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<td>AI</td>
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<td>AJB</td>
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<td>CarnuntumJb</td>
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<td>CIL</td>
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<td>JDA</td>
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<td>JFA</td>
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<td>JMC</td>
<td>Journal of Material Culture (Thousand Oaks, CA)</td>
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<td>JOÖMV</td>
<td>Jahrbuch des Oberösterreichischen Musealvereins (Linz)</td>
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<td>KJb</td>
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SMK A Somogy megyei Múzeumok Közleményei (Kaposvár)
SpecN Specimena Nova: dissertationum ex Instituto Historico Universitatis
Quinqueeclesiensis de Iano Pannonio nominatae (Pécs)
SprawArch Sprawozdania Archaeologiczne (Wrocław)
StComCar Studi e Comunicäri. Muzeul de Istorie Localäsi Etnografíe Caransebeş (Caransebeş)
StComit Studia Comitatensia (Budapest)
StComSib Studii e Comunicäri. Muzeul Brukenthal (Sibiu)
StudArch Studia archaeologica (Budapest)
SUBB Studia Universitatis Babeş – Bolyai (Cluj – Napoca)
SZ Štúdijné Zvesti Archeologického Ústavu Slovenskej Akadémie Vied (Nitra)
SzSz Székesfehérvári Szemle (Székesfehérvár)
TapolcaVMK Tapolcai Városi Múzeum Közleményei (Tapolca)
TeltudK Településtudományi Közlemények (Budapest)
Tibiscus Tibiscus. Muzeul Banatului (Timișoara)
TrZ Trierer Zeitschrift für Geschichte und Kunst des Trierer Landes und seiner Nachbargebiete (Trier)
TSz Történelmi Szemle (Budapest)
TT Történelmi Tár (Budapest)
UBA Universitettet i Bergen Årbok (Bergen)
UPA Universitätsforschungen zur Prähistorischen Archäologie (Bonn)
VAM Varia Archaeologica Hungarica (Budapest)
VMMK A Veszprém Megyei Múzeumok Közleményei (Veszprém)
VMP Veröffentlichungen des Museums für Ur- und Frühgeschichte Potsdam (Potsdam)
VýP Východoslovenský Pravek (Košice)
WiA Wiadomości Archeologiczne (Warszawa)
WMMÉ A Wosinsky Mór Múzeum Évkönyve (Szécszárd)
ZalaiMúz Zalai Múzeum (Zalaegerszeg)
ZfA Zeitschrift für Archäologie (Berlin – Heidelberg)
ZfAM Zeitschrift für Archäologie des Mittelalters (Köln)
ZSNM Zbornik Slovenského Narodného Múzea. História (Bratislava)
Contacts between two cultures in a traditional archaeological sense means similarities in the types of pottery or in the motives of pottery decoration, perhaps also in the stone or metal tool kit. In the beginning of archaeological research, the synchrony and diachrony of prehistoric cultural formations in Europe were exactly based on these similarities. Conclusions, however, were rather drawn on the basis of chronological sequences in distant areas, while the nature of contacts was analysed only to a lesser extent.

These typological or cross-checking analyses usually set out from the assumption of two or more separate archaeological cultures. Beyond establishing similarities, co-existences and drawing some inferences about possible trade or cultural contacts, further questions are seldom posed. Issues concerning whether these cultures had an impact on each other’s customs, ways of life, settlement structure; whether similar pot forms mean common features in food production and diet, whether similar stone or metal instruments mean similarities in the technology, are usually not raised.

In more recent research, the meaning of imported objects has been analysed. It is the provenance of raw material that poses one of the most interesting problems. Who had access to the sources, who were the “traders”, if any, what could be the basis of exchange, i.e. what did people get for their raw materials? Certainly, most evidence for exchange comes from non-perishable materials, although assumptions can be made of trading with fur, food products or salt as well. At this point, another type of imported objects, those from extremely long distances, such as fossil shells and spondylus, marmor, obsidian, pottery, subsequently gold or copper, can also reflect of prestige. Objects of non-local origins can be understood as a sign of certain differences in social status.

The archaeological analysis of cultural, trade and social contacts is an important and urgent task for another reason as well. Namely, we are living at the time of various contact analyses in European prehistory, based on different, non-archaeological data and scientific information. To mention only a few examples: Problems of prehistoric migration are increasingly at the peak of interest of bone chemists who analyse different stable components of human bone collagen, such as nitrogen isotope, stable carbon or strontium isotopes. It is necessary to compare the results gained by these analyses with migration hypotheses put forward by archaeological research. Similarly, DNA investigations regarding both marker genes and mtDNA analyses, should be cross-checked with traditional artefact typological data provided by archaeologists. Soil chemists and geologists, archaeozoologists, palynologists and macro-botanists seek for an archaeological verification for their results as well. Also, we are faced with having to compare the calibrated 14C and dendrochronological data to our results. Palaeolinguists are also involved in this multidisciplinary research.

I should like to emphasize that prehistorians are urged to successfully research and define contacts in the Neolithic, in order to join the efforts of colleagues in other fields. Namely, should hard scientific data show a certain discrepancy with our results, it is worth going into further details, and co-operate. However, when due to the gaps in research, archaeological data concerning contacts between or within prehistoric societies are lacking, our colleagues working in hard science stand alone in the evaluation. This has already happened, causing confusion or misunderstanding, leading to bad reactions on both sides. Therefore, every step forward in the research of cultural contacts between bearers of prehistoric cultures, helps clarifying these misunderstandings, and solving controversies between the parallel results.

The notion “contact” also means mutual impact, interaction between two or among several groups of people. Here I should like to mention an example, where – apart from the
difficulties known from the beginning – another problem emerges. In this case, the contact can be taken for sure, nevertheless, one of the participating groups remains in hiding. The example is taken from my own research, the earliest neolithic period in Transdanubia.

One of the participants was the intrusive Starčevo-culture from the South, as it is known from the detailed publications by N. Kalicz. On the basis of the new finds two territorial groups of the late Starčevo culture might be draughted in Transdanubia. Recently published finds from Southern Babarc belong to a group, which is strictly bound to its southern relatives beyond the Drava river: its best parallels can be found in Croatian sites.

Contrasted to the aforementioned stylistic and typological features, two late Starčevo settlements in the Northwest: Vörs and Gellénháza, as well as finds from the Northern banks of Lake Balaton, seem to belong to a slightly different group, with less evidence of straight Balkan contacts. As to the excavators of Vörs, a number of these features become typical in the oldest Linear Pottery culture (e.g. deeply incised linear patterns), which occurs in an unusually high quantity, compared to the whole Starčevo area.

A further argument for the existence of a Northern, specifically Starčevo group comes from the largest site excavated in the region: Szentgyörgyvölgy-Pityerdomb, close to the Slovenian–Austrian border. The settlement, which consisted of two houses and yards around, could be almost fully excavated and the find material has been evaluated, waiting for publication. The long houses evidently belong to early Central European types, whereas the pottery looks more like late Starčevo ware, or at most reflecting a mixture, a transition between the Spiraloid B phase of the Starčevo culture and the earliest Linear pottery. This concerns the way of firing, the temper and the surface of vessels, the cultic finds as well as the slightly incised decoration ("einpolierte Ware"), the majority of the biconic, strongly carinated forms, the polished fine ware and also the coarse ware. These typological parallels, as well as the similar geographical preferences, suggest not only a possible synchronity but also live contacts between the late Starčevo people and the prehistoric inhabitants of Pityerdomb.

In the case of a cultural formation such as the Starčevo culture, that remained almost identical in a vast geographic area from Macedonia to the Pannonian hills, the differences observed at the North-western boundary cannot be neglected! Consequently, another participant in the Transdanubian neolithisation process may be assumed.

In the last few years my own research in Transdanubia, based on three microregional projects and investigations around Lake Balaton led me to the conclusion that Western Transdanubia formed a frontier zone in the mid-centuries of the 6th Millennium. This means that Starčevo farmers of southern origins came into a longer contact with local forager groups. Both groups were in the position on the one hand, were forced on the other, to make some serious changes in their lifeways. The Starčevo people met a considerably more Atlantic climate here, cooler summers and particularly wet winters, with much snow. This adaptation must have taken place as people settled in an almost Alpine environment, as is reflected by the case of Szentgyörgyvölgy-Pityerdomb, as well as in low, marshy areas, on islands in wet moorland, as was the case with the inhabitants of Vörs. Local groups, however, must have faced emerging water-levels and a wet climate, so that they had to move onto the new banks of the more extended lake Balaton, but they would have also quickly adopted techniques of food-producing and pottery making from the Starčevo immigrants. The result of these connections and interaction was most probably a mixed population which slowly extended its farming activity in Transdanubia, and meanwhile – or at least very soon – rushed through the

Danube valley to the inner part of Central Europe to participate in forming the LBK culture and adopting a sedentary life.

What phenomena make such inferences possible? I have found some direct and also some indirect hints that speak for the existence of the processes outlined above. Among these traces I consider the following indirect proofs especially important:

**Direct hints:**

1. Trapezoid microliths and other types of the late mesolithic tool-kit have been known from surface finds for many years, their pre-neolithic character has never been argued. Two regions seem to be especially rich in such surface finds: the Kapos valley in Southern Transdanubia and the Vázsony basin in the Balaton highland stretching north of the lake.

2. According to pollen sequences taken from the lake sediments and also from the marshy area of the so-called Little Balaton, the contribution of hazelnut increased in the 6th Millennium to the extent that around 5600 BC, 55% of the ligneous plant pollens were those of Corylus! Western Transdanubia must have been a refuge area for hazelnut during the last Ice Age but the sudden growth just before the early Neolithic most probably can be ascribed to human activity. The appearances of pollen from the first domestic cereals are inversely proportional with those of hazelnut pollen: the spread of wheat and barley went together with the decrease of hazelnut.

3. Near the site Szentgyörgyvölgy-Pityerdomb, on the marshy banks of the Szentgyörgy-stream, traces of intentional burning were identified during the course of soil analysis. These were dated to 8771 ± 55 BP (=mid-7th Mill. BC). According to the calculations by M. Zvelebil,4 burnt organic residue and the small extent of erosion may indicate rather frequent episodes of burning, i.e. not more that 15–30 years apart from each other.

4. During the course of topographic investigations carried out near the Western banks of lake Balaton, a flat based wooden boot has been mentioned, found deep in the soil of the marshy Keszthely region that once had belonged to the lake but got eutrophised definitely before the early neolithic. In this way the boot can be considered as a find belonging to the groups being active in the region before the Starčevo people’s arrival.

**Indirect hints:**

1. Some features of the settlement structure seem to be of great importance in the mid-6th millennium. From sedimentological and palinological investigations it has become clear that, as has also visible in satellite photographs, the extent of the lake changed from time to time. At the beginning of the Holocene, in some periods water covered even the Tapolca Basin in the North and all the valleys to the South, reaching the Drava River. The bank of the Balaton has always been a moorland. While the final mesolithic period was fairly dry with surface of lake Balaton drawn back, around 5500–5400 BC the water level increased remarkably.

2. Accordingly, the late mesolithic sites most probably lie under the current water level. However, numerous early neolithic sites are known from the banks of lake Balaton, which are located in a very “mesolithic” way; i.e. within the swampy reeds or in small islands near the banks. There are a series of earliest “Linear Pottery” sites along long islands which did not emerge very much from the wetland – which could be a swamp, or, in the middle of the 6th Millennium, open water. The location of these settlements corresponds perfectly to the late mesolithic water-bound way of life. On the other hand it is also true, that this type of biotop is unsuitable for extended farming. Yet, almost all of the 65 earliest “Linear Pottery” sites lie in the marshy waterside area! Some, so-called late Starčevo sites can also be added to these.

3. In spite of this, quite a wide range of domestic plants could be identified in the earliest phase. Similarly to Pityerdomb: emmer and einkorn, common wheat (Triticum aestivum) and barley are present, in addition to some edible wild plants such as goose-foot. However, these cereal types did not occur in greater amounts at any of the sites. This phenomenon, the dimensions of farming activity, did not extend beyond the level of late mesolithic horticulture,

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4 M. Zvelebil: Plant use in the mesolithic and its role in the transition to farming. PPS 60 (1994) 35–74.
CONTACTS IN THE FRONTIER ZONE OF EARLY NEOLITHIC WESTERN TRANSDANUBIA

after N. Kalicz, M. Zvelebil, E. Bánffy, R. Tringham

MESOLITHIC
W-Transdanubia
Balaton area

ADAPTATION
- environmental
- socio-economic

COOPERATION
1. TRADE - CHANGE OF RESOURCES & PRODUCTS
2. CHANGE OF INFORMATION
3. COMPETITION, STIMULATION
4. MARRIAGE, ETHNIC MIXTURE

NEW CULTURAL IDENTITY
LBK in Transdanubia

"Keszthely" phase: intensive agriculture

NEOLITHIC
late Starčevo culture from the South

ADAPTATION
- environmental
- socio-economic

fig 1. Model of the neolithic transition in Transdanubia

i.e. small areas within or around the settlement, home to new domestic plant species received and the technology learnt from Starčevo immigrants. This all speaks for a qualitative change - but by no means a quantitative one - in this phase, concerning plant cultivation or especially life style. Thus, according to the settlement structure, autochthonous hunter-gatherer groups may be sought behind the earliest "Linear Pottery" sites.

4. To affirm the aforementioned hypothesis, the change in life-style happened indeed - but a phase later, at the time of the early/classical Transdanubian LBK. In the so-called Keszthely phase, people began moving upwards to higher terraces and hillsides, in search of good loess soils. A good example for this change is the densely settled Marcal valley north of lake Balaton, whereas the classical sites of this group may be found on loess terraces. Although no detailed macrobotanical analyses are yet available, pollen data speak for a more extended agriculture. The quantitative change in life ways must have happened, but not at the initial phase of the Transdanubian Neolithic. It became typical some three generations later. This also shows that there was no "revolutionary" process: the change to an intensive and irreversibly safe food-producing life lasted for over a century. Interestingly enough, its emergence was synchronous with the rise and flourishing of the Vinča–Tordos culture in the Mid-Balkans, characterised by efficient agriculture.

5. The thorough analysis of pottery yielded no information contradictory to this picture. In summary: I have found that in the emerging LBK sites only the proportion of the Starčevo pottery changes. At some sites, the strong Starčevo character most probably means real people of Southern origins. Pot sherds from other sites reveal, however, that they are of another character, of poorer quality. Types tend to be restricted to house ware. Linear decoration is negligible or completely absent on this pottery. On the basis of the analysis it seems that pottery of minor Starčevo character found at waterside sites, may represent the first attempts by local people who had adopted the know-how of pottery making.

6. A very similar observation can be made concerning the so-called cultic finds. Local, coarse imitations alternate with some real, elaborated Starčevo objects. Some elements of
the South East European cult life may have been adopted, while other elements – such as the manufacturing of figurines as mass products – diminished from the LBK cult life. These changes might not have happened unindependently from the beliefs of local groups.

7. The transitory phase with a quasi mesolithic way of life seems to be perfectly reflected in flint assemblages. Both in the early and in the developed phases of the LBK community, the use of exactly identical types must have been adopted from local earlier, hunter-gatherer groups.

Some sceptical, or rather critical voices may be expected concerning what has been said above. The traces under discussion here can be doubted, in the absence of rich archaeological materials from the late Transdanubian Mesolithic, relevant settlement traces and stratified lithic tools in Western Transdanubia and around Lake Balaton. Nevertheless, I join to the opinions of M. Zvelebil, P. Bogucki, M. Jochim, A. Whittle and others, who all emphasize the absurdity of the idea that the first farmers would rush through the greater part of Europe in a vacuum, in a no man’s land.5

In light of all this, I am concerned that two participants can be supposed in the mid-sixth millennium of Western Transdanubia. The late Starčevo people and indigenous groups must have been in contact with each other. I have already mentioned environmental adaptation. But, as the model shows, both groups also had to seriously adapt to each other (fig. 1).

During the course of contact and interaction between the mesolithic groups and the Starčevo culture, both went through an adaptation process to the new environmental, climatic circumstances as well as to the alien customs of the other group of people. As the aforementioned indirect and direct hints suggest, a sort of co-operation is to be assumed between them. In return for the generally distributed Szentgál red radiolarite, new information of the agricultural package must have been given, with the exchange of food, some other products, as well as the know-how of settled life such as architecture. In other words, a network of information must have developed. Not independently from all this, a twofold process may have been manifested in the form of personal contacts: marriages and kinship as well as a competing activity between the food producing and the forager lifeways. I should like to stress that I see trade and cultural connection as a form of social communication. In fact, it helps to reduce conflicts among different groups. Due to this complicated interaction a new cultural identity arose: that of the LBK in Transdanubia.

Within the Carpathian Basin, the Eastern, Alföld groups were in a far more advantegous position than those in Western Hungary in terms of nearly all parameters of life. So one day the question must be answered, why it was mainly the Western, Transdanubian groups participated in the neolithisation of Central European.

The differences might lie in the different ways of contacts and communication. While the Körös-early LBK in the Alföld region had good contacts to the East/Southeast they had little connection with Northern Transdanubia. Transdanubian groups, however, used long-distance routes to several hundred kilometers to the North and West. Szentgál flints in mesolithic sites in Southern Moravia, as well as pre-neolithic Danubian shell finds prove that these routes and

contacts may have preceded the LBK period. Considering also the extremely quick spread of early LBK groups, I can only think of already existing old, pre-neolithic, well-known communication routes which were re-used by a mixed population, consisting of Starčevo immigrants and local hunter-gatherers. The groups would possibly not go the Unknown, but rather to familiar people and places along the Danube. It is exactly this point that may have defined the character of the neolithic process toward the inner part of Central Europe.
CONNECTIONS IN THE KÖRÖS CULTURE WORLD: EXCHANGE AS AN ORGANISING PRINCIPLE

This short paper is an essay in speculation. I start with the known facts of movement of raw materials within and especially into the orbit of the Körös culture. I then reflect on what else might have been moving alongside and in exchange for these materials. From a possible sense of flow of other materials and of people, I consider whether ideas of connectedness and exchange could also have informed other aspects of what we could call the worldview of the people involved. I briefly discuss the historical setting of the emergence of the Körös culture, relations with the natural surroundings, connections with water and earth, various interchanges with animals, and linkages among and between the living and the dead.

The paper comes in the first instance out of our recent Hungarian–British project at the Körös culture occupation at Ecsegfalva 23, Co. Békés, which is nearing publication. I refer to results being prepared by several other colleagues, whose conclusions will be presented in our final report. I do not implicate them in this paper. In referring many times to 'the Körös culture', I do not mean to imply either a tightly bounded or closed entity in relation to what lay beyond the southern part of the Great Hungarian Plain in the first half of the sixth millennium BC, or any necessary sort of uniformity within the distribution of this archaeological grouping. Indeed, some of the ideas discussed here may serve to weaken the still strong hold of the concept of archaeological culture on interpretation of this world.

Movement of raw materials
I begin therefore with the known facts of raw material movement within and especially into the Körös culture world from the outside. There were, as is well known, no lithic resources within the Great Hungarian Plain, and lithic materials had to be imported from the fringes of the Carpathian Basin. As movement from the outside, we can cite obsidian from the Hungarian and especially Slovak sources to the north-east, normally over a distance of at least 150–160 km to the main known distributions of Körös culture settlement in the Körös, Tisza and Maros river systems (though the position of the site of Méhtelek in the north-east of the Plain serves to reduce this figure). Also from the outside came stone axes of various rocks, including from the eastern end of the Alps. There was also movement of limnoquartzite from the hills fringing the northern edge of the Great Hungarian Plain, some 110–120 km to the north of the main known distributions of Körös culture settlement. Finally, smaller quantities of radiolarite from the Szentgál source north of Lake Balaton have also been found in Körös culture sites. From the east, the rock for various stone axes can be found in the Apușeni hills in western Romania, and brown flint came from the Banat to the south, both over shorter but still significant distances.

