kühn, 1981, p. 60 and pl. 5.23; Kulakov, 1989, p. 184.
15. Kosewo (former Alt-Kossewen, Mrągowo district, Poland); found in the cremation burial no. 553b, together with an identical fibula; copper-alloy; L=6.4; Kühn, 1956, p. 95; Kühn, 1981, p. 60; Kulakov, 1989, p. 184.
16. Miętkie (former Mingfen, Olsztyn district, Poland); found in the cremation burial no. 424, together with a bow fibula of Werner's class I D and an amber bead; Kühn, 1956, p. 95 and pl. 24.8; Kühn, 1981, pp. 220-221 and pl. 54.343; Kulakov, 1989, pp. 181 and 230 fig. 14.1.
17. Miętkie (former Mingfen, Olsztyn district, Poland); found in the cremation burial no. 579, together with an identical fibula, a copper-alloy buckle, and glass beads; copper-alloy; L=6.3; Kühn, 1956, p. 95 and pl. 24.9; Kühn, 1981, p. 221 and pl. 54.347; Kulakov, 1989, pp. 182 and 232 fig. 16.3.
18. Miętkie (former Mingfen, Olsztyn district, Poland); found in the cremation burial no. 579, together with an identical fibula, a copper-alloy buckle, and glass beads; copper-alloy; L=6.3; Kühn, 1956, p. 95; Kühn, 1981, p. 221; Kulakov, 1989, p. 182.
19. Pastyrs'ke (Cherkasy district, Ukraine); copper-alloy, fragment; Korzukhina, 1996, pp. 379 and 618 pl. 28.13.
20. Pietroasele (Buzău district, Romania); stray find; silver, fragment; L=4.4; Curta and Dupoi, 1994-1995, pp. 217 and 219 fig. 1.
21. Răcari (Dolj district, Romania); stray find; copper-alloy, fragment; L=4.1; Werner, 1950, p. 154 and pl. 30.34 (where the fibula was found in Banat); Csallány, 1961, p. 196 and pl. 272.7; Tudor, 1964, p. 254 and fig. 11/2; Toropu, 1976, p. 133; Teodor, 1992, pp. 138 and 148 fig. 7.7.
22. Semenki (Vinnytsia district, Ukraine); found in the sunken-floored building no. 8, together with wheel- and hand-made pottery, including clay pans, and an earring with twisted end; copper-alloy, fragment; Khavliuk, 1974, pp. 207 and 202 fig. 11.2.
23. Smila (Cherkasy district, Ukraine); stray find; copper-alloy, fragment; L=6.1; Bobrinskii, 1901, p. 28 and pl. 1.8; Werner, 1950, p. 154 and pl. 30.32; Korzukhina, 1996, pp. 373 and 669 pl. 79.12.
24. Szátymáz-Fehértó (Csongrád district, Hungary); found in the inhumation burial no. 33 of the cemetery A, together with an identical fibula, two copper-alloy earrings with bead-shaped pendant, glass beads, and a wheel-made jar; silver; L=8.3; Csallány, 1961, p. 228 and pl. 309.17; Madaras, 1995, pl. 5.
25. Szatymáz-Fehértó (Csongrád district, Hungary); found in the inhumation burial no. 33 of the cemetery A, together with an identical fibula, two copper-alloy earrings with bead-shaped pendant, glass beads, and a wheel-made jar; silver; L=8.3; Csallány, 1961, p. 228 and pl. 309/18.