These facts are well known. What remains striking is the diversity of movements. With this is implied a diverse range of contacts with other situations beyond or outside the Körös culture (whether or not that was closed or bounded system). Obsidian, limnoquartzite and radiolarite must have come in this situation from various Mesolithic contexts, the former two from the foragers who may be presumed to have co-existed with the Körös culture to its north, largely around the fringes of the Carpathian Basin rather than within it. Movement across the northern part of the Great Hungarian Plain may have been through

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a largely little used region. Szentgál radiolarite may also be presumed to have come from a forager context, though just beyond the known limits of Starčevo culture settlement in Transdanubia south of Lake Balaton. The hills of western Romania were within the general orbit of the Criş culture, and the Banat firmly within the main area of the Starčevo culture. It may be noted how easy it is when using the terminology of archaeological cultures to think of rigidly separate situations, but it is clear, even if this kind of essentialism is removed, that materials were coming into the southern part of the Great Hungarian Plain in the first part of the sixth millennium BC from varying, at times impressive, distances, and from varying contexts.

At Ecsegfalva 23, close to the Hortobágy–Berettyó river near the known northern limits of the Körös culture, this same pattern is repeated; obsidian and limnoquartzite are dominant, and there are axes of probable eastern derivation. Not far to the south-west, the cache of Banat flint in a pot at Endröd 397 remains one of the most vivid illustrations of all these movements, and a reminder of how the pattern of movement can vary from site to site; there was very little Banat flint at Ecsegfalva 23.

What (and who) else was moving?

These sorts of patterns prompt a series of other questions. What other materials were moving? Who was engaged in making such movements, and can we narrow the range of actors involved? If in fact the people involved were diverse, can we say more about general principles of connectedness in the world of the Körös culture? Much of what follows is speculative, but it is not intended as pointless or self-indulgent imagining, since the questions asked here may serve on the one hand to make further sense of what is already known of the Körös culture world and on the other to frame programmes of research in the future.

One important lacuna in our knowledge of this situation is the extent of movement of materials or objects within the Körös culture. It is easy to assume that whereas there was extensive movement of lithic materials as shown above, pottery would have been made locally at this time. It is certainly true that it becomes easier by the later sixth millennium and into the fifth millennium BC to identify ceramic imports, as styles became more differentiated, but identifying the movement of pottery within and indeed between the Körös, Starčevo and Criş ‘cultures’ is an important goal for future research. A new programme of scientific investigation focused on Criş and Starčevo pottery may provide important further insights.

In the meantime, it is valid also to question what else may have accompanied the known lithic movements. This raises the central question of the nature of procurement. It is possible on the one hand that lithics (apart from pottery) were not the only substances on the move, and on the other that a variety of agents were involved, from foragers living beyond the northern limits of ‘Neolithic’ settlement, to people from the Körös–Starčevo–Criş worlds themselves ranging beyond their normal orbits to procure desired raw materials from distant sources. It is easy here to fall into the trap of essentialism, predetermining the separate existence of defined entities such as foragers and farmers. Indeed, contact and exchange may have been means by which identities were kept fluid, permeable and open at this time. At this stage of research it is strictly speculation to wonder whether the small quantities of raw materials were accompanied, in various directions, by other substances and by people. Carbohydrate-protein exchanges are

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6 Inna Mateiciucová, pers. comm.; Elisabetta Staminì, pers. comm.
7 Kuczanska et al. 1981.
8 Inna Mateiciucová, pers. comm.
9 Stephen Shennan and Michela Spataro, pers. comm.
well documented ethnographically in this sort of situation,\textsuperscript{11} as well as the movement of other materials or substances such as furs, feathers and shells. Recent isotope analyses further west in Europe suggest the possible movement of women, into LBK settlements in the Rhineland from the neighbouring hills, and into coastal parts of late Mesolithic Brittany from the interior.\textsuperscript{12} It will be necessary to refine these analyses, but their eventual application to both human and animal samples within the Carpathian Basin will be of crucial importance.

**Other forms of connectedness**

Is all such activity just to be reduced to the lack of lithic resources within the Great Hungarian Plain, or can it suggest, as already hinted, other forms of connectedness? Could we use the facts of lithic movement as an insight into other aspects of the worldview of people in the Körös culture?

**THE HISTORICAL SETTING**

All people are connected to greater or lesser extents. In the case of the Körös culture, there may have been particular reasons why, at a regional scale, history and contingency reinforced the nature or style of such relationships. Finding traces of the presence of later Mesolithic foragers within the Carpathian Basin, as opposed to in the surrounding uplands, in the Danube Gorges, or in Transdanubia, has proved enduringly difficult. The discoveries in the Jászság, north of the Tisza valley near Szolnok,\textsuperscript{13} point the way to other possibilities in the future. Early radiocarbon dates from Topole-Bač in northern Serbia and Maroslele-Pana in the southern part of the Great Hungarian Plain,\textsuperscript{14} as well as now Ecségfalva 23, might point also to sporadic visits by a pre-Neolithic population, though in each case these are single dates and might be dismissed as simply predictable statistical ‘outliers’. Analysis of pollen and charcoal from sediments in the southern part of the Plain might also in the future give clues to the pre-Neolithic human presence,\textsuperscript{15} that has already been investigated in the northern part of the Plain\textsuperscript{16} and has recently been suggested through pollen analysis in Transdanubia, at Zalavár at the western end of Lake Balaton.\textsuperscript{17} It remains the case, however, that it is likely that the Körös culture represents the first sustained Holocene occupation of the relevant parts of the Great Hungarian Plain. Moreover, the argument can be made that it also represents a fusion of both incoming population from the south and indigenous regional population drawn from areas around.\textsuperscript{18} In this scenario, we could envisage historical precedent for connections in many directions, and continuation of such contacts could be seen as in part an active commemoration of what had gone before.

**RELATIONS WITH THE NATURAL SURROUNDINGS**

There is a danger in this view of seeing the character of existence in the Körös culture as simply a function of its past and its setting. A more subtle and layered view can be proposed. From what has been called a dwelling perspective, it is possible to see people as inherently likely to be closely in touch with their surroundings, alert to its possibilities or affordances.\textsuperscript{19} It need not be the case that practice of particular techniques by itself defines the nature of how people perceived their environment or natural surroundings. The use of domesticated


\textsuperscript{14} Whittle et al. 2002.

\textsuperscript{15} Kathy Willis, pers. comm.

\textsuperscript{16} P. Sümegi: Reconstruction of flora, soil and landscape evolution, and human impact on the Berek Plain from late-glacial up to the present, based on palaeoecological analysis, in: J. Hamar – A. Sárkány-Kiss (eds): The Upper Tisza Valley. Tiscia monograph series. Szeged 1999, 173–204; Pál Sümegi, pers. comm.

\textsuperscript{17} Imola Juhász, pers. comm.

\textsuperscript{18} Whittle et al. 2002; Whittle 2003.

\textsuperscript{19} Ingold 2000.
animals and plants in itself need not determine a conceptual separation between people and their surroundings. Ingold\textsuperscript{20} cites several examples from the ethnographic record of people who practise horticulture but who see themselves as closely and intimately in touch with their setting, working within the metaphor of the giving or nurturing environment, in which the woodland or forest is conceived as a parent, or in which the whole woodland setting is thought of as a garden. These are all complex issues, but this is not the place to follow them in detail.\textsuperscript{21} Here I want to sketch some of the emerging characteristics of the Ecsegfalva situation (subject again to the qualification already noted above, that definitive details will be given in our final report) and to consider them from a dwelling perspective.

The occupation at Ecsegfalva 23 was beside the Kiritó, a meander or oxbow lake formed in the former course of the Hortobágy-Berettyó river. By 6000 BC this was still, shallow water, perhaps only periodically inundated.\textsuperscript{22} The wider landscape is very flat, with relief principally in the form of levées and terraces, of varying Pleistocene and Holocene origin. For wider comparison, a little to the south near Dévaványa, Körös culture occupations are to be found mainly on the terrace edges of the late Pleistocene alluvial delta,\textsuperscript{23} and further to the southwest, in the Gyomaendröd area, on a variety of Pleistocene terrace edges, isolated ridges, and the edge of the Holocene Körös river itself.\textsuperscript{24} Such a landscape would have filled with water very easily, demonstrable by GIS analysis. A rise of 1 m would have connected much of the immediate surroundings of the Kiritó with the already low-lying region to the north of Ecsegfalva,\textsuperscript{25} and at such putative flood times the levée at Ecsegfalva 23 would have become one of a small series of islands at the known northern limits of the Körös culture. This was potentially therefore a dynamic environment, but it has already been stressed that people chose to occupy such settings and that modern concepts of risk and danger are probably not helpful in our understanding of how people at that time perceived their environment.\textsuperscript{26}

Judging from pollen analysis, plant remains and animal bones\textsuperscript{27} the vegetation setting was a mosaic, with open woodland predominant. There is little sign of any major clearance impact.\textsuperscript{28} While people probably ranged widely through their taskscapes,\textsuperscript{29} as seen in the collection of shellfish from still- and flowing-water situations,\textsuperscript{30} the perhaps opportunistic hunting of a very wide range of bird species,\textsuperscript{31} and the hunting of game of various sizes,\textsuperscript{32} the emerging picture is a concentration on the herding of sheep,\textsuperscript{33} and the maintenance of small plots for the cultivation of cereals.\textsuperscript{34} The presence of people at varying points through the year appears to be indicated by these kinds of evidence, though the flow of people through the taskspace at particular seasons remains a matter for debate.

A picture is therefore emerging of more rather than less settled people, who concentrated above all on the herding of sheep and the cultivation of cereals, while also being aware of other resources in their taskscapes. It may also be possible to propose that these people saw themselves as working within and with their environment, rather than conceiving themselves as separate from or dominant over it. Successful existence required attention to the rivers and waters beyond the perhaps ‘safe’ setting of the Kiritó, and was carried forward by investment of labour and attention in gardens or plots\textsuperscript{35} as well as by time spent herding animals in open woodland, moving them seasonally, and from time to time perhaps folding

\textsuperscript{20} Ingold 2000, chapters 3-5.
\textsuperscript{21} Cf. Whittle 2003.
\textsuperscript{22} Pál Sümegi and Kathy Willis, pers. comm.
\textsuperscript{23} A. G. Sherratt: The development of Neolithic and Copper Age settlement in the Great Hungarian Plain. Part II: site survey and settlement dynamics. OJA 2 (1983) 13–41.
\textsuperscript{24} Makkay 1992.
\textsuperscript{25} Mark Gillings, pers. comm.
\textsuperscript{27} Kathy Willis, Amy Bogaard and László Bartosiewicz.
\textsuperscript{29} Cf. Ingold 2000.
\textsuperscript{30} Pál Sümegi, pers. comm.
\textsuperscript{31} Erika Gál, pers. comm.
\textsuperscript{32} László Bartosiewicz, pers. comm.
\textsuperscript{33} László Bartosiewicz, pers. comm.
\textsuperscript{34} Amy Bogaard, pers. comm.
them close to occupations and gardens. This does not perhaps need to be seen as an intrusive or aggressive form of agriculture, rather an accommodation of new ways of doing things to the existing possibilities. If so, one can suggest here another fundamental form of connection or connectedness. In this perspective, people were in touch with the beyond not only in order to get lithic resources unavailable locally, but were tied to wider regions by memory of their past, while simultaneously being bound closely to the rhythms and character of their immediate setting.

This is a speculative model based in the first place on the study of one small microregion, but it may be applicable to many other settings within the distribution of the Körös culture. Future research that can link the so far separate studies at Ecsegfalva, Dévaványa and Gyomaendrőd, for example, would be highly desirable.

**Connections with water and earth**

Further speculation can follow from this. In his study of people living beside the Amazon, Mark Harris has drawn attention to the inherent importance of the rise and fall of the waters of the river for the rhythms of life. The state of the river conditions sociality. In the flood season, people are largely confined to their houses, a phase of low spirits and reflection, but also a time for the maintenance and repair of familial and other close social ties. As the waters recede, so people can begin again to move more freely, and a season of aggregation for festivals and other gatherings begins, a period of high spirits and elevated mood, but also one eventually of tension and conflict. If flooding can be proven to have been a recurrent feature of the Körös culture environment, something of the same possibilities might apply. People would have had to act in tune with changes in water level, moving themselves and their animals around the taskscape. In some settings, such as at Ecsegfalva 23 itself, water rise might have led to isolation, leaving at least some people on their own. This is to see water rise in a negative light, though it might also have facilitated communication and movement by boat. In other settings, such as around Dévaványa, where larger Körös culture occupations are known along the Pleistocene alluvial terrace edges, such putative changes in water levels might have led to periodic aggregation. These are at present merely speculative differences, but they could be amenable to future investigation.

There is no immediately obvious indicator in material culture to suggest the symbolic importance of water in the Körös culture worldview, such as one can suggest in the Danube Gorges only a little earlier, as indicated in the half-human, half-fish sculptured representations of Lepenski Vir. But the likely symbolic and conceptual importance of water (argued also by Banner) remains.

There are more easily demonstrable connections with the earth, and some kind of duality between earth and water, dry and wet, might have been one of the basic nodes of thought with which people in the Körös culture formed their view of the world. Pits of many shapes and sizes have been the literal stuff of excavations of Körös culture occupations (and of course also those in the Starčevo–Criş orbit). Their purposes, just as their individual histories, must have varied. They need not be reduced to being only providers of material for building or receptacles for the deposition of material culture, though these uses may indeed have been major parts of their significance. Pit digging put people into direct symbolic as well as physical contact with the earth. To construct buildings, to create place, people drew on the earth itself, and as part of the cycle of occupancy of place, they returned materials with histories and biographies to the ground. People at this time can be defined as well as by

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their relationships with domesticated animals and plants and by their use of pottery, by their repeated and very direct use of material from the earth. At Ecsegfalva 23, the major pit so far excavated seems to have been dug early in the history of the occupation. It filled at first largely by natural processes, but was then filled up by the large-scale and probably rapid dumping of large quantities of silty clay (possibly unburnt daub), some burnt daub and selected spreads of pottery, shell and animal bone. The burnt daub is part of buildings or structures of some kind, probably including domestic shelters or residences, perhaps held on light wooden frames and certainly recurrently clothed with daub covered with daub.41 From this perspective, people were not only in an intimate and reciprocal relationship with their surroundings and taskscape, but specifically also with the very elements, which went to constitute the places by and through which they ordered their existence.

Interchanges with animals

Animals were at the heart of existence in the Neolithic period, if not also in earlier and later times. Archaeologists have tended to give prominence to the use of animals for primary and secondary products, but it is the combination of different roles that made animals so powerful. Not only could they provide both while alive and after slaughter, sustenance for people, but they constituted living symbols, as carriers and creators of value. They can be seen as agents in their own right, and it is often a moot point whether people directed the movement of animals or the converse; an inextricably intertwined relationship is a fruitful perspective. Live animals can be shared, exchanged and stored with other people, as part of bride wealth and alliance transactions. We can see from the ethnographic record42 innumerable examples of complex webs of value, in which animals played a central part in people’s lives. These relationships are often ambiguous, since alongside honour, ritual value and sacred status, may also exist the desire to kill and consume.43

The animal bone assemblage from Ecsegfalva 23 will take its place alongside that from Endrőd 11944 as an important indicator of patterns of animal use in the Körös culture.45 Once again, the final report will present definitive results, but a picture is emerging of sheep as the numerically dominant animal, with few cattle and pigs, and rather little game, though quite a wide range of species are represented.46 The final report will also discuss all available details of age and sex structure, and the possible economics of sheep exploitation. In the context of this discussion about connectedness and exchange, I want here to offer some other reflections about further dimensions of the relationship with sheep and other animals.

Preliminary analysis of lipids (fatty acids) in a small sample of shards from Ecsegfalva 23 indicates the presence of ruminant dairy fats, and thus probably the practice of milking; preliminary analysis of proteins may implicate cattle, but at this stage sheep (or indeed goats) cannot categorically be excluded.47 Taking these very preliminary results at face value, a complex set of relationships might be suggested. Sheep may have been the most numerous animal, and their tending and herding may have been a major concern from season to season. Their slaughter and consumption may have been a major feature of periodic aggregations if not also of daily life. Though it is often cattle and pigs that take centre stage in ethnographic accounts of animals, in the context of the Körös culture sheep might be thought of as having had two or three possible symbolic dimensions. Without any doubt, they originate from the south, and given an intimate human knowledge of the surroundings and the affordances of

41 Ángela Carneiro and Inna Mateiucicová, pers. comm.
45 László Bartosiewicz, pers. comm.
46 László Bartosiewicz, pers. comm.
47 Carl Heron and Oliver Craig, pers. comm.
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the taskscape,\textsuperscript{48} it is inconceivable that sheep were not recognised as coming from beyond, from the south. Within the spectrum of indigenous fauna in open woodland, sheep may have been quite distinctive in terms of size and herd behaviour. If they grouped together naturally at this time (which is of course uncertain), they could be seen as a kind of living solidarity, a metaphor for cohesion and togetherness.\textsuperscript{49} Quite apart from their practical advantages (and disadvantages), sheep would therefore have presented people on a daily basis with a distinctive visual and aural reminder of history — living with the sound of the past — as well as a metaphor of their own sociality, itself in part created by the agency of animals.

In other regards, however, other animals may have been at least as important, even if numerically less frequent. If cattle were milked, then the most direct practical connection or exchange was with them, rather than sheep. And in the representations of animals on Körös culture pottery, it is deer and goats, which are figured.\textsuperscript{50} Fragments of both appear in the pottery assemblage from Ecsegfalva 23.\textsuperscript{51} This perhaps mythic dimension is barely accessible, but speculatively it might be to do with wildness and rarity respectively.

Through their relations with these and other animals, people may therefore have been connected to both the remembered past and myth, as well as valuing different animal species for perhaps differing reasons. Animals need not be excluded from the web of exchanges, which constituted existence in the Körös culture.

L IN K AGES BETWEEN THE LIVING AND THE DEAD

The last dimension briefly to consider is that of people themselves, both living and dead. Identity may be a complex matter, and many notions of the individual and person can be found in the ethnographic record that run counter to the intuitions and ‘common sense’ of the modern western world. These have been debated at much greater length elsewhere.\textsuperscript{52} Here it is useful above all to stress the often-relational nature of personal identity. The important studies of Marilyn Strathern\textsuperscript{53} in Melanesia have evoked the notion of the individual, constituted in a web of relations and interchanges with others. Part of the conception of the singular person is its partibility, the way in which people are enchained by shared labour, whose products, especially in the context of ceremonial exchange, can be conceived of as parts of persons, ‘apprehended as detached from one and absorbed by another’.\textsuperscript{54}

It is also important, however, to stress that these need not be seen as universal non-western notions. The contrast between southern India and Melanesia can be cited.\textsuperscript{55} Gender in south India is fixed and stable, rooted in bodily difference and focused on the capacity for procreation. Relations between husband and wife are seen as a series of balanced exchanges, while relations with children depend on a sense of differently gendered substance; fathers feel closer to sons, and mothers to daughters.\textsuperscript{56} The capacity for procreation and nurture is fundamental for male and female gendering, and while these conceptions are different, they are seen to greatest effect in transactions and exchanges between the genders; the person is conceived of as ‘internally whole, but with a fluid and permeable boundary’ and there are ‘substantial connexions between persons who are not bounded individuals of the Western (stereo)type’.\textsuperscript{57} In Melanesia, by contrast, the person is ‘a mosaic of male and female substances, internally dividing up the body into differently gendered parts’.\textsuperscript{58} In this sense, gender is performative, and relational, since relationships make persons.\textsuperscript{59}

\textsuperscript{48} Cf. Ingold 2000.
\textsuperscript{50} N. Kalicz: Clay gods. Budapest 1970.
\textsuperscript{51} Krisztán Oross, pers. comm.
\textsuperscript{54} Strathern 1988, 178.
\textsuperscript{55} Busby 1997.
\textsuperscript{56} Busby 1997, 263.
\textsuperscript{57} Busby 1997, 269.
\textsuperscript{58} Busby 1997, 270.
From this kind of perspective, life can be seen as made up of a series of interchanges and exchanges, which must be performed rather than given in advance. It is extraordinarily unlikely that the exchanges of materials discussed earlier in the paper were neutral, or without implications for the constitution and reconstitution of the individuals concerned. In conducting relationships of exchange, it has been argued that the Maneo of eastern Indonesia are concerned for the response of others. Exchange among them is complex and important, objects circulating especially as marriage payments. Sociality in the sense of giving attention to others can be seen as an important factor. A disposition to generosity and an emphasis on expressing collective virtues by doing things openly have been part of Maneo sociality. ‘Moral sensibilities inform Maneo efforts to shape perceptions of actions and events precisely as a way to induce responsivenes and to mitigate the appearance of unresponsiveness’.