26. Tumiany (former Daumen, Olsztyn district, Poland); found in the cremation burial no. 3, together with glass beads and a copper-alloy torc; copper-alloy; L=6.6; Heydeck, 1895, p. 43 and pl. 3/4; Kühn, 1981, p. 104 and pl. 17.105; Kulakov, 1989, pp. 187 and 241 fig. 25.2.
27. Tumiany (former Daumen, Olsztyn district, Poland); found in the cremation burial no. 20, together with a copper-alloy buckle, two spurs and a copper-alloy finger-ring; copper-alloy; L=6.5; Heydeck, 1895, p. 45; Kühn, 1981, p. 105 and pl. 17.108; Kulakov, 1989, pp. 188 and 242 fig. 26.1.
28. Tumiany (former Daumen, Olsztyn district, Poland); found in the cremation burial no. 44, together with an identical fibula; copper-alloy; L=6.6; Kühn, 1981, p. 113 and pl. 24.148.
29. Tumiany (former Daumen, Olsztyn district, Poland); found in the cremation burial no. 44, together with an identical fibula; copper-alloy; L=6.6; Kühn, 1981, p. 113.
30. Tumiany (former Daumen, Olsztyn district, Poland); found in the cremation burial no. 105; copper-alloy, together with an identical fibula; Heydeck, 1895, p. 59; Kulakov, 1989, pp. 195, 216 fig. 4g, and 263 fig. 47.1.
31. Tumiany (former Daumen, Olsztyn district, Poland); found in the cremation burial no. 105; copper-alloy, together with an identical fibula; Heydeck, 1895, p. 59; Kulakov, 1989, pp. 195, 216 fig. 4g, and 263 fig. 47.1.
32. Tumiany (former Daumen, Olsztyn district, Poland); stray find; copper-alloy; Kühn, 1981, pl. 21.131.
33. Tumiany (former Daumen, Olsztyn district, Poland); stray find; copper-alloy; Kühn, 1981, pl. 21.133.
34. Tumiany (former Daumen, Olsztyn district, Poland); stray find; copper-alloy; Kühn, 1981, pl. 21.134.
35. Tumiany (former Daumen, Olsztyn district, Poland); stray find; copper-alloy; L=6.2; Kühn, 1981, pp. 102-103 and pl. 22.138.
36. Tumiany (former Daumen, Olsztyn district, Poland); stray find; copper-alloy; L=6; Kühn, 1981, pp. 102-103 and pl. 22.139.
37. Tumiany (former Daumen, Olsztyn district, Poland); stray find; copper-alloy; L=6; Kühn, 1981, pp. 102-103.
38. Tylkowo (former Scheufelsdorf, Szczytno district, Poland); copper-alloy; L=6.8; Kühn, 1956, p. 95 and pl. 24.5; Kühn, 1981, p. 312 and pl. 74.497.
39. Unknown location (Banat region, Romania); copper alloy; fragment; Tănase and Mare, 2001, pp. 190 and 203 pl. 5.2.
40. Unknown location (Eastern Prussia); copper-alloy; L=5.1; Kühn, 1956, p. 95 and pl. 24.11; Kühn, 1981, p. 264 and pl. 63.410.