It has also been argued that the emotional correlates of giving and receiving should be considered, through the case study of the Rauto people of coastal southwest New Britain in Melanesia. Among them, the gift is something corporate, an important part of collective social time, linking the living and the dead. Identity is acquired through a ‘narrative of exchange’, which involves and evokes memory, emotion, custom and obligation. The person is contributed by others, including through gifts; ‘persons are created by the gifts of others’.

A useful final example is that of the Foi of Papua New Guinea, whose lives are permeated by a sense of flow. James Weiner has written strikingly about the way in which among the Foi, women interrupt the talk of men, calling, commenting and interrupting from their smaller houses which flank the longhouse, where the men reside and also sleep, when they are all together in their central settlement. The people are not always together. In the drier half of the year, people are congregated in the central settlement, focused on both gardening and communal life based around the longhouse, with its attendant emphasis on ‘gregariousness, competitiveness and confrontation’. Public life in the longhouse collective is contrasted with the intimate sociality of the bush-house, never more than an hour away, in which the smaller unit of man and wife and immediate family work closely in complementary ways to achieve their own production goals. The wetter season of the year was associated with dispersal, especially to remote and isolated hunting lodges, and men’s experiences in this domain constituted much of the stuff of talk back in the longhouse. The Foi orientate themselves partly with reference to the flow of the rivers along whose banks they garden, and they make sense of life in their songs and their myths by reference to ideas of flow and movement.

None of these examples need give direct or immediate insight into the sense of identity and personhood that may have prevailed in the world of the Körös culture. But, linked also to the historical contingency of the formation of this context, they may suggest ways of thinking about both routine, daily interchanges between people as well as less frequent, more dramatic, longer-range exchanges of non-local raw materials. People may have been constituted as persons through a web of interchange. I have suggested elsewhere, arguing from such representations as are available on pottery and in the shape of figurines, that the concept of the individual in the Körös culture may have been fluid and even ambiguous. Figurine fragments from Ecsegfalva 23 include the typical elongated neck/head with schematic face, found frequently elsewhere. It might also be legitimate to connect mortuary practices. The sample is small, and excavations have been of limited extent. But a trend has been observed for more female and child than male burials. At Ecsegfalva 23, only scattered human bones can be

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60 Hagen 1999.
63 Maschio 1998.
67 Weiner 1988, 38.
68 Weiner 1991, 35.
70 Krisztián Oross, pers. comm.
assigned to the Körös culture occupation\textsuperscript{72} at Endrőd 119, there are certainly infant burials belonging to the occupation, and at least one adult, though sex is not yet established.\textsuperscript{73} I have questioned elsewhere\textsuperscript{74} therefore, whether conceptually the Körös female was in some way more closely linked to place, and the Körös male to the wider surroundings. Mortuary ritual may have been in part a final exchange, both an ending and a last settlement of connections.

**Conclusion**

This brief paper has been deliberately speculative. Further, larger scale excavation of Körös culture occupations may refine or overturn many of the possibilities discussed here. My aim has been, however, to try to evoke something of the worldview of the people involved. The starting point was the observed facts of raw material movements, but I went on to suggest a series of connections, through the circumstances in which people came to occupy the southern part of the Great Hungarian Plain in the first place, and through the concept and practice of place, relations with the natural surroundings, including water and earth, various interchanges with animals, and linkages among the living and between the living and the dead. Raw material movements may be only part of a pervasive sense of connectedness, which helped to constitute this world.\textsuperscript{75}

\textsuperscript{72} Ildikó Pap, pers. comm.

\textsuperscript{73} Makkay 1992, 132.

\textsuperscript{74} Whittle 1998; Whittle 2001; Whittle 2003.

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TRANSYLVANIA AND THE BANAT IN THE LATE NEOLITHIC. THE ORIGINS OF THE PETREȘTI CULTURE

As archaeological research developed at the beginning of the 20th century, large amounts of prehistoric painted ceramic materials came to light. Even from the beginning, these materials constituted a distinct cultural entity both in terms of their aesthetic value and the way they were formed and fired. This cultural entity was successively termed by the specialists who studied it "the western Romanian painted ceramics culture",1 or "central Transylvanian painted ceramic culture",2 or "the civilisation with painted ceramics within the western Dacian circle",3 "the Petreții type"4 and, finally, "the Petrești culture".5

The archaeologists who outlined the main features of this culture were Dumitru and Ion Berciu.6 Iuliu Paul however, established the internal chronology of the Petrești culture. He divided the Petrești culture into three phases A, AB and B on the basis of the development the painted ceramics.7

The origin of the Petrești culture is disputed. Two opinions have been formulated as a result of the discussions concerning this complex problem. The first opinion defines the local origin of the Petrești culture in the painted pottery of the Starčevo-Criș culture transmitted via Vinča-Turdas.8 Based on a few vague analogies, the second opinion attempted to connect the appearance of the Petrești culture to the southern Thessalo-Macedonian world.9 If the first hypothesis of the local origin could not be confirmed by the archaeological means, the second

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3 Berciu – Berciu 1946, 53–63.
4 Berciu – Berciu 1949, 41.

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fig. 1. Red monochrome painted pottery from Foeni
fig. 2. Red painted patterned pottery from Foeni

one, more credible, could not be demonstrated by the presence of links between Thessalonica-Macedonia and Transylvania. Consequently, this matter remains to be resolved.

A possible answer to the problem of the origin of the Petreștii culture comes from the region of the Banat. Here, in the 1980’s, excavations resumed at Parța. Intensification of the investigations contributed to the discovery of some painted ceramic materials very similar to the Petreștii culture.10

Discovery of these ceramic materials marked the beginning of some important systematic investigations at Foeni, Chișoda, Parța II, Sânmihaiu Român and other sites where so-called painted Petreștii materials were recovered.11

After 1985, but especially during the last decade when excavations were carried out in parallel at the sites of Vinča and Foeni, the characteristics of the ceramics of the two cultures could be separated. That is why the cultural content of the Foeni group, named after the settlement with the most significant finds, could be specified and defined.12

The ceramics of the Foeni group is substantially different from that of the Neolithic cultures from the Banat. In spite of all these differences, in the 1980’s, only the painted materials discovered here in the settlements of the Late Neolithic were regarded as a distinct cultural entity and considered imports from the Vinča milieu.13 This was possible because the characteristics of the Foeni ceramics were unknown, especially the unpainted category derived from the coeval Vinča culture.

The technology of the Foeni group ceramics is distinct. Thus, the well-burnt paste is red-orange, orange-yellowish and black in colour. The vessel surface of the fine ware, almost without exception, is heavily polished. Some of the vessels had been fired using the black topped technique. Among the ceramic materials, those that are red-cherry and orange in colour stand out (figs 1, 2). They are associated with pottery with a white-limy background on which the painted ornament is executed. The ornament is painted with red, brown-reddish, cherry coloured, black, and rarely white colours. The decoration comprises thin lines grouped in angular motifs (figs 2, 5, 6). Inside the vessel, opposite the lip, there are scaled-down truncated triangles (figs 4. 1; 6. 1, 2, 6). Some bowls are painted inside with cherry-coloured comma shapes (fig. 4, 5; 6. 2, 5, 6) or parallel lines bordered by a straight line at the ends (fig. 4. 3; 6. 3). Besides the painting in red and black, the vessels are decorated with white angular motifs on a red-cherry background, (fig. 7). Rarely, some ceramic fragments are decorated with a red background applied after the vessel was fired. The painted ornaments represent 8% of the total ornaments at this point in the stage of research at the Foeni settlement.14

11 Drașovean 1994a; Drașovean 1994b; Drașovean 1996a, 84–86; Drașovean 1997.
12 Drașovean 1996a, 84–86; Drașovean 1997, 78.
13 Lazarovici 1979, 166.
Besides the painted ornaments, the polished decorations executed inside the vessels represent another feature of the Foeni pottery group. These polished ornaments consist of lines or wide bands that start from the lip running down towards the base of the vessel (fig. 9). They include motifs within nets, hatched triangles and, more rarely, spirals. This type of decoration was believed to belong exclusively to the repertoire of Vinča ceramics, but subsequently it was also shown to be represented at Foeni comprising over 27% of the ornament ensemble.\footnote{Drasovean 1994b, 145; Drasovean 1997, 58–59 and fig. 2.}

Incised ornamentation is very rare. Such motifs comprise only 6% of the ornaments on the pottery from Foeni\footnote{Drasovean 1994b, 145; Drasovean 1997, 59.} and they consist of angular incisions that seem to imitate some of the painted decorations.

In terms of vessel shapes the ceramics of the Foeni group are characterised by carinated bowls with profiled lips (B1-B4a type),\footnote{Drasovean 1994b, fig. 3; Drasovean 1997, 145, 147 and fig. 3; Drasovean 1997, 58–59 and fig. 2.} bi-conical bowls (B4c, B4d), two-handled pots (C4 type) and tri-conical pedestals (E3 type).\footnote{Drasovean 1997, fig. 2.} Besides these features, there are bi-conical dishes with profiled shoulders, flat trapezoidal handles and slightly raised edges (fig. 3).

Analysing the stratigraphical realities from Banat in which these materials appear, we see that the Foeni levels overlay Vinča C1 layers at Parta.\footnote{Drasovean 1996a, 30.} Painted ceramic imports typical of the Foeni group\footnote{Hegedűs – Makkay 1987.} were discovered at Chișoda Veche, in level II assigned to Vinča C1.\footnote{Raczky 1987.} At Chișoda Veche too, the second level superimposes another level attributed to a beginning phase of Vinča C1.\footnote{Kalicz – Raczky 1987.} These stratigraphical realities permit us to suggest that the Foeni group is in part contemporaneous with or later than some Vinča C1 settlements from Banat and contemporaneous with the classical Tisza settlements from Vésző-Mágor\footnote{Kalicz 1989.} and Öcsőd\footnote{Lazarovici 1979, 166; Lazarovici 1987, 39–40.} which are, in turn, synchronous with Vinča C1.\footnote{Kalicz – Raczky 1987.} Consequently, the chronological moment of the Foeni group can be placed towards the end of Vinča C1.\footnote{Drasovean 1996, 84–86; Drasovean 2002, 77–78.} Studying the spread of these ceramic materials in the neighbouring areas of the Banat, it was noted that the closest analogies to the Foeni group ceramics in Transylvania may be found in the pottery of the Petrești culture. In fact, as mentioned before, in the 1980’s, this type of Banat painted ceramics were considered imports from the Petrești cultural milieu in Transylvania.\footnote{Lazarovici 1979, 166; Lazarovici 1987, 39–40.}

Thus, the technology of the Foeni ceramics is so closely connected with the discoveries from Transylvania so that if some ceramic categories of the two cultures were artificially

\footnotesize{fig. 3. Red painted patterned pottery from Foeni}
mixed, from the point of view of the firing technology, the colour of the vessels and the smoothing and polishing of their surfaces, it would hardly be possible to separate them.

An essential element in connecting the ceramics of the two archaeological cultures are the painted decorations on the potteries, especially those composed of thin lines grouped in angular motifs and “in rafters” in cherry-red or brown-reddish colours (fig. 2; 4. 1–5; 5. 1, 2, 5, 6). They share decorative elements with similar discoveries from Daia Română, Păuca and Ghîrbom, attributed to the oldest phase of the Petrești culture. Also, the polished decorations on pottery from Daia Română are identical to those from the Foeni area. Besides these specimens, the polished incisions have analogies on pottery specimens from Mintia, Daia Română and Păuca (Iuliu Paul, personal communication). Bi-conical vessels on whose lip there was a trapezoidal hand-ear with the lateral edges slightly raised are met at Mintia (unpublished material), Șoimă, Turdaș II, Baciu and Archiud.

The vessels’ shapes in this sense are also eloquent concerning associations between ceramic types. Thus, the most frequent pot shape encountered in the Foeni group from Banat, B4d type, has analogies in the Petrești A settlements, as well as in the bi-conical shapes with profiled lips (B type). At the same time, the tall necked and round shouldered vessels that prefigure the Petrești carina correspond typologically with ceramics from the settlements of Daia Română and Păuca from phase A.

As emphasised on other occasions, there are also differences between the materials from Banat and Transylvania because the former do not employ all possible genres of painted decorations typical of the phase A. On the other hand, white painted ornaments were discovered at Foeni and have, by now, been found in Transylvania, too.

In spite of all these analogies, however, at first sight, a hypothetical organic connection between the Foeni group and the Petrești culture is impossible because the beginning of the was coeval with Vinča B2-end of Alföld-end ofPrecucuteni I. Thus, the beginning of the Petrești culture would have been earlier than the time of the Vinča C1 to which the Foeni group is associated. To back this opinion up, a series of arguments are provided by discoveries made at the investigated sites of that period in Transylvania.

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28 Paul 1981, Pl. 54/5, 6; Paul 1992, Pls. XXXII/10–11, XXXII/1, 2, 8, XXXII/6.
29 Drăgoșeanu 1994, 163.
30 Drăgoșeanu – Luca 1990, figs. 1/5, 2/3, 4, 3/2, 4/10.
32 Luca 2001, 150 and fig. 24/5, 6.
33 Maxim 1999, Pl. XIX/1.
34 Drăgoșeanu 1997, 56, fig. 2.
35 Paul 1992, Pls. XXXIII/14, XXIV/16, XXVIII/2, 4, 9, 10, XXXII/1.
36 Paul 1992, 53 and Pl. XXIII/9; XXVI/8; XXVIIa/5; XXXI/2; XXIX.
37 Drăgoșeanu 1994, 163; Drăgoșeanu 1997, 72–73.
We shall analyse the arguments brought to support this chronology in light of the new discoveries from the last ten years of excavation in Transylvania.

Thus, at the settlement from Daia Română, the Petrești A level is superimposed over another level from the Turdaș culture, more precisely Turdaș II, based on the system used by Iuliu Paul and synchronised with Vinča B2. At that time, ceramic materials discovered in this level were considered “linear influences” and included in the final phase of the Alföld culture. Ceramic fragments characteristic of phase I of the Precucuteni culture were found in that layer, too.

Analysing the so-called late Alföld ceramics from Daia Română, it is noteworthy that they have close analogies to ceramics from Turdaș, Valea Nandrului, Turdaș, Orăștie and Mintia. As at Daia Română, Mintia, Turdaș and Orăștie the so-called Alföld elements are associated with Precucuteni I and II imports. These levels, through the materials that they contain, belong to the Turdaș culture, the late phase of the Turdaș culture (Turdaș, Orăștie, Valea Nandrului), and to the Foeni group (Mintia). They are contemporary with the end of the Vinča C1 phase. Consequently, the attribution of these materials to the late Alföld culture is an artifact of the history of archaeological investigations in the region because this culture, that evolved in the south of the Tisza Plain, ends its development at the end of the Vinča B1 phase when the Szakálhát culture appears. It is in no way contemporary with Vinča B2. These linear decorations are not part of the motif repertoire of the Alföld culture, but of the ceramics from the late Turdaș cultural horizon which is, in turn, synchronous with the end of Vinča C1.

Another argument for an early dating of the Petrești culture to the Vinča B2 horizon, was the presence of some Precucuteni I imports in the Turdaș level (I) at Daia Română. The Precucuteni materials are a constant presence in the late Neolithic settlements of Transylvania. They have been discovered at Iclod, Lumea Nouă Ia, Turdaș II, Tăuălaș II and Mintia.
If the association of the Vinča B2 phase with level IIa from Lumea Nouă is, in light of new investigations, disputable, all the other levels where Preecuteni I imports were found belong to the cultural medium subsuming the sites of Iclod (Iclod), Turdaş (Turdaş, Tăuălaş) and Foeni (Mintia) and are coeval as well with the Turdaş level from Daia Română associated with the Vinča C1 phase.

The third argument - and the most important one - used to place the beginning of the Petreşti culture in the Vinča B2 phase was the use of the old chronological sequence of the Turdaş culture. In the 1960s, this culture was divided into three phases: phase I contemporary with Vinča B1, phase II contemporary with Vinča B2 and phase III contemporary with Vinča C. This chronological sequence was established by specialists who were not very familiar with the cultural content of the Vinča culture. From the point of view of its derivation, the Turdaş culture is at the very least connected to the Vinča culture. Over the last decade, as a result of detailed analysis by specialists familiar with the ceramics of the Vinča culture and new investigations at late Neolithic sites in the Mureş valley, the cultural content of the Turdaş culture and its chronological and developmental sequence could be specified much more exactly. Thus, at this stage in the research, the beginnings of the Turdaş culture and of its eponymous settlement can not be placed earlier than Vinča C1. Consequently, the Turdaş level at the settlement of Daia Română, placed by its excavators in Vinča B2, can not date to before the Vinča C1 phase. Moreover, on the basis of the Preecuteni I pottery imports, the lower level at Daia Română is contemporary with Turdaş II, Tăuălaş II and Mintia all dated to the end of the Vinča C1 phase.

In conclusion, all the arguments brought to sustain a high chronology for the Petreşti culture must fail before a detailed analysis of the new materials discovered over the last ten years in Transylvania. All these data make it clear that the beginning of the Petreşti culture should fall during the Vinča C1 phase and not earlier. Thus it is also partly contemporaneous with the Foeni group from Banat.

Following the spread of the Foeni group ceramics, we find that they can be also found in a series of settlements from Transylvania and north of this province as well.

57 Drășovean – Luca 1990, 13 and fig. 3/4; Drășovean 1996a, 92.
59 Paul 1981, 232, Table 21; Paul 1992, 125, 126, 129, 131 and Table 1 and 2.
60 Lazarovici 1977a, 223; Lazarovici 1977b, 29–31; Luca 1997, 62, 66, 73, 75.
This was probably the result of a process of migration of the Foeni communities, penetrating Transylvania at the end of the Vinča C1 phase. The proportion and the dynamism of this migration are related to the fact that Foeni communities may be found from the Mureş valley to the north of Transylvania in the Cluj and Bistriţa areas. This wave – the second one following the Vinča C1 phase, which comes into the area of Transylvania during the late Neolithic – determine the dissemination of the late Turdaş communities towards the northern Transylvania and stops the development of the Turdaş culture in the Mureş valley.

From an archaeological perspective, results from excavations over the last five years in Transylvania demonstrated that Foeni materials appeared either in cultural layers of the Turdaş culture at Tâuală II, Turdaş II and Orăştie-Dealul Pemilor, or as independent occupations at Mintia, Zău de Câmpie, Baciu and Archiud. The Turdaş layers, where Foeni ceramic imports appear to date to the Turdaş II phase, are contemporary with the end of the Vinča C1 phase.

The C14 dates also confirm this finding. Thus, dates for the Foeni group from the Banat are 5835±40 BP or 4726 cal BC (Deb-5725) and 5855±85 or 4739 cal BC (Deb-5771) and are partly contemporary with C14 dates for the Petreşti A phase.

From a chronological perspective, the Turdaş II phase occurs before the early phase of the Petreşti culture. This means that the Foeni materials from Transylvania are earlier than the early phase of the Petreşti culture. This matter has been stratigraphically demonstrated as well, by finding a Petreşti A layer superimposed over a Foeni cultural layer at the tell of Zău de Câmpie.

From an material culture perspective, these two archaeological cultures, the Petreşti and the Foeni, are similar in many ways.

On the basis of these similarities corroborated through stratigraphic and radiocarbon data, we can state that it was the Foeni group that substantially contributed to the appearance of the Petreşti culture.

The Foeni communities, within the developmental process culminating in the appearance of the Petreşti culture, had ceramics manufactured using the same firing and modelling technology, most vessel shapes, the same painting techniques and style, as well as similar plastic modelling in clay.

The development of the Foeni communities into the Petreşti culture took place in Transylvania within the ethno-cultural context of the presence of the Lumea Nouă group and
the stage of maximum dispersion of the Turdaş culture. It is difficult for us to follow at this stage in the research, the role played by the Lumea Nouă group in the genesis of the Petreşti culture. Nevertheless, on the basis of the data from Zău de Câmpie, where the Foeni materials seem to be associated with Lumea Nouă painted ceramic fragments, and comparing some Lumea Nouă ornaments with some similar early Petreşti ceramic ornaments, we can postulate that the Lumea Nouă ceramic inventory contributed to the constitution of some Petreşti painted motifs. The people who created pottery associated with the Foeni ceramic group settled in Transylvania during a period when the ceramic material culture was undergoing a process of transformation towards the attributes of the future Petreşti ceramic culture with the inclusion of the pointed-incised ornaments and the quadrilateral vessels, which would be a constant presence in ceramics of the Petreşti settlements of phase A and AB.

At this stage in the research it is possible to talk about a fully formed Petreşti culture in the horizon represented by level II at Daia Română, at the chronological moment of 4750 cal BC, that is, the Vinča C1/C2 phase.

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ANALOGIES AND DIFFERENCES BETWEEN ANIMAL HUSBANDRY AT THE LATE VINČA AND FOENI GROUP SITES IN THE BANAT (SW ROMANIA)

This article focuses on results from faunal analyses of assemblages from Late Neolithic sites in the Banat. Animal remains were brought to light during excavations carried out in the following sites: Foeni – “Orthodox Cemetery” (Foeni Group), Parta, tell II (Vinča C and Petrești cultures), Sânandrei (Vinča C and post Vinča C) and Liubcova – “Ornita” (Levels II–I, Vinča C). The settlements are located in different biotopes. Foeni, Parta, Sânandrei are located in the lower Timiș Plain, on natural mounds rising slightly above the surrounding areas. Although, in the past, the Timiș, Bega, Bârzava rivers and their old branches caused frequent flooding and seasonal swamps and lakes, nowadays, they are canalised. Quaternary alluvial deposits, loessy deposits, overlie the relief. At present, secondary meadows and agricultural crops, with scattered oak groves dominate the landscape. In the past it was a forest-steppe region, at least partially covered with plain forests, mostly along the watercourses. The settlement of Liubcova – “Ornita” is located in the southern Banat, on a middle terrace of the Danube, in the large depression of Sîchevița. Argillic brown soils and luvis ones are spread along the Danube bank (beneath pastures) and on the basin slopes (under mixed oak patches). They are of a medium fertility, especially for grasslands. Alluvial soils developed on the lowest Danube bank, at present flooded.

The species frequencies at Foeni

To date, about 30,963 bones have been brought to light during the excavations at the above-mentioned sites, Foeni settlements furnishing the better part of the samples with about 23,565 fragments. First, beginning some words will be said about the Foeni assemblage, as a departure point for our discussion. It is the richest Neolithic sample in the Banat, accounting for some 23,565 bones from three cultural layers: lower, middle and upper (Table 1).

We should also add that a preliminary report was published some years ago, supported by a smaller faunal assemblage. According to this latest data, cattle dominate the proportions in all contexts, comprising over one third of the assemblage. In term of number of specimens, their proportion visibly increased from 38.2% at the beginning of the habitation to 45.5% towards the upper layer. In contrast, the small ruminants appear to decrease in number. At the beginning of the habitation they total 22.7%, with their numbers decreasing to 14.2% (middle layer) and increasing to 16.7% later. A decrease of 6% during the lifetime of the site is significant in consistent assemblage. The number of domestic swine is also subject to important fluctuations. In the lowest layer pig is represented at 11.6%, clearly increases to 20% as the number of caprinae falls. Finally their numbers stabilize at 12.6%, a slightly higher value for that period on the Banat Plain. The question of whether dog was eaten at the site remains difficult to substantiate one way or the other. However, some dog skulls showed signs of having been opened intentionally to remove the brain for consumption.

1 Drașovean 1994, 141.
3 Idem, 151.
5 The faunal assemblages from Foeni and Parta will be enriched in the following years.
6 El Susi 1998b, 139–163.
Table 1. The species frequencies at Foeni – “Orthodox Cemetery”

The domestic/wild ratio varies between 74.5–25.5% in the earlier layer and 76–24% later. In a way, the distribution of wild mammals undergoes few changes during the analysed period, but some trends have been observed. Red deer, a species requiring a forested environment (bushy woodlands, edge of woods – 180), was the most hunted mammal in all contexts; but a slight decrease in its frequency has been observed, from 16.2% to 14.5% during the habitation. The percentage of wild boar (for which the forest was “at most a fostering factor, a refuge against predators or during periods when sows have litters or are suckling their young”)7 reduced from 4.2% to 2.9%. On the other hand, wild mammals as indicators of an open landscape (woodland-steppe) such as aurochs, roe deer (in some measure) increase in frequency towards the upper layer: from 2.5% to 4.0%. Bones of typical, forest-dwelling

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mammals (lynx and wild cat) occurred in insignificant percentages, 0.01–0.02%. The above-mentioned data suggests that there was an intensification of clearing activities, as well as a reduction in the forested areas during the lifetime of the site. A review of the above-mentioned data suggests that some changes may have occurred in the animal husbandry practices of the Foeni inhabitants towards the upper layer. They could be summarised as a decline in the number of small ruminants number together with a better use of them; an increase in the proportion of cattle is an expression of a more settled economy.

The species frequencies in Banat sites

The base of the animal economy at sites from the beginning of Late Neolithic comprised cattle, followed by caprovines and/or pig. This is the general schema but many there are many astonishing differences in the detail of the composition and proportion of species for each site for each culture. Cattle were, with a single exception, at Liubcova – “Ornita” the most commonly exploited mammal, totalling about 43–57% regardless of cultures. Only at Liubcova – “Ornita” does cattle rank second after red deer at 28.9% (Table 2).

<table>
<thead>
<tr>
<th>Site</th>
<th>Sânandrei</th>
<th>Partă tell 2</th>
<th>Liubcova-O</th>
<th>Sânandrei</th>
<th>Foeni</th>
</tr>
</thead>
<tbody>
<tr>
<td>Culture</td>
<td>Vinča C</td>
<td>Vinča C levels</td>
<td>Post Vinča C</td>
<td>Foeni group</td>
<td></td>
</tr>
<tr>
<td>Bos taurus</td>
<td>52.9</td>
<td>43.1</td>
<td>28.9</td>
<td>57</td>
<td>43.1</td>
</tr>
<tr>
<td>Ovis/ Capra</td>
<td>7.9</td>
<td>15.8</td>
<td>9.8</td>
<td>6</td>
<td>17.9</td>
</tr>
<tr>
<td>Sus scrofa dom.</td>
<td>9.1</td>
<td>10.1</td>
<td>8.3</td>
<td>6.4</td>
<td>13.2</td>
</tr>
<tr>
<td>Cervus elaphus</td>
<td>13</td>
<td>18.8</td>
<td>29.5</td>
<td>20.4</td>
<td>15.1</td>
</tr>
<tr>
<td>Sus scrofa fer.</td>
<td>6.5</td>
<td>5.4</td>
<td>15.9</td>
<td>4.2</td>
<td>3.3</td>
</tr>
<tr>
<td>Capreolus cap.</td>
<td>8.5</td>
<td>3.7</td>
<td>2.8</td>
<td>2</td>
<td>1.8</td>
</tr>
<tr>
<td>Bos primigenius</td>
<td>0.6</td>
<td>1.1</td>
<td>2.7</td>
<td>2.8</td>
<td>3.5</td>
</tr>
<tr>
<td>Other species</td>
<td>1.6</td>
<td>2</td>
<td>2.1</td>
<td>1.2</td>
<td>2.1</td>
</tr>
<tr>
<td>Total sample</td>
<td>1,150</td>
<td>2,854</td>
<td>1,107</td>
<td>2,287</td>
<td>23,565</td>
</tr>
</tbody>
</table>

Table 2. The species frequencies at Late Neolithic sites in the Banat (Frags.)

Beyond all doubt, the location of the site in a different and complex ecosystem (The Danube Valley) encouraged another type of economy focused on hunting. As a rule, the small ruminants rank second in almost all contexts. For all that, at Vinča C sites they were recorded in lower frequencies, 7.9–9.8% except for Foeni where their quota strongly increased up to 18%. Parta occupies an intermediate position with cattle comprising 15.8%. The inner development of the animal exploitation displays a strong increase in the percent of caprinae towards the Petrești layer at the site. Pig ranked third among the domestic mammals and its frequency, slightly oscillated within the faunal spectra. It never totals more than 10% at Vinča C sites. Even if a higher value has been estimated at Foeni (13.2%), pig never attained significant numbers throughout Neolithic, except in the Banat Culture (33–35%).

The domestic/wild ratio little varies in the sites from the Banat Plain due, somehow, to their similar bio-geographic locations. Liubcova is an exception, with an increased share of game of over 50%.

<table>
<thead>
<tr>
<th>Site</th>
<th>Sânandrei</th>
<th>Partă tell 2</th>
<th>Liubcova-O</th>
<th>Sânandrei</th>
<th>Foeni</th>
</tr>
</thead>
<tbody>
<tr>
<td>Culture</td>
<td>Vinča C</td>
<td>Vinča C levels</td>
<td>Post Vinča C</td>
<td>Foeni group</td>
<td></td>
</tr>
<tr>
<td>DOMESTIC</td>
<td>70.4</td>
<td>69.9</td>
<td>47.6</td>
<td>70</td>
<td>75.7</td>
</tr>
<tr>
<td>WILD</td>
<td>29.6</td>
<td>30</td>
<td>52.3</td>
<td>30</td>
<td>24.3</td>
</tr>
</tbody>
</table>

Table 3. Domestic/wild ratio at Neolithic sites from the Banat (as Frags.)

8 Ibidem 9 El Susi 1996a, 311.
At the sites located on the Banat Plain, wild remains comprise no more than 25–30% of the samples. Red deer was the most common game animal, during Neolithic times it was widespread in the lower levels of sites. It attained higher percentages (17–24%) in the Banat Culture and visibly decreased to 20–13% during the Vinča C and Petrështi periods. Perhaps, some alterations in its biotope related to intensification of clearing activity lie at the base of this assertion. In more southerly areas, its contribution to the meat supply was considerable, up to 29.5% at Liubcova. Wild swine always contributed less to the communities’ meat supply, attaining just 3–6% in the plain. Liubcova is again an exception with wild swine comprising 15.9%. Roe deer and aurochs never exceed 4% of the total assemblage except for the Vinča C levels from Sânandrei, where roe deer comprised 8.5%. A significant number of both small and large carnivores and rodents completes the faunal spectra. The group “other species” includes about 146 remains from nine taxa: hare (74 bones), beaver (14), fox (13), marten (13), badger (11), wildcat (8), bear (9), wolf (3) and lynx (1). In our quantification, dog remains were included within “other species” in addition to the afore-mentioned remains. Their contribution to the meat supply was insignificant. In connection with environmental conditions fishing, mollusc gathering and the capture of birds and pond-tortoise would have had a certain importance in the supply of meat. Generally, the lower proportion or the absence of these animal groups does not reflect the actual situation during prehistory. The location of sites in the vicinity of aquatic resources provided good conditions for their exploitation. Taking into account the inadequate method of bone collecting (hand collection) it may be that aquatic resources would have been much more important than the statistics presented here suggest (Table 4).

<table>
<thead>
<tr>
<th></th>
<th>Sânandrei</th>
<th>Parţa tell 2</th>
<th>Sânandrei</th>
<th>Liubcova</th>
<th>Foeni</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mammals</td>
<td>99.4</td>
<td>98.3</td>
<td>99.9</td>
<td>93.3</td>
<td>94.7</td>
</tr>
<tr>
<td>Birds</td>
<td>0.6</td>
<td>0.04</td>
<td>0.9</td>
<td>0.1</td>
<td></td>
</tr>
<tr>
<td>Reptiles</td>
<td>0.3</td>
<td></td>
<td>0.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fish</td>
<td>0.3</td>
<td></td>
<td>3.3</td>
<td>0.7</td>
<td></td>
</tr>
<tr>
<td>Molluscs</td>
<td>1.3</td>
<td></td>
<td>2.3</td>
<td>4.2</td>
<td></td>
</tr>
</tbody>
</table>

Table 4. The animal group percentages at Neolithic sites

A comparison between Foeni and Sitagroi I and II emphasises the great importance of caprinae exploitation at both sites. Some differences emerge in the details, related to dissimilarities in environmental conditions in both areas. Thus, in Greek sites (located in a drier climate) caprinae contribute 27–44%, followed by cattle at 25–30%. The Banat Plain was better for cattle breeding than for caprinae. Consequently, even if in the lower levels of the Foeni site small ruminants were an important component, during the period of habitation cattle breeding gained in importance as an adaptation to local resources. The same situation occurred during the Starčevo – Körös culture in the Banat. In this respect, we believe that archaeozoological data provides supplementary evidence for the southern origin of the Petrești Culture, implicitly that the Foeni group. In the same chronological context we attempted to compare our settlements to those of the Herpály culture. However, there is no resemblance. Hence, cattle total 12–20%, caprinae 2–5.6% and pig 9–10% at Herpály sites. Domestic species account no more than 29–36%. Among hunted mammals, bones from aurochs contributed from 23–38% in the Pannonian area. As for the Vinča C sites, a comparison between the settlements from the Banat Plain and those from Vinča (late levels), exhibits some common features such as: the high proportion of bovines and lower values for pig and caprinae (below 11%). Also, in the

11 Bökönyi 1977, 11.
12 El Susi 1996b, 145.
14 Bökönyi 1977, 12.
15 Bökönyi 1990, 50.
16 Bökönyi 1988, 420.
lower regions (where all the sites mentioned here lie) there was a rich hunted fauna, the wild species contributing up to between 62.4–85%. A similarly high proportion was apparent at Tisza and Herpály settlements also.

**The exploitation of domestic species**

Cattle management at the previously mentioned sites falls into two groups, despite the cultural uniformity. The former group includes Foeni and Parta, the second, Liubcova and Sânandrei. In the first case, we note a proportion of 40.4–41.8% animals killed before the age of reproduction (less than two years), values rather high for rational exploitation of a uniparous species. On the other hand, the small percent of very worn teeth suggest that few animals were exploited to the end of their useful life. The adult/young-mature specimens represent 61.8% at Foeni and 59.7% at Parta. These values suggest that the targeted objectives of the inhabitants were, aside meat, milk (and other dairy products) and draught power. At Foeni, a significant number of oxen was noted. Thus, on metapodii, out of 17 complete bones, 11.8% come from females, 35.3% from males and 52.9% from oxen. At the same site, of 70 horncores, 40% originate from cows, 57.1% from bulls and 2.9% from oxen. Consequently, an increased percent of males were emphasised in both cases. They were mostly slaughtered as adults, protecting the stock of cows. This fact supports the hypothesis of a balanced exploitation of species, despite the greater contribution of immature specimens: males for meat and females for dairy products. Unluckily, equally detailed information was not forthcoming from other sites due to the absence of complete bones. At Liubcova and Sânandrei the proportion of juveniles and subadults is smaller, 20% and 15.2% respectively. The percent of adults and mature individuals rises sharply to 80% in the former settlement and 84.6% in the second one.

That reflects better management of species as compensation for a lower number of individuals, mostly at Liubcova. At Sânandrei, cattle were numerous but they were the single important domestic mammal, and simply better care would have sustained the animal economy.

<table>
<thead>
<tr>
<th>Site</th>
<th>Juvenile</th>
<th>Subadult</th>
<th>Adult</th>
<th>Mature/senile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cattle</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parta-tell 2</td>
<td>21.1</td>
<td>19.2</td>
<td>21.1</td>
<td>38.6</td>
</tr>
<tr>
<td>Sânandrei</td>
<td>7.6</td>
<td>7.6</td>
<td>33.6</td>
<td>51.2</td>
</tr>
<tr>
<td>Liubcova-Ornija</td>
<td>10</td>
<td>10</td>
<td>20</td>
<td>60</td>
</tr>
<tr>
<td>Foeni</td>
<td>19.9</td>
<td>21.9</td>
<td>35.3</td>
<td>22.8</td>
</tr>
<tr>
<td>Caprimae</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sânandrei</td>
<td>29.4</td>
<td>41.1</td>
<td>17.6</td>
<td>11.7</td>
</tr>
<tr>
<td>Parta-tell 2</td>
<td>20.5</td>
<td>35.9</td>
<td>28.3</td>
<td>15.2</td>
</tr>
<tr>
<td>Liubcova-Ornija</td>
<td>40</td>
<td>25</td>
<td>25.8</td>
<td>9.2</td>
</tr>
<tr>
<td>Foeni</td>
<td>22.7</td>
<td>14.4</td>
<td>45.5</td>
<td>17.4</td>
</tr>
<tr>
<td>Pig</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sânandrei</td>
<td>42.1</td>
<td>47.3</td>
<td>10.5</td>
<td>0</td>
</tr>
<tr>
<td>Parta-tell 2</td>
<td>20</td>
<td>25.9</td>
<td>41.6</td>
<td>12.5</td>
</tr>
<tr>
<td>Liubcova-Ornija</td>
<td>28.5</td>
<td>11.5</td>
<td>31.5</td>
<td>28.5</td>
</tr>
<tr>
<td>Foeni</td>
<td>27.9</td>
<td>12.6</td>
<td>54</td>
<td>5.4</td>
</tr>
</tbody>
</table>

Table 5. The age class distribution in percentages

At sites where the breeding of small ruminants was of less importance, their exploitation was disadvantageous. Regarding kill-off patterns, the following should be noted: the young/subadult to adult/mature ratio differs from site to site. In this respect, the most significant proportions of young/subadults individuals occur at Sânandrei – 70.5%, Liubcova – 65%, followed by Parta with 56.4% and Foeni with 37%. In relation to this percentage, the adult/mature contribution increased in the same way. Foeni offered the most balanced animal

17 Bőkönyi 1988, 430.
exploitation, focusing on secondary products, without dropping their role in the meat supply. In contrast, the small ruminants were kept mostly for meat at Sânandrei and Liubcova. This was also an important animal category at Parta. Among the Caprinae, there was a female/male ratio, of 41/7 (based on horncores). This reflects the prevalence of she-goats among killed animals, especially at a mature stage. It suggests also that females outnumbered males within flocks kept for diary products. For the sheep, of the 53 horncores, 17 originate from ewes and 36 from rams. Many of male horncores come from subadult and young adult animals, killed for mutton. The different kill-off patterns has a connection with the frequency of each species; in this context caprovinines are not very numerous at Liubcova and Sânandrei and better represented at Parta and Foeni.