41. Unknown location (Macedonia, Bulgaria); copper-alloy; L=5.7; Werner, 1950, p. 155 and pl. 31.50; Mikhailov, 1961, pp. 43 and 41 fig. 3.1.
42. Unknown location (Kiev district, Ukraine); Korzukhina, 1996, pp. 409 and 669 pl. 79.14.
43. Unknown location (southern Romania); copper-alloy; L=7.1; Popescu, 1941-1944, pp. 505 and 504 fig. 11.122; Werner, 1950, p. 155 and fig. 3; Teodor, 1992, pp. 138 and 148 fig. 7.1.
44. Vârtoape, in Roşiorii de Vede (Teleorman district, Romania); stray find; copper-alloy; L=8; Dolinescu-Ferche and Voevozeanu, 1969, pp. 354-355; Dolinescu-Ferche, 1974, fig. 128; Teodor, 1992, pp. 138 and 148 fig. 7.4.

PASTABOS APIE WERNERIO I J TIPO „SLAVIŠKAS" PIRŠTUOTĄSIAS SEGES

Florin Curta

Santrauka

Daugiau nei prieš 30 metų Adolfas Tautavičius paskelbė apie prie Dailydžių (Joniškio valsčius, Utenos apskritis) aptiktą bronzinę segę. Nors nežinoma tiksli jos radimo vieta, tačiau pagal jos gerą išlikimą galima teigti, kad segė yra dalis laidosenos įkapių, matyt, iš degintinio palaidojimo, kuris priklausė Rytų Lietuvos pilkapių kultūrai, kuri buvo paplitusi ir segės radimo vietoje. Ši segė pagal Wernerio klasifikaciją yra I J tipo. Kartu su Dailydžių sege yra žinomos devynios šio tipo segės, iš kurių keturios buvo aptiktos Baltijos jūros regione. Werneris pavadino jas „slavišku" tipu, tačiau akivaizdžiai tai nepasitvirtino, paaiškėjus, kad tokios segės Rytų Europoje paplito migracijos laikotarpiu.

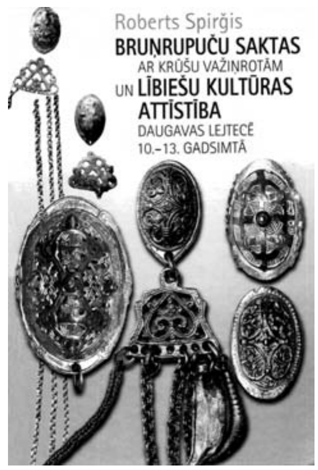
Nepaisant to, Wernerio I J tipo segė buvo aptikta toli nuo kitų (kaip Novi Banovci ir Kielary) labai panašių segių. Tačiau Dailydžių segė yra unikalus šios tipologijos radinys pagal dydį ir ornamentiką. Atsižvelgiant į segės proporciją ir ornamentiką, Wernerio I J tipo segės yra panašios į jo išskirtas I F tipo seges, kurias galima susieti su metalo apdirbimu Dunojaus žemupyje ir vidurupyje V a. pabaigoje – VI a. pradžioje. Iš to, kad šie du segių tipai buvo taip pat paplitę Rytų Europoje, galima manyti, kad Wernerio I J tipo segės buvo I F tipo segių imitacija, kur nesudėtingą linijinį ornamentą pakeitė voliutų ornamentas. Kita vertus, labai panašus ornametas randamas ant panašių segių iš VI a. pradžios Csongrád gamybos vietos Mozūrijoje.

Pagal stiklo karolių duomenis, segė iš Óföldeák gali būti datuojama ankstyvuoju Avarų periodu – 7-ojo amžiaus pirmąja puse. Segės iš Kielary ir Tumiany gali būti šiek tiek ankstyvesnės (VI a. pabaiga), jų dalis ornamento motyvų yra perimtos iš Csongrád tipo segių, ir datuojamos VI a. pabaiga. Wernerio I J tipo segės kildinamos iš Mozūrijos, o Dailydžių segė, kaip lokalinės produkcijos gaminys, gali būti pagaminta pagal Mozūrijos segių originalus. Ryšiai tarp Olštyno grupės Mozūrijoje ir Rytų Lietuvos pilkapių kultūros bendruomenių mažai įtikėtini, tačiau yra kitų patikimų duomenų, kad tokie ryšiai egzistavo. Tai diržo sagtis iš Ziboliškių (Švenčionių r.) ar „slaviška" pagal Vernerį I D formos segė iš Mikolcy netoli Medelio (Baltarusija). Priešingai – Mozūrijoje nėra segių, kurios žinomos Baltarusijos (Nikadzimava), Latvijos (Boķi and Strīķi), Estijos (Jägala Jõessu) ir Kaliningrado srities (Linkuhnen and Schreitlauken) teritorijose. Dailydžių segė, aptikta Rytų Lietuvos pilkapių kultūros teritorijoje, matyt, yra pasekmė mainų, vykusių tarp to meto Mozūrijos ir Rytų Lietuvos pilkapių kultūros diduomenės ir vėliau užsimezgusių ryšių su nutolusia Karpatų regiono diduomene.