On the subject of age class distribution of the pig several differences between sites may be observed. Thus, the share of young/subadults is 40.5% while individuals killed as adults (54%) prevail at Foeni. The proportion of reproductice stock lays around 5.4%. A similar percentage of young/subadults was noted at Liubcova although mature individuals are more common. Taking into account the prolificacy of the species, in addition to the favourable environmental conditions for this species, the 28.5% share held by mature individuals would have been sufficient to maintain vigorous breeding at the site. Unexpectedly the percent of pig is low at sites. Similar exploitation of pig was noted at Sânandrei although a different picture was offered by the Parta sample. There was an absence of mature individuals, a lower proportion of adults (10.5%) and the highest percentage of juvenile/subadults (89.4%). On the other hand, “pork from flat and skinny pigs with lean and dry meat resulting from traditional keeping, could be less easily prepared and consumed once the animals reached maturity”. In other words, the pursued purposes were to obtain meat, to maintain the stock (not to increase it, as the proportion quota of mature animals show) at most of the sites. As for the exploitation of wild mammals adult and mature animals are most important in almost all cases.

The species

**BOVINAE**

About 9,330 remaining bones were collected from domestic species and 667 from aurochs. From the very beginning it the presence of three “bovine varieties” cattle, aurochs and crossbreeds was observed at almost all the sites. The phenomenon was most clearly expressed on the metapodials. In general, measurements suggest that cattle from this period were large or medium-sized with many values falling within the size limits of the wild population. During the Late Neolithic the bovines from the Banat Plain were more robust and taller compared to those from the Danube Valley (fig. 1–2). Unfortunately, few long bones were found at Vinča C sites so that most of the values were deduced from the Foeni sample. At a first sight, there were no substantial differences between sites with the same breed of cattle exploited throughout the low regions. On the whole, the withers’ heights vary between 122.8–129.2 cm (Matolcsi) (mean – 126 cm) in the Danube Valley (estimation only for males) and between 120.3–138.8 cm (mean – 128 cm) in the Banat Plain. The mean withers height of bulls in the plain is higher than in the Danube Valley at 129.5 cm. It is also worth mentioning that the phenomenon of castration was widespread throughout the region, especially at Foeni.

In brief, it appears that the same type of bovine could be found everywhere in the Banat at the beginning of the Late Neolithic regardless of cultural affiliation; however, their greater robustness seems to be a characteristic of cattle in the lower regions of the Banat as opposed to those from southern regions. In their dimensions, they fit well within the size range calculated for the Pannonian area.

18 Vörös 1994, 172.
19 Most probably this crossbreeding would have had a spontaneous character.
20 The phenomenon is more emphasised at Foeni.
21 The great number of cattle bones may influence this fact; the phenomenon was also pronounced at Săndrei and Parta.
22 El Sissi 1996b, 111.
23 Bökönyi 1962, 175–214.
OVINAE and CAPRINAE

About 3,450 remaining bones were collected from small ruminants, sheep being at least three
times more numerous than goat. Three types of horncores related to sex distribution were
documented on the basis of skull parts and horn cores. The males had heavy, three-edged
horncores which twisted outward, the so-called "copper age type" (28 pieces). The form
dominates at all sites. Characteristically, all the pieces are medium-sized. Means of 46.5 mm
(40–56, n=28), greatest diameter of the base; 33.6 mm (28–39, n=27), the smallest diameter of
the base; 135 mm (114–156, n=27) and the circumference. Of the base were estimated. Females
had rudimentary horn cores - "turbary types" (4 pieces) or were hornless (5 cases). Based on
24 complete long bones, the stature of sheep was estimated as being between 42.6–59.8 cm
(Teichert) (mean – 49.6 cm), at Foeni. A slightly greater value for the mean was estimated
for Parta at 52.1 cm. In the Neolithic sites from the Danube Valley values of 56.5–62.5 cm
(mean – 61.1 cm)24 were presumed. Unfortunately, no such values were recorded at Vinča C
sites from the Danube Valley. As a general rule, the existing data seem to indicate the presence
of the same type of sheep during the Neolithic in the Banat. However, it is no less true that
the abundant material from Foeni contained sheep which were extremely gracile and smaller,
compared to contemporaneous sites. This smaller type could be nicely tied to the populations
from contemporary settlements from Greece.25

The goat horncores are mostly of a "aegagrus type" (females), with a typical morphology:
scimitar forms, not twisted, biconvex or plano-convex in cross-section. Means of 34.3 mm
(32.5–37; n=25), greatest diameter at the base; 24.4 mm (19.5–27.5; n=25), smallest diameter
at the base; 96.5 mm (92–116; n=25), circumference at the base were calculated. Another five
pieces with large dimensions and with well-developed outwardly twisting ("prisca type")
horns come from bill-goats. Means of 52.1 mm (49–61; n=5), greatest diameter of the base;
34.8 mm (29–41; n=4), smallest diameter of the base; 147.7 mm (137–163; n=25) and the
circumfrance were estimated. Goat was more robust and taller than sheep as
disclosed by the data. No more than three wither' heights could be estimated in this period:
60.3, 60.6 and 61.5 cm (Schramm).

SUIDAE

About 2,536 bone remains come from domestic species and 818 from the wild one. The
existence of a mixed domestic pig-wild boar population (particularly in the Danube Valley)
make it difficult to separate them; consequently the group "Sus sp." includes a large number
of bones. In terms of their size, many complete bones permitted the following appraisal: for the
domestic species, values range between 64.2–73.4 cm (Teichert) (mean – 68.5 cm; n=12) on the
Banat Plain and 69–74 cm in more southerly regions. Despite some values exceeding 70 cm,
domestic pig was small and slender throughout the Banat during Late Neolithic. No separate
breeds could be differentiated in the faunal assemblages from northern or southern regions.

Wild swine was medium to large size; values of 79.3–110 cm (mean – 93.5 cm; n=38)
were approximated for animals from sites on the plain and 87.7–109 cm (mean – 98.7 cm; n=3)
at Liubcova-"Ornita."26 The higher values of the withers height' mean at Liubcova versus the
wild swine remains from sites on the Plain is explained by a greater percentage of males at
the former site.

CERVIDAE

The group includes the remains of 3,168 red deer and 421 roe deer bones. In terms of
measurements, deer bones exhibit values that fall within the greater variability of the Neolithic
species in Romania.27 For all that, the means estimated on red deer material from the lower
regions of the Banat exceed those from the southern regions.28 The red deer population
from the Banat Plain has good parallels in the Tisza and Lengyel materials from regions in
Hungary.29 The same situation is found for roe deer. As a general rule, the roe deer exploited

24 El Susi 1996b,121.
at the Banat Plain sites was more robust than those from the Danube Valley (particularly at Liubcova—“Orniţa”) and Divostin, and matched the Hungarian roe deer population.

CANIDAE
A significant number of dog bones came to light at the sites discussed here, especially at Foeni (234 specimens). According to the basal length from Dahr, 52.6% of mandibles fall into the “palustris” class, 31.6% into the “ladogensis” and 15.8% into the “intermedius” ones. This supposes that over half of the estimated individuals were small in stature; fewer animals attained medium size.

Conclusions
In brief, the above-mentioned data suggest that a special kind of animal husbandry developed at the site of Foeni sustained by cattle exploitation, an increased proportion of small ruminants, and sustained hunting, lower by at least 5% lower than at other sites. However, cattle comprised an increased proportion with pig and caprinae of less importance at Vinča C settlements on the Banat Plain. A decrease in the percentage of cattle was balanced by an intensification in pig breeding and sustained hunting. A low contribution of caprinae in the supply of meat to the community was found in Vinča C sites from the Danube Valley.

30 Bökönyi 1988, 71.
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ERSTE ANZEICHEN DER REGIONALISIERUNG
SOWIE NACHWEISE VON FERNKONTAKTEN
IN DER ÄLTEREN LINEARBANDKERAMIK

In dem Titel meines Beitrages scheinen zwei gegensätzliche Themenkreise vereint. Tatsächlich ergänzen die Hinweise auf die Regionalisierung und die bisher nachweisbaren Fernkontakte einander vortrefflich und eröffnen neue, lohnende Forschungsziele.

Ein kurzer Blick auf den derzeitigen Forschungsstand soll die Ausgangssituation klären: die Kultur der Linearbandkeramik ist mit hoher Wahrscheinlichkeit in Transdanubien und seinen unmittelbaren Nachbargebieten entstanden, d.h. im nordwestlichen Vorland der Starčevo-Kultur. Entscheidende Entwicklungen für diese Neuformung dürften dabei im Umfeld des Balaton, also direkt im nördlichen Randbereich der Starčevo-Kultur stattgefunden haben, wie E. Bánffy so eindrucksvoll in ihrem Beitrag darlegte. Im Detail sind jedoch noch wesentliche Fragen offen:

wie dieser Entstehungsprozess genau vorzustellen ist und
wie die weitere Entwicklung, insbesondere die sehr rasche Ausbreitung von dem vermutlichen Entstehungsgebiet bis an den Rhein verlief.


Ich möchte mit den Spiegelmotiven beginnen, die in großen Teilen des altbandkeramischen Verbreitungsgebietes so regelhaft vorkommen, dass sie viele als das typische Motiv der LBK I ansehen. Dabei sind die Stücke gar nicht so zahlreich, auf denen ein derartiger Dekor auch nur annähernd vollständig erhalten ist. Die Gestaltung des Motivs weist dabei eine beachtliche Variabilität auf (Abb. 1). Nur jene Fundplätze, die mit dem Nachweis eines annähernd vollständigen Spiegelmotivs auf Karte 1 eingetragen sind, bei Berücksichtigung der fragmentierten Nachweise ließe sich die Zahl der Punkte im Bereich Deutschlands, Tschechiens, Polens und Österreichts sicher beachtlich verdichten. Wesentlich an diesem Kartenbild ist, dass es aus der Slowakei und aus Ungarn nicht nur je einen Fundpunkt, sondern nur je ein Stück gibt, das dieses Dekorationsprinzip aufweist.

Ein durchaus gegensätzlicher Eindruck ergibt die zweite Motivgruppe, die nach unten gekrümmten Kreisbögen, deren exakte Erfassung im westlichen Teil des altbandkeramischen Verbreitungsgebietes vorläufig an dem schlechten Erhaltungszustand der relevanten Gefäße scheitert. Nur in Bífá in der Slowakei und in Bieske, Ungarn, ist dieses Motiv völlig eindeutig

1 Cladders 2001, 111 und Abb. 87.


Während die entsprechenden Stücke aus Bíña (Abb. 2. 3) und aus Bicske (Abb. 3. 4) jeweils einen größeren Anteil innerhalb des Fundensembles stellen, handelt es sich bei den übrigen Nachweisen dieser Ziertechnik um Einzelstücke aus großen Grabungsinventaren (Abb. 3: Bruchenbrücken, Schwanfeld und Strögen) oder einem größeren Fundbestand (Abb. 3: Nördlingen). Diese Mengenrelation des Verzierungsmerkmals muss man unbedingt auch bei der Bewertung der Kartierung berücksichtigen (Karte 2). So markieren die Fundpunkte aus

³ Gläser 1993.
⁴ Kalicz 1993, 91.
⁵ Pavůk 1980, Abb. 5, 6 und 13.
ERSTE ANZEICHEN DER REGIONALISIERUNG

Ungarn und der Slowakei jeweils den mehrfachen Nachweis innerhalb kleiner Fundinventare, während die übrigen Punkte für einzelne, oft sehr kleine Fragmente aus umfangreichen Grabungsinventaren stehen.

Ich denke also, dass wir mit dem Dekor aus eingeglätteten Linien ein nur für die östlichste Region der LBK I typisches keramisches Merkmal vor uns haben. Die vereinzelten Nachweise in weit entfernten Gebieten verdeutlichen wohl nur die Langstreckenkontakte, wie sie auch durch die Nachweise einzelner Silexrohmaterialien dokumentiert sind (siehe später).


Die eben kurz umrissenen Verteilungsschwerpunkte und Verteilungsgrenzen der vier keramischen Merkmale sind m.E. als erste Anzeichen der Regionalisierung aufzufassen, wie sie aus der nachfolgenden Entwicklung der jüngeren Linearbandkeramik auf der Basis eines um ein Vielfaches größeren Materialbestandes so gut bekannt ist.

Nachweise von Fernkontakten liegen bisher für die ältere/älteste Linearbandkeramik (LBK I) nur anhand von Sileximporten vor. Eine erste überregionale Studie dieser Art zeigte bereits beachtliche Fernverbindungen u.a. für den berühmten Szentgál-Radiolarit aus dem Bakony-Gebirge nördlich des Balaton auf.6 Besonders auffällig ist, dass das Verteilungsmuster dieses Rohmateriales weitgehend jenem der Einglättverzierungen auf der Keramik entspricht. Neuere Untersuchungen zu diesem Thema ergaben nun nicht nur weitere Nachweise dieses

6 D. Gronenborn: Silexartefakte der ältesten bandkeramischen Kultur. UPA 37, Bonn 1997, Abb. 3. 45.


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17. Ravelsbach (Lenneis 1989, Abb. 3/1)
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UNGARN
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Literaturnachweise zu den Abbildungen 1 – 6
Abb. 1 – 2: siehe Literaturangaben zu den einzelnen Fundstellen für Karte 1
Abb. 3 – 6: siehe Literaturangaben zu den einzelnen Fundstellen für Karte 2
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Abb. 1.
Abb. 2.
Abb. 3.
ERSTE ANZEICHEN DER REGIONALISIERUNG

Abb. 4.
Abb. 5.
Krisztian Oross

DAS NEOLITHISCHE DORF VON BALATONSZÁRSZÓ
(Forschungen zwischen 2000–2002)


Geographische und stratigraphische Verhältnisse des Fundortes


Verlauf der Ausgrabungen


3 Für die Information möchte ich mich bei Herrn Dr. Pál Sümegi, bei dem Lehrstuhlleiter des Lehrstuhls für Geologie und Paläontologie der Universität von Szeged bedanken.


Im Jahre 2003 führten wir die vierte Grabungskampagne auf dem Fundort durch. Wir wollten in diesem Jahr den nördlichen Teil des Fundortes grundsätzlich erforschen.4

Häuser und Hausgruppen


7 Modderman 1972, 77; Egry 2003, 104.
Plateaus eingetieft, so ist es völlig unmöglich, Hüttenlehm von diesen Gruben zu gewinnen. Nach unseren Untersuchungen wurden die Längsgruben mit dem Haushaltsabfall verfüllt, die Bewohner tiefen aber weitere Gruben in die Längsgruben hinein. Die andere oft erwähnte Funktion dieser Objekte, die Ableitung des Regenwassers, das vom Dach herunterfließt, scheint deshalb auch sehr fragwürdig zu sein.


16 Lüning 1980, 54.


18 Pavuk 1994, Beilage 1.


20 Mithay 1966.

21 Makkay 1978, 12–16, Fig. 1.


Die Grabenanlage


32 Pavík 1986.


Die Bestattungen


37 Egry 2003, 106.
40 Butler – Haberely 1936, 14–32.
43 Kalicz 1988, 194.
ziemlich hoch, die obersten Gebeine fanden wir in vielen Fällen in der oben erwähnten Schicht des rotbraunen Waldbodens. Bei der Entfernung der oberen Humusschichten beschädigten die Maschienen oft die Knochen, vor allem die Schädel. Der Erhaltungszustand der Skelette war sehr unterschiedlich, die im Waldboden liegenden Skeletteile waren häufig in schlechtem Zustand.


44 Die Gräber des mittelalterlichen Gräberfeldes und die der neolithischen Siedlung wurden auf dem Fundort in einem einheitlichen System nummeriert, deshalb haben manche jungsteinzeitliche Gräber eine Nummer über 700.
47 Letkés 1988, 195.

Schlußfolgerungen


Die Hausgrundrisse in Balatonszárszó sind im Durchschnitt wesentlich kleiner als im westlichen und im zentralen Bereich der Kultur. Dieser Unterschied besteht auch bei einem Vergleich mit den Hausgrundris sen von Nordtransdanubien und mit denen der Südwestslowakei. In Mosonszentmiklós-Egyénő földke erreichte die Länge mehrerer Gebäude sogar 40 Meter.62 Das Haus der Zseliz-Kultur in Almásfüzitő-Foktorok war 29 Meter lang.63 In Újvár (ung. Párvány) betrug von den vollständigen Bauten das längste 37 Meter.64 In Čataj (ung. Csataj) beträgt die Länge der zwei freigelegten Hausgrundrisse 34,6 und 30,0 Meter.65

Nach der Aufteilung von P. J. R. Modderman und H. T. Waterbolk haben die bandkeramischen Gebäude drei Haupttypen: Großbauten, Bauten und Kleinbauten, die

61 Im Jahre 2003 konnten wir auch hier bandkeramische Hausgrundrisse freilegen.
62 Egry 2003, 104.
64 Pavlik 1994, 63.
65 Pavlik 1986, 367.

Das allgemeine Fehlen der Überschneidungen unter den Hausgrundrissen kann unserer Auffassung nach als Beweis für eine kontinuierliche Besiedlung mindestens im südlichen Teil des Fundortes gelten. Den jüngeren Generationen waren die Hofplätze und die Häuser der Ahnen gut bekannt, sie wurden nach den gleichen Bauprinzipien in allen Bauperioden errichtet.


Im allgemeinen können wir in der Siedlungsstruktur und unter den Befunden von Balatonszárszó–Kis-erdei-dülö alle wesentlichen Merkmale eines bandkeramischen Dorfes finden. Die Baukultur der Linearbandkeramik erscheint in einer ganz entwickelten Form auf dem südlichen, großen Bauareal des prähistorischen Dorfes. Einige Besonderheiten

67 Mudderoman 1972, 80–81.
68 Mithay 1966, Abb. 5.
69 Egry 2003, 104.
70 Pavák 1994, 40–41, Abb. 18.
74 Nieszery 1995, 16–18.
76 Peschei, 1992, 77–78.

78 Lüning 1980, 46–47.
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**Pavúk 1994**  

**Peschel 1992**  
Abb. 1. Die Umgebung der Ausgrabung von Balatonszárszó
Abb. 2. Übersichtsplan des südlichen Teiles der freigelegten Oberfläche von Balatonszárszó
Abb. 3. Luftbildaufnahme über die Ausgrabung im Sommer 2001

Abb. 4. Luftbildaufnahme über die östliche Oberfläche im Jahre 2002
Abb. 5. Haus 18

Abb. 6. Pfostensystem des Hauses 6
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Abb. 8. Grundriß des Hauses 12
Abb. 9. Luftbildaufnahme über die Hausgruppe mit den bandkeramischen Gebäuden 10, 4, 3 und 9

Abb. 10. Grundrisse der Häuser 10, 4, 3 und 9
Abb. 11. Abschnitt der Grabenanlage mit Eingang 5

Abb. 12. Abschnitt der Grabenanlage mit Pfostengruben
Abb. 13. Grab S-779

Abb. 14. Grab S-780
MATERIAL FINDS FROM BALATONSZÁRSZÓ, NEOLITHIC SETTLEMENT: CONNECTIONS WITHIN AND WITHOUT THE TLPC TERRITORY

The present paper is a summary – like a preliminary analysis – of the material finds from the Neolithic settlement of Balatonszárszó where excavations were carried out from 2000 until the present as part of rescue excavations on the planned route of the M7 motorway in County Somogy. The settlement is located in an enclosed area on a loess plateau running along the southern shore of lake Balaton. During the three seasons of excavations a very large Middle Neolithic settlement was unearthed revealing the complete settlement structure of the site including house remains, as well as graves and other settlement features.1

I would like to discuss some of the possible connections of these material finds based on the study of the small finds; bone and stone objects, and then offer some first impressions about the pottery. Unfortunately, at present, ceramic typological dating of the site has not been completed.2 This is a very important aspect of our research because the selection of the material reflects a more general problem: we were unable to detect any kind of vertical stratigraphy within the settlement. The best interpretive approach involves the statistical analyses of the finds within each settlement feature as well as across the whole territory of the Neolithic settlement.

The bone tools and worked bones were not the most common artifact groups in the find material. We brought to light only a few half finished pieces of antlers, formal bone tool types which were generally rare (circa 40 pieces), and bone points which are very characteristic of Middle Neolithic settlements in the Carpathian Basin.3 Another type of bone tool recovered was a “mattock head” in which a ground stone axe blade may have been hafted. This bone “mattock head” is unusual in the sense that at other Neolithic settlements they are generally made from antler; however, this atypical piece reflects the overall absence of antler at the site as a whole. One hairpin was also recovered ‘in situ’ from a burial. Based upon its position in relation to the skull, it was probably used to hold the hair of the deceased in a bun.

From the standpoint of bone tool production: the distribution, accumulation, and segregation of animal bones inside the territory of the settlement seems to have been significant. We could detect three different situations which may be interpreted as some kind of part-specific distribution system. First, a young pig’s skull was deposited at the bottom of a circular ditch which was located the southern part of the settlement. Based upon our reconstructions of this feature and the internal stratigraphy, we suggest that the skull was deposited at the time the ditch was constructed and not as secondary fill. This phenomena can be explained as some kind of ritual behavior; for example, as a building sacrifice.

The second and third examples are – if these settlement features are contemporary – most probably associated with an independent household system. In a pit near a house we discovered many complete pairs of sheep or goat horns still attached to the frontal bones. The pit seemed to be a common rubbish pit with many other kinds of material deposited together with the horns. The situation was the same in another pit which was also structurally

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2 The pottery material have been cleaned but have not yet been selected and remain unrestored at present.

fig. 1. Bracelet, made on Spondylus-shell and consisted of two sections: a double bored oval disk and a band (grave 288)

associated with the same household system (inside the long ditch of the house); however, in this instance many mandible fragments were found together with other kinds of material. This type of accumulation and deposition can most probably be interpreted as some kind of workshop activity.

Spondylus or carved shell objects were found very rarely. They include one bracelet fragment and few beads recovered from settlement features. Only one bracelet was found as a burial offering and consisted of two sections (a double bored oval disk and a band) which were found on the leg of an infant skeleton (fig. 1).

Many pieces and different types of grindstones were brought to light from settlement features. Their size and shape are diverse. The most typical form is the so-called “bread-like” type, occasionally with a rim at the narrow ends and sometimes recovered with burnt grain on the grinding surface. Not so well-shaped, but more functioned pieces are also known. A relatively smaller and finer type of grindstone functioned for grinding red ochre mineral paint. The raw material of these tools is predominantly Permian red sandstone, which derives from the northern shore of lake Balaton.

The other types of ground stone tools are the ground stone axes which were found representing a relatively low percentage of the total ground stone at the site. We found the smaller trapeze-form, the so-called “shoe-last” type and only a few pieces of the bored variant.

Many thousand fragments of chipped stone tools were found in the settlement features and additionally these types of tools were also part of the grave goods.

Their distribution inside the settlement territory seems to be fairly homogeneous with only a few pits exhibiting unusual concentrations.

The general forms of chipped stone production are the relatively large, conical or prismatic blade cores (fig. 2. 4–5). Precores or nodules of raw material are also very rare. Many pieces of core rims and rejuvenation flakes were brought to light, both of which are associated with local workshop activity. Further evidence for workshop activity includes a high percentage of flakes, blanks and irregular flakes.
fig. 2. Chipped stone implements from the Balatonszárszó settlement.
1. Unretouched blade – sickle insert (pit 4275); 2–3. Unretouched blades (pit 4585 and stray find); 4–5. Cores (stray find and pit 3000)

Relatively regular flakes have been used as simple cutting edges although the most characteristic forms and the basis of the chipped stone industry at the settlement were regular blades (fig. 2. 2–3). We can suggest two main ways to utilize regular blades. First, the very thin, narrow and long blades seem to be technological blanks (which can be associated any kind of exchange system and used only after secondary working). These were very frequently found with no retouch or end flaking while the edges have significant wear derived from use on plants or as sickle inserts (fig. 2. 1). End scrapers, side scrapers and truncated implements are also frequently encountered while the ratio of borers and retouched points is relatively high.

The dominant raw material is the so-called Szentgál type red radiolarite⁴ and the Úrkút–Eplény and Tevel types⁵ are also present. Rarer raw materials imported from greater distances include obsidian and hydroquartzite. One piece of Kraków – Jurassic flint – was also found.

fig. 3. Pottery find from the Balatonszárszó settlement. Biconical vessel with incised and incrusted motifs (pit 4960, early phase of the Linear Pottery Culture)

We can try to present a preliminary general picture about the pottery finds which form the most numerous group within the find material from the excavations. In conjunction with this we would also like to discuss the potential for connecting and separating the ceramic material in hopes of identifying different “cultural phases” within the Balatonszárszó settlement.

There are many ceramic sherds, which accumulated in settlement features and, in few situations, were deposited as grave goods too. In general, we found sherds and only a few whole pots, as well as idol and altar fragments.

The soil of the site was favorable for the preservation of painted and the organic decorations.

During the first excavation season we found material of the Zseliz culture, which has been identified as a late phase of the TLPC, but after the last season this picture became more complex. Of course, in the future we will use more accurate numerical data. Here, however, we will attempt to demonstrate our current impressions of the cultural–chronological sequence which may be as follows:

The earliest phase of the settlement is contemporary with the so-called “early phase of the LPC”. This period is characterized by biconical forms (fig. 3), black-burnished and black
fig. 6. Pottery finds from the Balatonszárszó settlement (grave 531). 1. Globular vessel with fine incised motifs; 2. “Bomb-shaped” vessel with linear motifs (Zseliz culture)

polished technology, a relatively high percentage of “barbotine” (“slickwurf”) decoration and, quite simple linear motifs. This cultural phase seems to have analogies with the material from Budapest III.–Aranyhegyi Road,6 the earliest phase of Bicske–Galagonyás,7 Bína (Bény)8 and contemporary with the early Vinča culture.9 This horizon is also represented at the neighboring excavation of Balatonszemes–Bagódbomb.10

The second phase is characterized by material of the so-called Keszthely group (“middle or classical phase of the TLPC”) with a few imported sherds of the Notenkopf period. The most common forms are the conical, globular and the so-called “bomb-like” vessels all decorated with deep incised linear motifs (fig. 4). The relatively high percentage of red painting is an unusual phenomenon in comparison with earlier data. We can identify a very local element in decoration too. Many pieces of sherds had incised linear motifs with incrustation inside, often together with painting (fig. 5). The cores of a wild plant, the so-called millet, were used in this type of incrustation. This cultural horizon is associated with material from other settlements of the Keszthely group (e.g. Kustánszeg,11 Becsehely12), the Flomborn and Ackový cultural sphere in Southeast German and Czech territories,13 and contemporaneous with the Notenkopf phase in Northern Transdanubia.

We can isolate a characteristic third phase, which is not entirely independent from the preceding one. Typical Keszthely material was found together with elements of the early and classical phase of the Zseliz culture.14 The decoration of the Keszthely group exhibit general continuity with the last phase although there are some new elements. First, the complete decoration system of the Zseliz culture (fig. 6) and Keszthely group occasionally appear

mixed within a single decorative motif. Second, it is possible to identify a higher frequency of red painting. Faced pots (fig. 7), human figurines and zoomorphic modeled forms are also represented. This chronological horizon seems to be contemporary with the Zseliz culture in Northern Transdanubia, but does not include the latest phase of the Zseliz culture.¹⁵

These hypothetical cultural phases were identified primarily through territorial separation. The earliest phase was detected in the northern part of the excavated area after which it is postulated that the settlement focus shifted to the south. Finally, the latest occupations are located in the western part of the plateau.

ANGABEN ZU DEN HAUSTYPEN DES MITTLEREN NEOLITIKUMS IN UNGARN


An der nördlichen Trasse der Autobahn 2/a kam das im Frühling 1996 ausgegrabene Siedlungsdetail von Dunakeszi (Kom. Pest) vor. Das erste Haus stand am östlichen Rand der freigelegten Fläche. Die hausbegleitenden Objekte (Objekt 4, 3, 10, 11, 2, 29 und 6) konnten keine Fundamentgräben dieses Hauses sein (Abb. 1), da das Gebäude in diesem Fall mindestens 15 m breit gewesen sein sollte, und das eine unwahrscheinliche Breite bei einem neolithischen Haus wäre.\(^5\) Das Gebäude selbst war N–S orientiert, mit einer kleinen Abweichung nach NO. Von den, die Stützpfeiler und Pfosten des Hauses bedeutenden Objekten gelang den Ausgräbern Anna Endrödi und Attila Horváth 17 kleinere und größere Gruben zu beobachten.\(^6\) Das südliche Ende des Hauses, genauer gesagt die Objekte dieser Wand, blieben nicht erhalten. Die Distanz zwischen den noch sicher dem Haus zuordnenden Objekten ist 20 m (Abb. 1; 2. 1).


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6. Ich bin beiden für die Zulassung des Publikationsrechts für Dank verpflichtet.


Früher haben wir schon erwähnt, in welchen Zügen unsere Häuser von den bis dahin registrierten mittel- und westeuropäischen Gebäuden abweichen. Aber auch das ist festzustellen, dass dieser Haustyp in die bisherigen Einteilungen auch nicht aufgenommen wurde, diese Häuser wurden als „fehlerhaft“, oder „beschädigt“ erwähnt. Im folgenden versuche ich zu untersuchen, ob es richtig sei, oder ein, bis dahin nicht registrierter Haustyp in der europäischen Linienbandkeramik existiert.

Die erste Parallele unserer Häuser liegt sowohl räumlich als auch zeitlich weit von Dunakeszi. In Szentgyörgyvölgy–Pityerdomb (Kom. Zala) erschloss E. Bánffy in der zweiten Hälfte der 90er Jahre außer zahlreichen anderen neolithischen Objekten einige kettenartig angelegte kleine Gruben, die in N–S-Richtung lagen (Abb. 2. 2). In den Längsgruben fand sie kleine Pfostenspuren, aber auch im Zwischenraum der Gruben kamen ähnliche Objekte vor. Die Länge der sich so unerrissten Häuser schätzte die Ausgräberin auf 11,5–12,0 m. Das innerhalb des erwähnten Gebietes befindene, Feuerspuren aufweisende Objekt konnte aller

7 Waterbolk – Modderman 1958-59; Modderman 1958-59; Modderman 1970; 36; Modderman 1972, Abb. 49; Modderman 1985, Abb. 3; Lüning 1988, Abb. 47.
10 Modderman 1972, 78.
11 Bei diesen soll man aber auch mit der Möglichkeit rechnen, dass diese Objekte nicht tief genug waren und so durch die maschinelle Vertiefung der Flächen vernichtet wurden.


Innerhalb einer linienbandkeramischen Siedlung wurden 26 Häuser in Rosdorf (Deutschland, Kr. Göttingen) freigelegt, von denen fünf unserem Haustyp formal gut entsprechen. Von ihnen wird jetzt ein Objekt abgebildet (Abb. 2.6).

Einen ähnlichen Grundriss wie das in Enkinken (Landkreis Donau-Ries, Bayern, Schwaben) erschlossene neolithische Haus. Die innerhalb des Gebäudes gefundenen
Pfostenlöcher folgten einander unregelmäßig und lückenhaft, so, dass dieser Bau praktisch nur durch die Längsgruben gedeutet wurde (Abb. 2. 7). Dieses Haus könnte ein „Kleinbau“ der Einteilung von Moddermann nach gewesen sein. 21 Ein wichtiges Moment ist in diesem Fall die westlich vom Gebäude laufende Pfostenreihe, die vielleicht der Rest eines Zaunes gewesen sein könnte.

Obwohl die Beispiele noch lange erwähnt werden könnten, wegen Platzmangel wurden hier nur die wichtigsten Entsprechungen aufgezählt. Weitere Parallelen wurden schon in einem früheren Artikel behandelt. 22

Die oben gesagten kurz zusammenfassend können wir vielleicht mit Recht feststellen, dass es hier von einem nur teils erkannten, aber bis dato nicht definierten Typ der früh- und mittelneolithischen Häuser handelt, der in mehreren Hinsichten von dem Standardtyp der mitteleuropäischen Linienbandkeramik abweicht. 23 Sie vertreten alle drei, der Größenordnung nach aufgestellten Typen (Kleinbau, Bau, Großbau). Diese Gebäude bestehen aber nur aus drei Pfostenreihen, während die hausbegleitenden Längsgruben manchmal Pfostenspuren erkennen lassen. Diese Pfosten konnten aber keinesfalls eine so große und schwere Konstruktion wie die Außenwände dieser Häuser tragen, sie waren eher einfache Dachstützen. Diese oftmals erkennbare schwächere Konstruktion läßt besonders bei den Kleinbauten eine andere Funktion – Speicher oder Ställe – vermuten. 24


Diese Gebäude können nicht einem oder anderen Areal, bzw. einer oder anderer Unterperiode der Linienbandkeramik zugewiesen werden, weil sie in einem riesigen Gebiet von den Niederlanden bis zur mittleren Donaugegend auftreten und von der frühesten Linienbandkeramik an (Brunn, Szentgyörgyvölgy) bis zur Flomborn-Notenkopferamik-Periode (Rosenburg) datieren, während ganz genaue Entsprechungen auch in gleich frühen Siedlungen (Altdorf, Schwanfeld) zu finden sind.

Wie gesehen, hatten diese Häuser also einen einfacheren Aufbau als der Standardtyp, und sie waren in einigen Fällen auch kleiner. Jedoch können wir diese „Abweichungen“

24 Dagegen liegen auch Langhäuser von diesem Typ, die trotz ihrer schwächeren Konstruktion auch Wohnhäuser gewesen sein könnten.
Die Typologisierung der frühlinienbandkeramischen Häuser im Laufe späterer Analysen noch weiter verfeinert werden kann.

**LITERATUR**

Bánffy 2000  

Boelicke 1982  

Lüning 1983  

Lüning 1988  

Modderman 1958-59  

Modderman 1970  

Modderman 1972  

Modderman 1982  

Modderman 1985  

Nitra 1982  

Waterbolt – Modderman 1958–59  
Abb. 1. Die neolithischen Häuser von Dunakeszi–Székesdülő
ANGABEN ZU DEN HAUSTYPEN DES MITTLEREN NEOLITIKUMS IN UNGARN

PROVENANCING: METHODS, POSSIBILITIES, PROBLEMS

Provenance studies are fairly topical in modern archaeological research, being part of geoarchaeology, on the one hand and general archaeometry on the other. These studies can help us to follow the movement of goods and obviously the movements of the people transporting them. By coming to an understanding of how things moved special significance can also be recognised - both aesthetic and functional - in terms of quality and the effort involved in transporting objects over longer distances.

Most of the archaeological objects found on various types of sites - settlements, graves, depot finds etc - have been detached from their original contexts bedrock, habitat etc. - to become “utensils” or “goods” used by these prehistoric ancestors and seen as “finds” by us. Provenancing deals with tracing back the route of the object found on the site to the source or some stations along this route: mines and workshops using scientific analysis. It is only a small portion of the finds that can unambiguously be traced from quarrying/processing/use to the archaeological site proper. However, the number of these items and the ratio of their contribution to general knowledge of prehistory is constantly growing.

Materials particularly suitable for provenancing include natural materials where their occurrence is in a restricted region like rocks, minerals and fossils, as well as animals/plants from restricted areas. These aspects clearly depend on the natural characteristics of the archaeological sites.

Artificial materials with some natural components and special production technology can also be traced back to source(s) and workshop(s), i.e. some distinct spatial/temporal location in the former life of the object when it underwent some important and specific activity - extraction, processing, firing, melting etc.

M. DeGrooth suggested a scheme for describing the “life” of the object from bedrock to discarded tool. She elaborated the scheme for chipped stone tools: however, a similar more general - outline can be drawn up for almost all of the human products (fig. 1).

The actual movement of goods can be observed, provided the conditions of preservation are favourable. Quite a large part of the objects actually traded have never come down to us. It is evident from ethnographical analogy that most of the goods traded and exchanged, even looted, comprise materials that leave few traces in the archaeological record like food, spices/narcotics and textiles. Even if the preservation is favourable, e.g. in the case of livestock which was often traded, there is little chance to demonstrate that the bones were not of local origin. Large-scale movements, however, can be deduced from isotope studies as great changes in the environment (altitude, food basis) all of which leave their signatures in the bone material.

In a number of cases, however, the non-local existence of the finds can be clearly demonstrated. Marine shells found in continental contexts or various rocks found in a flat alluvial plain are themselves clear signs of the movement of goods. For most such objects of alien origin, the source (region) can be identified with some certainty.

Provenancing techniques

The identification of the source of objects can be based on various methods. There are, however, some necessary steps to be followed.

The first thing is to identify the problem, i.e. the material suitable for provenancing. We start this process of recognition by the macroscopic analysis of the finds, separating the

1 Herz - Garrison 1998.
2 Jerem - Biró 2002.
“special” and “curious” from among the mass of more general finds. In doing this we are certainly following the practice of the prehistoric people who also separated these materials from the surrounding world and preferentially selected them for their own purposes. We can say that our ancestors were very good field geologists and had a sound knowledge of different materials and their suitability for different activities.

After focusing on the specific raw material, it becomes possible to map known occurrences on archaeological sites – possibly also noting the temporal (stratigraphic) and functional dimensions as well. The more specific and unique the material we are tracing, the more can be expected from simple distribution studies, even without knowing the exact place of origin. Thus, distribution maps of, e.g. obsidian or specific pottery, such as Samian ware, yield meaningful results on trade and contacts long before the actual scientific characterisation of the sources/workshops takes place.

The distribution pattern of a given specific raw material in itself speaks clearly to the attractions and popularity of the stuff. Depending on the acquisition strategy, the core of the distribution area will be located around the source(s). In the case of interacting supply regions, distinguishing the individual sources and their production may be essayed by certain “fingerprinting” techniques. For this, knowledge of the source proper is not indispensable because the distinct “groups” can be distinguished based on certain qualities inherent to the archaeological evidence itself.

The more typical and perspective approach, however, begins with the identification of the potential sources in a region and their distinction by, hopefully, objective methodology and transferring experience to the archaeological evidence. Such a strategy – a collection and database approach – was adopted in “Lithotheca”, the comparative raw material collection of the Hungarian National Museum. By surveying the sources and creating a systematic description of the material, most of the important raw materials, present in great quantities, can be identified and allocated to source regions with reasonably probability.

Normally, a raw material of inferior quality would be used only in the immediate vicinity of the sources. The better the quality, the larger will be the observed radius of distribution and the limits of the regular supply zones will be balanced between available raw material source regions. The problem starts again with the highest quality raw materials, which can “move” over hundreds of kilometres, across prehistoric cultural boundaries and supply regions. For the identification of distant raw materials, scientific (s.l.) characterisation is indispensable. The problem is that most of the procedures suitable for unambiguous (?) identification of the source are typically expensive and often destructive. The exact identification of raw materials is even more complicated because the level of knowledge on the sources will be very different and often inadequate. Therefore provenancing is a very time-consuming and difficult task where co-operation is most important, on the regional as well as the disciplinary scale.

Scientific methods suitable for provenancing include standard petrographical, physical and, chemical analytical techniques. For natural substances and composite materials made of unaltered, or not too greatly altered constituents, petrographical and mineralogical methods of analysis can be very revealing. The main drawback is that relatively large amounts of material are necessary and, consequently, this can cause serious damage to the object itself. The harmful effects can be minimised by using fragments for analysis and documenting the pieces investigated, in drawings and photos prior to and after analysis. To start a destructive analysis on an archaeological object, however, needs a well-defined purpose anyway. Using petrographical methods, the identity (name, origin) of the rock can be clarified and hypotheses on provenance (at least, region or regions to be considered) can be made.