Vertė Algirdas Girininkas

REVIEWS

THE LIVS – NEIGHBOURS OF THE NORTHERN BALTS. Notes on the margin of Roberts Spirĝis's monograph *Bruņrupuču saktas ar krūšu važiņrotām un lībiešu kultūras attīstība Daugavas lejtecē 10.–13. gadsimtā*, Rīga 2008. – 511 pp., 206 illiustrations



In Roberts Spirğis's monograph *Bruņrupuču saktas ar krūšu važiņrotām un lībiešu kultūras attīstība Daugavas lejtecē 10. – 13. gadsimtā* (*Tortoise Brooches with Pectoral Chain Ornaments and the Development of Liv Culture in the Lower Daugava Area in the 10th–13th centuries*), the author defines the chosen subject and chronological boundaries of the work in minute detail. The discussed monograph is an impressive 511 page text (consisting of an introduction, 9 chapters with subsections, and conclusions) with 206 graphic illustrations and coloured photographs, 40 tables, diagrams and a thorough bibliography, pp. 445-470 (Fig. 1).

That the book is attractive is an uncommon thing to say about a scientific monograph. But for its thoroughly thought over layout, R. Spirĝis's monograph about the Daugava's Livs' culture in the 10th-13th centuries is namely an attractive book, whose well-considered text and abundant visual material does not make it particularly difficult for the foreign language speaker who reads this Latvian text. Moreover, in the more difficult parts of the Latvian text, the reader is aided by the extensive summary in English. The summary was splendidly translated by Valdis Bērziņš – the "English voice" of Latvian archaeologists in recent years, who also contributed to the success of this large, coherent work.

From the very Early Roman Period, East Baltic women paid especially much attention to the elaborate pectoral sets; both Baltic and Baltic Finno-Ugric women did so. It is as if it was never a secret that in Viking times and in the Early Middle Ages, Livian womens' pectoral ornaments were impressive for their multi-components – for their tortoise brooches, to which small chain clasps, rows of small chains, or openwork dividers would be fastened, and then various small household accessories hung from the chains – from knives with bronze sheaths to needle-cases and ear-picks, as wells as a great number of amulets. But never was this magnificent, multi-component ornament so scrupulously analysed and linked to all of the Daugava Livs' material culture development in the way done by the author of this thorough monograph, R. Spirğis.

Especially careful attention in R. Spirğis's monograph is paid to typology, which is, in fact, the axis of this work, around which turn all the other Livian culture aspects examined in this work. I shall not discuss the nuances of the typology the author presents in this review, since suitable individual features of the artefacts are selected for the author's typology, features that undergo certain traceable stages in their development and transformations from their appearance to disappearance. So, tortoise brooches, their small chain fasteners and dividers, and everything that is hung from them are painstakingly typologized in this work. But I wish to emphasize several main points in this text. In these high-speed internet times, artefact typology looks like an old fashioned and boring job – an end in itself ... or, better yet – pointless. However, this younger generation's Latvian scientist used this "old fashioned" method splendidly, and from what can be gathered from the text, is acquainted with archaeological theory and has mastered the new technologies. On the other hand, typology has old and good traditions in Latvian archaeology; one need only remember, for example, Raul Šnore's published work (Dzelzs laikmeta latviešu rotas adatas. *Latviešu aizvēstures materiāli*, vol. I, Rīga, 1930, pp.39-108) that analysed Late Iron Age pins. It must be emphasized that even later Latvian archaeologists placed huge, often primary importance on typology, just as they still do, as we can see from the reviewed work's example. But in order to firmly construct a typology, one firstly needs an exceptionally deep knowledge of the material culture, expenditure of time, and thoroughness. A deep knowledge of Livian material culture (a huge volume of material is analysed in the work – 1542 grave complexes and isolated finds), consistent work, and, apparently, a work pursued for several years "gave its fruit" – a reliable typology. A solidly built typology allowed this monograph's author to examine the Livs' culture from various angles. It must be stressed that it was namely the typology that provided R. Spirğis with one of the means which helped to establish the origin of single elements of this multi-component artefact as well as the entire ornament's development.