Methods of minimal destruction such as Laser Ablation Mass Spectroscopy and various Ion Beam Analysis techniques (PIXE, PIGE) are easier on the object but since they are derived from a very small surface, may be less informative. Standard geochemical analyses

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5 Particle Induced X-ray Emission Spectrometry
6 Particle Induced Gamma-ray Emission Spectrometry
fig. 1. Flow chart on the "life" of archaeological finds from raw material acquisition till moment of discard
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Table 1. A selection of provenancing studies – methods and results – published from Hungary.

45 Optical Emission Spectroscopy
46 Instrumental Neutron Activation Analysis
47 Electron Energy Dispersive Spectroscopy
48 X-Ray Fluorescence Spectroscopy
49 Particle Induced X-ray Emission Spectrometry
50 Particle Induced Gamma-ray Emission Spectrometry
51 Fission Track Dating
52 X-Ray Diffraction Analysis
53 Prompt Gamma Neutron Activation Analysis
54 Röntgen emissziós analízis [X-Ray emission analysis]: abbreviations by the authors
55 Infra-Red Spectroscopy
such as INAA\(^7\) or ICP-MS\(^8\) preferentially use a larger quantity of well-homogenised samples. Also, a relatively small amount of material is needed for isotope geochemical analysis, preferable for the identification of marble and investigation of organic materials, i.e. bone or tooth enamel.

Recently, we have tried to apply a new and non-destructive analytical technique (PGNAA\(^9\) or PGA A\(^10\)) for the analysis of bulk chemical composition of archaeological artefacts. Good results have been achieved on different lithic raw materials\(^11\) and preliminary applications have begun on pottery and metals as well.\(^12\)

Different dating techniques, used for the determination of the age of the rock can also help in the identification of the source: a good example is the application of FTD\(^13\) on obsidian.\(^14\) In a similar manner, FTD can be useful for identifying workshops producing glass.

The number of objects for which for provenance analysis may be used is gradually growing and the results are more and more meaningful in an archaeological context. We are, however, quite far from using this methodology in a routine way on archaeological finds. A lot has to be done in basic research, documentation and integration of results into an archaeologically oriented interpretation.

Without aiming at full coverage, in Table 1, we have attempted to summarise some successful or promising provenancing studies made on archaeological (mainly prehistoric) materials.

### Provenance in the archaeological context

**ARCHAEOLOGICAL SITES: SPATIAL, TEMPORAL DIMENSIONS**

Archaeological sites are traditionally interpreted in a chronological and geographical framework. Coeval sites with basically similar material cultures and spiritual worldview constitute the basic technical units for archaeology, ranked into “entities”, “cultures”, “groups” depending on the assumed coherence of proximity. These units, more or less, hopefully correspond to the formerly existing structure in prehistoric communities.

Movement of goods obviously did take place within the communities characterised by similar material culture. The resources are unevenly distributed with time and place for all activities within the group, however it actually functioned. The land use of prehistoric communities remains fairly unexplored, though certain patterns have already been established. Exploitation sites/mines are found typically outside the normal habitation zone, their location determined mainly by the geological conditions. The popularity of certain sources, however, compared to other sources of similar quality might depend on accessibility resulting from geographical as well as settlement historical factors.

Prehistoric mines are fairly well catalogued due to the initiatives of the Bochum Mining Museum.\(^15\) The most recent complete catalogue with respect to “flint mines” was compiled on the occasion of the VIIth Flint Symposium\(^16\) and for Hungary, in the recently published volume “Magyar régészet az ezredfordulón (Hungarian archaeology at the Millenium)”. New data on polished stone tool quarries were also added.\(^17\)

The goods may simply move from quarry/plase of origin to the habitation site or the place of utilisation, which is not necessarily the same. Different stages of workshop activity can intrude in-between or at the above loci. Some “industrial regions” with respect to certain prehistoric raw materials can be postulated in different periods and with respect to certain raw materials. Thus, in the past few years distinct workshop regions were recognised in the Bakony Hills for the exploitation of radiolarite and flint.\(^18\) On some sites with favourable

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\(^7\) Instrumental Neutron Activation Analysis

\(^8\) Inductively Coupled Plasma Spectroscopy – Mass Spectroscopy

\(^9\) Prompt Gamma Neutron Activation Analysis

\(^10\) Prompt Gamma Activation Analysis


\(^12\) Kasztovszky et al, in print.

\(^13\) Fission Track Dating


\(^15\) Weisberger 1980.

\(^16\) Lech 1993.

\(^17\) Bácskay – Biró 2003, fig. 26 in: MRE 2003.

- probably very consciously selected - geological/geographical settings such as Aszód–Papi földek\textsuperscript{19} or Zengővárkony,\textsuperscript{20} various kinds of workshop activity took place, comprising several kinds of raw material (Aszód: bone and antler,\textsuperscript{21} obsidian and limnic quartzite,\textsuperscript{22} basaltic andesite;\textsuperscript{23} Zengővárkony: Mecsek radiolarite\textsuperscript{24} and phonolite).\textsuperscript{25} The area around the Tokaj Hills has long been known to be rich in raw materials and, consequently so are settlements specialised in the exploitation of high quality raw materials and their processing to various degrees. The obsidian-workshops located by the best quality obsidian in Slovakia already operated in the Upper Palaeolithic period (Čejkov and Kašov).\textsuperscript{26} In the Early Neolithic, expeditions were seemingly mounted to the source area by the people living on the lowlands (Kőtelek, Méhtelek, Mezőkövesd, Füzésabony\textsuperscript{27}) resulting in a very high percentage of obsidian use on the sites and practically no known traces of habitation around the sources. A different strategy for raw material procurement and probably inter-tribal division of labour had developed by the Middle Neolithic. The heyday of workshop activities around the sources was probably during the time of the Tiszadob and Bükk cultures,\textsuperscript{28} when these top-quality sources were heavily exploited. Lengyel culture obsidian processing workshops (Aszód, Csabdi, Kolary) are already located at considerable distances from the sources and work on much smaller nodules appear to have been grabbed in haste from already impoverished sources.

The structure of the hydro- and limnoquartzite supply seems to be entirely different. The workshops around sources like Hejce or Boldogkővárálja\textsuperscript{29} realised a high level of elaboration on the material which was transported to regions poor in stone raw materials in the form of blades. This was necessary because the expertise necessary for working the very rigid post-volcanic siliceous rocks with numerous “faults” – traces of plants, inclusions, cavities - was not common knowledge and working on these materials resulted in a large amount of waste. A new workshop-site for processing Northern Tokaj limnic quartzite, has recently been excavated by Judit Koós.\textsuperscript{30} The elaboration of the material is currently in progress.

Some degree of local working also took place on the regular habitation sites, however the overall quantity of tools and more typically that of production waste is much lower. Differences between a general (not “industrial” site) and a workshop site are mainly apparent in the relatively high ratio of (finished, used, broken etc.) tools compared to production waste, mainly in the initial phases of production.

The movement of special quality raw materials, such as obsidian, Szentgál radiolarite, greenschist etc. surpassed the boundaries of communities characterised by similar material cultures. High quality raw materials travelled in the form of typically finished tools or elaborate half-products (e.g. blade cores) across cultural/political boundaries.

**RAW MATERIAL “SITES”: SPATIAL, TEMPORAL DIMENSIONS**

Raw material utilised by prehistoric people embraced a large number of commodities. Quite a large proportion of these was available in their immediate surroundings and yield very few, if any, grounds for provenance analysis. Such items include organic matters - bone, antler, vegetal substances like wood or plant tissues for fabric and textile. Some of the utilised materials of organic origin, though may have a definable spatial dimension, e.g. the use of marine shells (Spondylus, cowry) or other substances undoubtedly of distant origin: coral, ivory etc. Organic materials and raw materials of organic origin were typically “recent” in the sense that they had been existing coeval to the group using them. There are, however, instances when fossil bone or fossil molluscan remains were utilised, such as Tertiary molluscan shells by Upper Palaeolithic hunters.\textsuperscript{31} In the opinion of István Vörös, most of the mammoth bone objects from the Late Pleistocene were collected as sub-fossil elements, i.e. bones of an already

\textsuperscript{19} Kalicz 1985.
\textsuperscript{20} Dombay 1939; Dombay 1960.
\textsuperscript{21} Antoni 1990.
\textsuperscript{22} Biró 1998.
\textsuperscript{23} Biró 1992; Judik et al. 2001.
\textsuperscript{24} Biró 1989; Biró 1990.
\textsuperscript{25} Biró et al. 2001; Biró et al. in press
\textsuperscript{26} Bánez 1967.
\textsuperscript{27} Bácskay – Biró 1983; Starnini 1993; Biró 2001.
\textsuperscript{28} Bánez 1991; Biró 1998.
\textsuperscript{29} Losits 1981; Vértes 1965.
\textsuperscript{30} Hidasnémeti-Köteles
\textsuperscript{31} Gábori 1969; Dobosi 1985
practically extinct animal. The spatial dimension of the contemporary distant elements agree with their habitats (e.g. Spondylus) while fossils can be associated with known collecting spots already form a geological time scale.

Inorganic materials used, more or less, consciously certainly provide more information for provenance studies. Clay extracted from pits to be used for wattle walls and pottery was typically, though not necessarily, local. Tempering material used for the production of pottery could be also local (sand, chaff) but it seems that distant materials – metamorphic and igneous rock fragments – were also frequently used. These tempering materials of distant origin could also be “local” in the sense that small fragments grit from worn quern-stones, polishers, axes etc. could be used occasionally or with and with intention. There are also a lot of “household stone utensils” – hammer-stones, cooking stones, rocks used for fixing i.e. tent bases (Dömös) which are basically local, originating from the immediate surroundings of the site. In most archaeological surveys till the very recent times these “blocks of stone” were not collected and only mentioned in the very best cases. On modern large surface excavations where all evidence from closed archaeological units are preserved, these stone tools may occur in very large quantities. For example, on the excavations of the motorway M7 in Zala county, close to the Mura river, came an incredible number of heavily utilised pebbles (mainly local quartzite). The large number of finds is obviously related to local characteristics, i.e. the wealth of handy and hard pebbles – a feature which had probably considerable impact on the life of the people along the Mura river.

Specialised tools, however, always needed better raw materials. Since the Early Palaeolithic we can observe very conscious use of optimal raw materials. In the Early and Middle Palaeolithic periods, accessibility of good raw material not very far from the habitation site was one of the factors influencing the spatial development of human settlement systems. Long distance movement of special quality raw materials emerged by the Middle Palaeolithic, though we do not know if these early instances of long distance transports can be assigned to trade, gifts or movement of the related communities e.g. occurrence of Swieciechów flint in Sőyomkúti (Vidróczky) rock shelter or obsidian in Pilisszántó II cave, both dated to Middle Palaeolithic. A regional supply of preferred raw materials, far surpassing one-day-walking distance was already established by the Middle Palaeolithic, as is apparent from the results of a new field survey conducted by A. Markó and A. Péntek in the Cserhát Hills. The collected items of Middle Palaeolithic character were often made of Szeletian felsitic porphyry, a favourite raw material collected in the eastern parts of the Bükk Mountains. The identity of the rock was checked by instrumental analytical technique, i.e. Prompt Gamma Activation Analysis.

The first exploitation sites clearly documented by traces of mining could be also dated to the Middle Palaeolithic, though dating a quarry site is always a difficult problem. First, because the traces of exploitation in themselves carry no chronological implication, second, because very few datable remains were left behind by the (temporary) users of the resources and, finally, because of the possible permanent/lasting use of the raw material sources over the different cultures. Quarry sites associated with the Middle Palaeolithic/Early Upper Palaeolithic in Hungary comprise Budapest–Denevér street, Miskolc–Avas, Korlát, and Erdőbénye–Sás stream.

By the Upper Palaeolithic, the chipped stone lithic inventory reached the height of its complexity. In spite of the long use of this technique in the production of tools, the wealth of forms was not enlarged essentially by (later) prehistoric stone knappers. Also, the complexity of the raw material distribution pattern seems to be fully functioning by this time. It is very difficult today to draw supply zones and reconstruct systems because due to the large time scale of the Palaeolithic we do not really know the existing coeval communities as well as

32 Vörös 2000.
34 Gábori 1964.
38 Simán 1986a.
40 Bácskay 1995.
the units of controlled land. We cannot see the Upper Palaeolithic system of raw material circulation as a network yet although more importantly we can – and do – draw the so-called "action radius" of Upper Palaeolithic communities on the basis of the provenance of raw materials found on the sites. Long distance distribution of certain high quality raw materials (obsidian, Prut flint, rock crystal) can be demonstrated in quite a few instances over distances of several hundred kilometres.

By the beginning of the Neolithic period, habitation sites finally become detached from the environs of the raw material sources. It was more important to live on fertile arable land, which could be cultivated than live close to raw material sources. It seems that early farming communities typically solved their bulk raw material needs by expeditions to the sources, starting out from the agricultural settlements located from 30–100 km from the source. With the formation of the dense settlement system of the fully developed Neolithic communities, a certain division of labour appeared among the settlements. The sites lying relatively close to the raw material sources definitely specialised in exploiting/controlling the source and producing half-products for further transport to the "non-industrial" settlements. Such habitation sites with intensive workshop activity were, for example Kup (for Tevel flint) and Meneshely –Vöröstó (for Szentgál radiolarite). By the end of the Middle Neolithic, the success of the agricultural communities on the Great Hungarian Plain (Alföld) region probably provided a basis for clearly industrial settlements in the North–Hungarian Mid-mountain range (typically, Tokaj Hills) to exploit and work materials full-time for lowland communities.

**PROVENANCING COMPOSITE/CHEMICALLY TRANSFORMED MATERIALS**

Determining the source of something of distant origin is difficult enough for goods made from natural products, transformed by humans only in a physical way – cutting, chipping, polishing etc. It is evident that most of the archaeological materials found on prehistoric sites are not like this. From the Palaeolithic period onwards, the number/ratio of artificial materials which do not occur in nature increased continuously. These materials could be chemically transformed (heated, burnt, melt) and they could be mixtures of several components, each component coming from different – identifiable? – sources. The resulting new materials – e.g. ceramics and metals (alloys) – are not found naturally in the environment and provenancing may be directed to locating some of the components or the "birthplace" of the new quality, the place of production – the settlement, workshop. For example, in the study of pottery, temper can be more characteristic of the origin of the grit used for temper. This place of origin can be indirect: fragments of used-up stone utensils, broken pottery fragments (grog) are often used, materials which may have a complicated history in themselves. The bulk composition, especially in the case of very special pottery may have more to do with the place of production, i.e. recipes and technology characteristic of a particular workshop. Hence the success of the provenancing for Samian ware and certain types of glass.

The investigation of metal and alloys is even more complicated as by re-melting the objects several times, these substances can be used and the chemical composition changed accordingly. Therefore most successful metal provenancing studies were made on very early (not recirculated) metals and special, homogeneous raw materials like lead.

The investigation of the quarry sites (mines) is most important in the case of composite materials as well, though traces of prehistoric utilisation will be often over-printed by modern industrial activity, like the threatened danger to the Rosia Montana Roman gold mines by planned modern industrial operations. The ore coming from a certain mine region may contain characteristic trace elements or have a characteristic isotopic composition that permits identification of its origin even following the elaborate processes of ore-dressing, smelting and forging.

With the composite materials made through chemical transformation, however, it is more likely to get data on the place of production, typically on a wider scale. Recipes for producing a certain substance like glass may be widespread over a relatively large area but certainly typical of the particular cultural context.41

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41 Fórizs et al. 2000.
fig. 2. “Movement” of the raw material: Possible route covered with one “owner”

Interpretation

It is clear that provenance studies on different levels can be of great help in understanding the past. At the same time, they raise new problems as to the actual mechanism of transport.

The simplest case would imply a self-sufficient approach. As the resources are unevenly distributed and everyday life takes place on a location different from the source of raw materials, it is necessary to collect/exploit the commodities used for the actual needs of the community. The production of the finished tool/vessel etc. would normally take place on the settlement (with tools and production waste). Their place of use may be confined to the settlement but more typically “moves” with the owner. The discarded pieces are typically found again in the context of the settlements because personal belongings would tend to be more concentrated here than in places where their use was uncertain. A special case is provided by grave goods and depot finds, stored for further use in this world or beyond earthly concerns (fig. 2).

The movement of material can be quite complicated even in this simple “autarchic” case. The typical situation, however, must have been even more complex. Probably different members of the community exploited the quarries, prepared the materials and used the various types of artefacts. The geological/geographical characteristics of a region and natural division of labour no doubt connected a given piece of artefact and made from a certain raw material, to a number of persons during its life-cycle from raw material to rejected piece of worn artefact, i.e. discarded junk. The same exploited block could serve widely different ends in the hands of several persons, simultaneously and over a longer time period as the artefact was transformed and reworked several times (fig. 3).

As we can see, one person could have carried the same (block of!) raw material to various places and have distributed it among several users without the need to hypothesise any sophisticated forms of social contact and exchange system. The finished artefact, however, did not necessarily remain in the possession/use of the community exploiting and processing the raw material. Typically, products from the “industrial region” were spread in the form of regular supply to other communities, which belonged to the same cultural/ethnic/political? community (category?). The bulk distributions of regional raw materials seem to follow the territory of cultural units defined on the basis of other elements of the material culture. This process is clearly seen in the analysis of the main raw materials used for chipped stone artefacts in Hungary from the Neolithic till the Copper Age. The regulation of access to the sources (if any), that is, the mechanism of actual distribution is not known to us. We can only form our conclusions from the traces and the quantity and ratio of half-products compared to finished/used artefacts on the individual sites. It is clear that the pattern changed depending

on the raw material and chronological period. Raw materials which needed special expertise tended to be processed close to the sources and travel in a highly elaborate form as reflected by the blade-depot made of limnic quartzite (Boldogkőváralja). On the other hand, easily worked valuable raw materials like obsidian can be processed from the stage of lumps and pre-cores quite far from the sources (e.g. Csabdi or Kolary). The strategy of raw material acquisition also changed through time as a function of the general settlement features and a seemingly more intensive protection of the source regions.

Raw materials with special — aesthetic, functional — merits could also circulate beyond the “homeland”. These “long-distance” raw materials travelled over very large distances and, sometimes crossed several, cultural boundaries. Their identification can be more difficult due to the extremely great distance from the source while the mechanisms by which they were transported is even more enigmatic. We can suppose the mediation of tradesmen, “diplomatic” gifts including kindred relations and also some form of warfare — as loot or goods abandoned in a far-away land by the intruders (fig. 4). These possibilities are not imaginary situations for prehistory; it is enough to mention Troy and its siege to see clearly that war and booty can work at least both ways. As time advanced it appears that materials and situations both become more complex and the range and intensity of contacts constantly increased.

Seen from the perspective of the sites, the extent of contacts documented by non-local materials present on the settlement, an “action radius” is hypothesised for prehistoric (mainly Palaeolithic) communities. The name in itself implies that the members — at least, some members — of the community actually covered these distances. In more recent prehistoric periods, however, the transport of the goods may have been restricted to a selected few persons (trades people) or, even more likely, the items physically moved by being passed from hand to hand. The most likely routes the objects actually covered seem to naturally agree with the modern road network, which is one of the reasons for the richness and variety of the prehistoric settlements along the new motorways. The geographical factors — proximity of mountains, waterways, passes and fords in rivers — governed the main roads of communication from the earliest times of human history till the present.

Conclusions and perspectives

Provenancing is a most useful tool for the historical interpretation of archaeological evidence. It is, however, time-consuming and expensive due to the number of (preferably) non-destructive analytical techniques necessary for objective analysis. It is very easy to make mistakes for several reasons including not knowing all the sources used, interaction of

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43 Vértes 1965.  
fig. 4. “Movement” of the raw material: Goods crossing beyond cultural boundaries

the physical/chemical properties of different sources studied by specific methods, problems of interpretation and so on.