A reliable chronology of Livian women's multi-component pectoral ornaments, neck-rings, and bracelets is yet another of this painstaking work's successes. As many as three chapters are devoted to chronological problems. It stands to reason that a solid typology of pectoral ornaments and their correlations with other important finds in graves (neck rings, bracelets, and pottery made on a potter's wheel) help to solve chronological problems. Grave complexes, the correlations of these complexes, and burial traditions allowed the author to establish four Livian culture phases. Of course, the abundant finds of coins in the Daugava basin also aided R. Spirğis in solving the chronological problems.

The analysis of these pectoral ornaments showed that tortoise brooches, elements of multicomponent pectoral ornaments, and their compositions all are diverse. The tortoise brooches themselves that are found in Livs' graves are imports, local transformations, and imitations. The appearance of this complex multi-component pectoral ornament was motivated by the Livs' contacts with their closest neighbours and with the Scandinavians. This deduction prompted the author to conclude that the ornament's elements and their décor show the different ethnic nature of the women who wore them. On the other hand, in all respects the various pectoral ornaments allowed the author to consider the Livs' society's social relationships, based on a huge data base.

Thus, the reliable typology of the Daugava Livs' multi-component pectoral ornaments and its inseparable "friend" chronology allowed the author to compare the various combinations of Baltic Finno-Ugrians, ascertaining the cultures' similarities, differences, and mutual influences, to discuss the Scandinavians' and other ethnic groups' influences upon the Livs' culture. Having discussed the typologically well analysed and solidly dated material, the author distinguished the grave complexes characteristic of the Livian, Vendian, Saami and Estonian, Latgalian and Selonian, as well as Semigallian women in the Daugava basin's material, and indicated how many women of which ethnic groups lived in this region in the examined period (based on grave data). The author's reasoning's concerning the semantic meanings of the Livian women's pectoral ornaments analysed in the monograph are interesting; he links these ornaments with a mythological tripartite world conception. On the other hand, such ornaments of various ethnic groups and that covered women's chests were created just for that – for rendering protection. The Livian jewellers' workshops, the ornaments' production technologies – these also did not escape this monograph's author's outlook.

Thus, the monograph's value lies within the Livs' archaeological material profile which enables an investigation of Livian culture from all possible angles from its formation in the 10th century to its extinguishment at the end of the 13th century. R. Spirĝis's monograph *Bruņrupuču saktas ar krūšu važiņrotām un lībiešu kultūras attīstība Daugavas lejtecē 10.–13. gadsimtā* is a fundamental work about the Daugava Livs' 10th-13th century culture.

A book is good when, after reading it, one can say "yes, I learned much" and its information lends arguments for new insights. There is no desire, therefore, to put a period here regarding R. Spirğis's monograph, since the book provokes discussion with its insights.

The Baltic Sea region is examined more as a general Scandinavian cultural area in the monograph, ie., as a Finno-Ugric and Slavic cultural area in the Viking Period and Early Middle Ages; in my opinion, it lacks a Baltic accent. Ethnic boundary contacts, stimuli, and influences received from their southwestern neighbours – the Curonians – are looked at somewhat less. On the other hand, these are mentioned while discussing the Livs' cultural origins because R. Spirĝis maintains that in the second half of the 10th century, Scandinavian colonists, whose material culture was very influenced by the cultures of the Livs and Balts migrated from Northern Curonia to the lower Daugava, where Livian culture had been formed in several stages. Common ornament types do, indeed, link the Curonians and Livs (e.g., neck rings with trumpet terminals and others; see Fig. 116). Bead necklaces with holders for the strings of beads (Figs. 96, 97) were an impetus from Gotland in the 9th/10th-11th centuries both for the Curonians and the Livs; they were distinctively accepted and originally recreated in both cultures. Such examples of strings of beads from Curonain women's graves and the possible cultural interaction from them "slid by" the author. Rectangular chain dividers (Figs. 83-88) are reminiscent of Curonian flat openwork brooches decorated with plaits; the elements of these ornaments also could be analysed as a result of common East Baltic transformations. All the more so, since the rectangular flat brooches with plaits that were used in place of tortoise brooches to connect the elaborate pectoral sets are very similar to Curonian ornaments. Such rectangular brooches fastened pectoral ornaments in place of the tortoise brooches in the Doles Vampienie u I (grave 154) and Salaspils Laukskolas (grave 230) cemeteries (Figs. 189, 190).

Upon concluding R. Spirĝis's monograph's review, I would like once more to congratulate the author on an impressive work – on material about the Daugava Livs' culture that is typologically well categorized and analysed, and chronologically well organized, and to wish the author new insights... and another monograph!

Audronė Bliujienė

GUIDELINES FOR AUTHORS

Archaeologia Baltica is a semiannual academic refereed journal published in English about the archaeology of the regions around the Baltic Sea, with the focus on the eastern shore of the Baltic. The editorial policy is to publish a wide range of contributions in all fields of archaeology related to the Baltic Sea Region, from methodology to synthesis and theory. These may take the form of substantial research papers (up to 8,000 words) or shorter research reports. Short papers may include, for instance, new techniques, philosophical discussions, current controversies and suggestions for new research, as well as conventional research papers. Review or overview papers are welcome, as long as they are sufficiently critical, succinct and make a conceptual contribution to the field. The submission of a paper will be held to imply that it represents an original article, not previously published, and that it is not being considered for publication elsewhere.

Separate volumes publish materials of international conferences concerned with archaeological research in the Baltic Sea Region.

Articles for Archaeologia Baltica should be typed in English, double-spaced on A4 paper, with at least 30-millimetre margins. Submitted articles must include:

- the name(s) and address(es) of the author(s), as well as an abstract of up to 100 words, and up to eight keywords;
- a summary up to an eighth of the length of the whole text, for translation into Lithuanian;
- captions for figures and tables supplied separately and appended to the disc copy of the text;
- numbers and labelling on figures should be in publishable form, the font size of the numbers and letters should not exceed 12, figures and tables should be not bigger than 16 centimetres wide and 24 centimetres high, with thin frames.

Three hard copies and a computer version (in Word for Windows) of contributions must be sub¬mitted to the Managing Editor. Computer-generated drawings must be provided in hard copy and digital format (TIFF, EPS or CDR), the resolution should be not less than 300 dpi.

References should be arranged using the Harvard citation system (for full explanation see http://www.bournemouth.ac.uk/library/using/harvard_system.html):

- citation in the text, eg Thomas 1996, p.10.
- references at the end of a piece of work
- eg THOMAS, J., 1996. *Time, Culture and Identity*. London: Routledge (reference to a book).
- eg Bantz, C.R., 1995. Social dimensions of software. In: J.A. ANDERSON, ed. Annual review of software management. Newbury Park, CA: Sage, 502-510 (reference to a contribution in a book).
- EVANS, W.A., 1994. Approaches to intelligent information retrieval. *Information processing and management*, 7 (2), 147-168 (reference to an article in a journal).

References in Cyrillic should be transcribed in Roman letters according to the following system:

Cyrillic	Roman	Cyrillic	Roman	Cyrillic	Roman
а	a	к	k	х	kh
б	b	л	l	ц	ts
в	v	м	m	ч	ch
г	g	н	n	ш	sh
д	d	о	o	щ	shch
е	e	п	p	ъ	”
ё	e	р	r	ы	y
ж	zh	с	s	ь	’
з	z	т	t	э	e
и	i	у	u	ю	iu
й	i	ф	f	я	ia

Footnotes and endnotes should be avoided if at all possible.

Authors will be contacted by one of the editorial team. Articles will be submitted to two referees and to a professional language reviser. Manuscripts will then be returned with comments. After the completion of suggested changes (the computer version should be corrected too), a new manuscript should be sent to the editors for distribution. Text proofs of papers will be provided to authors, to which only minor corrections are allowed.

One free hard copy of Archaeologia Baltica and reprint’s digital version in PDF format of each paper will normally be supplied to the authors.

The contents of the Archaeologia Baltica volumes are available at : http//www.ku.lt/leidykla/leidiniai/archaeologia

More detailed information is available from the editors.

Contact us at:

Klaipėda University,
Institute of Baltic Sea Region
History and Archaeology

Herkaus Manto g. 84, LT-92294 Klaipėda
Ph. +370-46-398806
Fax +370-46-398805
E-mail: algisg@post.skynet.lt

Archaeologia Baltica can be purchased or ordered from:
Herkaus Manto g. 84, LT-92294 Klaipėda
Ph. +370 46 398892
Fax +370 46 398999
E-mail: alfonsas.jankantas@ku.lt

The volume cost 35 Lt (10 EUR) plus postage.

Klaipėdos universiteto leidykla

ARCHAEOLOGIA BALTICA 12

Edited by Algirdas Girininkas

Klaipėda, 2009

SL 1335. 2009 11 25. Apimtis 18,25 sąl. sp. l. Tiražas 350 egz.
Klaipėdos universiteto leidykla, Herkaus Manto g. 84, 92294 Klaipėda
Tel. (8~46) 398 891, el. paštas: leidykla@ku.lt
Spausdino spaustuvė „Petro Ofsetas“, Žalgirio g. 90, Vilnius

1

2

3

4

Plate I

1 Cut marks found on horse's neck vertebra. Kretuonas 1C (photograph by D. H. Pauža)

2 Cut marks found on the surface of a red deer's mandible. Kretuonas 1C (photograph by D. H. Pauža)

3 Cut marks on boar's humerus. Kretuonas 1C (photograph by D. H. Pauža)

4 Cut marks found along medial edge of *fossa oleccranii* of boar. Kretuonas 1C (photograph by D. H. Pauža)

1

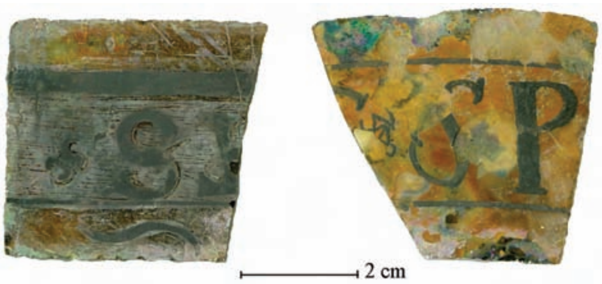
2

Plate II

1 Excavated burials at the cemetery of Veselava.

2 Interior remains of residential house built in 1542: 1 – column fragment, 2 – kitchen hearth, 3 – board near hearth, 4 – kitchen's dirt floor, 5 – base fragment of living room's stove (photograph by I. Masiulienė).

1



2

3

6

7

4

5

8

Plate III
1 Frame, floor, and other parts of barrel remains found in Storehouse II, tentatively dated beginning of the 17th century – 1678 (photograph by I. Masiulienė).
2 Fragments of stain-glass window, with painted ornaments and letters, dated 1542-1554 (photograph by I. Masiulienė).
3 Part of round form of stained glass window, dated 1542-1554 m. (photograph by I. Masiulienė).
4-5 Fragments of stained glass window with painted ornaments, dated 1542-1554 (photograph by S. Satkūnaitė).
6-8 1510 Sigismund I the Old half-penny; Free Riga's 1571 shilling; Free Riga's 157(5?) shilling (photograph by I. Masiulienė).

1

2

3

4

5

Plate IV

1 Construction elements of residential house built in 1542: 1 – cuttings of secondary use timbers, 2 – blocks, 3 – framework fragments, 4 – upright remains, 5 – 18th-19th century gutter fragment (photograph by I. Masiulienė).

2 Frame and remains of oak floor of annex built in 1554 (photograph by I. Masiulienė).

3 Book cover's brass binding, middle – end of the 16th century (photograph by I. Masiulienė).

4 Fragment with decor details of horn artefact with Renaissance woman's engraving, tentatively dated 1542–1554 (photograph by I. Masiulienė).

5 Pot cover fragments decorated with stamps, middle – second half of the 16th century (photograph by R. Bračiulienė).