Therefore, it is considered a good plan of action to share knowledge and responsibilities in multi-disciplinary and international co-operation programs using available fast channels for communication and sharing information. Such a project was currently realised within the framework of UNESCO, lead by D. Hovorka, entitled “Raw materials of the Neolithic/Aeneolithic polished stone artefacts: their migration paths in Europe” (IGCP-442, http://www.ace.hu/igcp442). A closing monograph of the project can be expected soon, reflecting our present state of knowledge in this matter.

For the same ends, we have just finished a National Science Foundation (OTKA 025086) project “Atlas of prehistoric non-metallic raw materials in the Carpathian Basin”. We are trying to summarise existing data in a public, easily understandable form which can be also updated relatively fast (www.ace.hu/atlas). We have started to publish the data – and images! – of our comparative raw material collection in the same way (www.ace.hu/litot).

The investigation of provenance is a complex task that needs the co-operation of analyst and archaeologist to achieve reliable and meaningful results. It is not easy to separate facts from hypotheses and hypotheses from dreams, not to speak about clearly mistaken views. Communication is also not easy but absolutely necessary. By the accumulation of data, availability of analytical facilities and regular scientific discussions we can better serve the historical interpretation of archaeological finds.
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E. Bánffy:
Today’s meeting focused on three, closely related archaeological phases within the Neolithic of the Carpathian Basin: the neolithisation process and the earliest neolithic period, both in the Alföld (Great Hungarian Plain) region and in Transdanubia, Western Hungary; the more developed LBK phases that followed the initial phase; and finally, the late neolithic formations that developed in the eastern region of the Carpathian Basin.

Similarly, discussing the problem of contacts has concentrated on three basic elements:
- the controllers and/or exploiters of resources;
- the others to whom the foreign material or ware arrived; and finally,
- the hypothetical mediators, who might have stood in-between groups living at great distances.

F. Horváth:
I should like to propose that the word “trade” not be used in societies with no monetary exchange. Let us restrict our terminology to the expression “exchange”.

P. Raczky:
From the great conference volume edited by C. Lamberg-Karlovsky and C. Renfrew we know the precise definitions. Trade, therefore, is a meaning for actions of exchange in general. K. Polanyi defined the notion of trade without money. Thus the terminology is fixed.

E. Lenneis:
According to the neolithisation process, Transdanubia is a possible region for the formulation of LBK. Some other areas, however, also come into question, especially when the origins of long houses are considered. Although the Pityerdomb houses are the earliest buildings in the South, it is not clear from the remains whether they belong to e.g. the Mohelnice type or to some other type.

E. Bánffy:
I do not want to vindicate myself the right to name the only region of the LBK formulation. I also think that each of the geographic regions where LBK developed with the contribution of Southern immigrants and local populations could be called a formation zone. On the basis of my investigations I only wanted to point out that Transdanubia is unique for one reason: it is the Northern periphery of the Starčevo culture distribution area and thus the only region where the earliest LBK could have formulated with a direct contribution by a greater influx of real immigrants from the Mid-Balkans. In addition to the components of this – to my mind complicated – process we can identify some elements. However, I think we must be brave enough to admit that there are still other elements that we do not know yet. Both statements are equally important for future research.

P. Raczky:
Both E. Bánffy and E. Lenneis spoke about the material facts among the elements of the transition. I think you are right, it is necessary to discuss these. But it is also a very important task for research to see behind the screen. We should, therefore, also discuss the human factor. What was the mechanism of adaptation? That is, this adaptation is not simple, because it happens on a totally new scale, and is a new way of life, a new psychological setting. It is thus something difficult to catch on the basis of material culture. Agriculture, for example, represents a totally new body of knowledge. What is the historical movement of this process? The new book by Leroi-Gourhan stresses this mechanism, which is a change within the mind. What was first? Adaptation followed by the change in mind, or a change in thinking that was followed by adaptation?
E. Bánffy:
It is also a possibility that these two actions took place in a continual interaction with each other, thus the answer is “both”.

P. Raczky:
I agree.

A. Whittle:
Considering the transition period and the participation of the Starčevo culture in it, Transdanubia is certainly an important region. There were times when the Körös culture was claimed to be the main participant in the process, but this was a time when there was no research in Transdanubia. Now it is investigated and the model constructed is more and more convincing, as far as the contact between local mesolithic groups and the Starčevo groups is concerned. But just one more reflection: we see, on the basis of the Balatonszárszó site, how big excavations can change the picture. From the M3 motorway excavations we also know quite early long houses. Nonetheless, it is not to exclude that similar settlements would be found somewhat southwards in the Alföld region, let us say, some fifty kms from the Northern limit of the Körös culture, which could give new information about the transition processes there. We might see that there was not only a Transdanubian front but also an Alföld front. I certainly do not want to influence where your next motorway should go, but I think until new information of the northern Körös culture my question remains a question.

E. Bánffy:
My problem concerns the observation that the two contact zones have fairly little in common in terms of the archaeological remains. The early Neolithic in Eastern Hungary as well as the earliest transitional materials to the LBK, look more to the East. It has evidently close connections with Transylvania, and both the Romanian and the Serbian Banat. However, as the large excavation material from Budapest–Aranyhegy suggests, there was little connection between the Szatmár II culture settlements and the earliest Transdanubian LBK.

P. Raczky:
I should like to separate the two regions totally: Transdanubia and the Great Hungarian Plain at the time of the transition. The Starčevo culture has altogether some dozen sites in Transdanubia; the Körös sites however reach the number of five thousand! Körös settlements can have sometimes more that one-meter high accumulation of layers, while the Starčevo sites in Transdanubia are small, single-layer settlements. In Serbia, Starčevo sites can be one and a half meter high! So this is a great difference. Statistically it has a dramatic meaning: it shows that the character and the development of the two cultures are totally different. Those who speak about the Körös-Starčevo culture in common blur these differences and are thus unable to solve the problems of different lines in development. Thus, first of all, we must define these differences, and only then will it be possible to study the different ways of development.

F. Horváth:
I should like to add something to this problem. The old excavation at Bicske, also the new excavation in Pityerdomb with its typological plates, and especially the new Balatonszárszó material, clearly show to me, what a strong Vinča A impact might have been in Transdanubia! I cannot explain how and why but it is clearly there. This concerns both ceramic technology (tempering etc.) and some pottery types. This contribution might be explained, at least in part, by a direct migration of Vinča people to Transdanubia.

P. Raczky:
This is one tendency. The other one is new concepts coming with new knowledge. We must not forget the first Bicske publication, in which there is an interpretation of a pit being a house. It is of importance that the new generation of archaeologists not only have new sites but also new concepts, new attitudes. To mention only one example: everyone knows the excavation Kiskőre–Gát in the Alföld. Here the ditches were interpreted as houses, while the posthole structure in-between was thought to have been a waste disposal area.
A. Whittle:
Some questions to Krisztián Oross: how large is the plateau you have the settlement on? How long could the early phase last? How many generations can you calculate with within the classical phase?

K. Oross:
The plateau is about 450 meters from the east to the west. The northern part of the plateau is empty. We have excavated a part of an early LBK site there, which extends into the unexcavated area. The classical site may stretch for another 200–300 m more towards the South, but to the East and West both the plateau and settlement end. To the other question: no houses intersect. As to the finds, we have just finished the excavation, so that more time is needed for the processing of finds. Therefore, I cannot answer your question concerning the number of generations now.

E. Bánffy:
I could add to the question of time depth a few 14C dates from Transdanubia: I have heard from Nándor Kalicz that the late Starčevo site of Vörs was dated to 5400 (!) BC, Pityerdomb began at 5480 and lasted for about 90–100 years. I am aware that there is a discrepancy with the early dating of Brunn II. near Vienna, which should start at 5620.

E. Lenneis:
The new results from Brunn are not published yet but I have heard that the laboratory in Switzerland might have measured the earliest dates too high, the improved and correct ones should be not earlier than 5500.

L. A. Horváth:

A. Whittle:
Wir warten noch auf mehrere Daten, die aber aus Ecsegfalva schon jetzt bekannt sind. Diese sind 5800, 5700 BC. Es gibt auch ältere Datierungen aus Endröd, i. e. 6000 BC, und die späten Körös-Daten gehen bis 5500 BC. Wenn die Frage aber so gestellt ist, welcher Keramikstil dazu in Ecsegfalva gehört, so kann Krisztián Oross eine genauere Antwort geben.

K. Oross:

L. A. Horváth:
Es ist aber sehr interessant. Nämlich lebten noch Mesolithiker um 5800 im Alpengebiet. Es wäre wichtig zu wissen, ob – wie die Karte zeigte – die Träger der Körös-Kultur Kontakte tatsächlich mit diesen Mesolithikern hatten.

E. Bánffy:
I should like to pose a question to Florin Draşovean. Twenty years ago, when I participated in the excavation at Herpály, Nándor Kalicz showed me some shards, telling that they were imported pieces from the Petreşti culture. Therefore I tried to memorize them, as well as the relative chronological position of the two cultures to each other. From what you said today about the origins and contacts of the Petreşti culture, it appears to me as a part of a sort of new melting pot in the Banat, a region from where finally some new chronological and typological relations were emitted. How is that?

F. Draşovean:
First of all, I do not believe that all imported painted shards from Herpály belong to the Petrești culture. I have not seen them, only some colour photos in the small volume “The Late Neolithic in the Tisza region”, but one of those in the picture surely belongs to the Foeni group. Secondly, at the present state of research in Banat only the Foeni pottery is painted. It
is clear that the Banat region had a stronger connection with the Alföld that to Transylvania during the Middle Neolithic. In the Late Neolithic, things change a little bit, because the Herpály and – what Professor Lazarovici calls – the Cluj–Cheile Turzii–Lumea Noua–Iclod complex all have painted pottery. It is not fair to discuss what exactly this formation means because Professor Lazarovici is not here. But in my opinion we can speak about extremely strong relations between Transylvania and the Eastern and Northern part of the Alföld region. These types of material as well as some imported shards published by János Makkay from Vésztő–Mágó belong to a hundred percent to the Foeni group.

P. Raczky:
It is always dangerous to think about a relative chronology only on the basis of some potshards. It is well known, that in the history of a tell settlement the ground was sometimes cleared in connection with destruction activities, so that pottery fragments might begin to “live their own lives” and move around. Therefore to make a chronology based only on potshards is difficult. Secondly, the Herpály painted styles are different. The first style is the black painting, and it transforms into the red, white and finally unpainted styles. With the help of 14C dating we established that this process took approximately 400 years. This is a long time as this change may mean very complex relations to the most different cultural formations within the polichrom groups to the East. Similarly, the Öcsöd site contained several areas from the vertical stratigraphy to the totally eroded and mixed layers. It is thus, once again, quite dangerous to build a chronology on the presence of some imported potshards at a site.

F. Drașovean:
Pál Raczky is right, because our interpretation depends to a hundred percent on the accuracy of the excavation. If it is carefully done, we can pay more attention to imported ware. Speaking about the imported shards from Vésztő-Mágó: according to the publication, they belong to the classical Tisza period. At Öcsöd, those sherds were published from both the Szakálhat and the Tisza layers. In my opinion, this is too early. As for the formation of the Tisza culture, we should need another round table of discussions. But in Herpály, all sherds were published from the early phase of the tell settlement, which is to my mind correct. What is more, the imports occur at both sides! So I see no contradiction. In Transylvania, both painted and unpainted specimens of the Foeni group appear as imported pieces in the late Tordos settlements. This is, therefore, not a problem of some isolated sherds: these are units of cultural content in Transylvania, together with a comparative stratigraphy. Unfortunately, most of them remain still unpublished.

P. Raczky:
It was a great problem for us to precisely establish the real phasing of the pots found in the central part of the tell at Csőszhalom. Secondary re-deposition within the stratigraphy was so great that, for example, we encountered numerous black painted, Herpály type shards as well as white painted ones. Some of these fragments, however, were sunken into postholes. This created quite a difficult situation. To cite another example: at the excavation of László Domboróczki in Füzesabony, some grave spots were not visible, although burials were dug into the settlement from above. However, there was no sign of intruding features. Such phenomena can also bias the chronology.

E. Bánffy:
Instead of a proper summary, I only want to draw attention to one remarkable result of today’s meeting. In the morning I began with a warning that we should urgently proceed with the analysis of contacts using purely archaeological methods; otherwise we shall be unable to cooperate with those colleagues investigating the same question but approaching it from other fields of science. It has become clear, however, that we have much to do in order to make each other’s results comparable even within Neolithic archaeology! There are plenty of methods and research attitudes that have proven to be essential in contact analyses, as has also been shown during the session. Just to mention one: it is possible to establish provenance on the basis of the analysis of pottery motifs alone, certainly, not in the 19th century style. We have also seen that the occurrences of different types of objects, pottery, lithic raw materials etc.
can be plotted onto the same map. The circles that outline various distributions can thus be compared to each other, reflecting the mobility and contact areas of a given cultural group. This all shows that there is a great need for cooperation even amongst us. It is particularly important for us to compare our results at every phase, not only at the end, so that discussion helps us to change our mind during the course of our work as well. I think that exactly this took place today. Thus, I hope that all of you experienced as many new impressions and, like myself, were given courage for further research into contact analyses.
ENVIRONMENTAL CHANGES UNDER THE NEOLITHIZATION PROCESS IN CENTRAL EUROPE: BEFORE AND AFTER
(Keynotes lecture)

According to the archaeological, archaeobotanical and archaeozoological information available for us today the major centers of production must have developed in several places on Earth independently from one another. It was the area of the Middle East and Anatolia where a new developmental trend could first emerge, justified by chronological data, leading to the appearance of Neolithic agricultural production; i.e. plant and animal farming. This Neolithization process in the Near-East must have taken place at the end of the Ice Age and the beginning of the Holocene sometime around the turn of the 10-11th millennia BC.

According to environmental historical data the global climate at the end of the Pleistocene preceding the emergence of neolithization was fundamentally different from its present day counterpart. Continental ice sheets reached their greatest expansion around 18 000 BP covering an area of approximately 50 million km². The extension and location of the climatic belts were totally different during this glacial period from the one observable today’s interglacial. As a result of this fundamentally different vegetation and soils could have developed in the given regions with average July palaeotemperatures being 5–10 C° colder in the central and southern parts of Europe than today. The average January palaeotemperatures for the same area were 20–40 C° lower than today.

Following the Last Glacial Maximum (LGM) a gradual warming started leading to the retraction of inland and montane ice sheets. This resulted in a gradual reorganization of the climatic and vegetation belts as well as the soils on our planet between the LGM and the beginning of the Holocene. According to calibrated radiocarbon data global warming culminated in the areas of the present-day Mediterranean and subtropics around 11–12 000 BP, in the temperate warmer parts of Europe at 10–11 000 BP and in Northern Europe at 9–10 000 BP. All these data seem to justify the development of climatic, soil and vegetation conditions characteristic for the Holocene in the Near East preceding the neolithization process. In other words highly significant transformations occurred in the climate accompanied by alterations in the soils and the vegetation in the area before the emergence of the Neolithic.

There was such a great coincidence between the climatic changes occurring at the beginning of the Holocene and the process of neolithization that even the older so-called new archaeological models hypothesized in the 1960s emphasized the importance of climate-change induced sea-level, vegetation and faunal changes in the process of Neolithization. The Neolithization process affected not the whole of the SW Asian region but only the areas with the most favourable natural endowments. This region is known as the Fertile Crescent in the literature.

shelter during the Ice Age for a part of the cereals (wheat, barley) and the wild animals later domesticated and farmed (sheep, goat, auroch, pig). The emergence of food production fundamentally transformed the interaction and relationship between man and environment, and man and the society. Humans successfully managed to alter their surrounding environment via several ways; i.e. the establishment of arable lands, pastures and showing preference for and intentionally spreading certain plants and animals while controlling and gradually restricting others (weeds, predators). Parallel with these events large numbers of people were crammed together in the newly developing permanent settlements, their ethos, social energies and interpersonal relations suffering radical changes. However the emergence of permanent settlements also enabled the large-scale, efficient, long-term accumulation of human knowledge and experiences from generation to generation.

In contrast to this several prerequisites for agricultural production and the development of productive societies were missing in Europe despite the presence of favorable climatic and soil conditions in Southern Europe. As a result of this mainly Mesolithic hunting-fishing-gathering groups inhabited the continent at this time. The remains of seasonal hunting camps of these Mesolithic groups refer to the presence of relatively smaller and highly mobile groups of people in the area. This Mesolithic population of the European continent started to get acquainted with the Neolithic type of production around 9000 BP as a result of the cultural and ethnical impulses reaching the area from the region of the Fertile Crescent during its northwest expansion. The SE part of the European continent had a crucial and pioneer role in the process of neolithization of the Mesolithic Europe thanks to its favorable geographic location. The earliest traces of Neolithic technical (clay pottery, polishing and drilling of stones, spinning–weaving) and economic innovations originating from the area of the Fertile Crescent were restricted to this region.

The Carpathian–Balkan region is of crucial importance regarding the neolithization of the European continent as these areas acted as transit areas and mediators for the earliest food production cultures originating from the area of the Fertile Crescent to expand their areas of influence into the central and western parts of the continent. The area of Carpathian Basin can be regarded as one of the most important areas in the process of European neolithization as its central part forms the northern boundary of expansion of the Anatolian–Balkan agricultural civilization. There are two major models for the expansion of the Neolithic cultures bearing Mediterranean roots from the area of the Fertile Crescent to the southern parts of the Carpathian Basin and onwards to the European continent. According to the first hypothesis the continuous spreading and migration of humans must have enabled the expansion of Neolithic civilization from its birthplace. The other theory accounts for the gradual adaptation of the Neolithic technical innovations and lifestyle. Most likely both assumptions must have played a role in the process. However no matter which process we account for a time-transgressive phenomenon emerged from the area of the Fertile Crescent resulting in the penetration of a new Neolithic civilization into the European continent, becoming dominant in the majority of the regions there between the 10th and 5th millennia BC.

The emergence and spreading or expansion of Neolithic cultures poses a large number of important and interesting archaeological and environmental historical questions. From these we would like to touch upon the most important ones, mainly those that are somehow related to the areas of the Carpathian Basin and Central Europe.

Question No. 1: What triggers the expansion of Neolithic culture and the process of neolithization? Is there an environmental aspect of this process?

The interrelationship between man and environment can be grasped most accurately in a relatively simple way via the analysis of existing relations between the social, technical and environmental conditions or factors. The engagement in a Neolithic lifestyle, sedentism and more reliable food resources might have led to significant population growths in contrast to the hunting cultures. The main reason for this is while for a hunting-fishing-gathering family a minimum area of 50–100 km² is sufficient to get by, it is only an area of 5–10 hectares that can efficiently provide for the needs of a Neolithic family due to the more intensive landscape utilization (fig. 1) (large rectangles—Mesolithic and small rectangles—Neolithic).

As a result of the steady population growth deriving from lifestyle differences the Mesolithic communities could have been easily overwhelmed by the Neolithic groups in a given area within the period of a couple of generations. However, the ability of the environment to provide for the needs of a larger population even among intensive landscape utilization is restricted controlling the possibilities for population growth (fig. 2). When the Neolithic communities reached the Neolithic limit of the environment to provide for their needs they had to face two alternatives to choose from: 1. the introduction of a more intensive landscape utilization and the development of a more advanced social system and order, 2. migration to new areas untouched by Neolithic groups. This latter option was relatively easier to implement at the time of birth of the Neolithic civilization. Thus the ability of the environment to provide for the needs of humans must have had a crucial role in the initiation of migrations out of the area of the Fertile Crescent for the Early Neolithic groups.

Naturally the Neolithic groups and the civilization itself during its course of expansion lasting several thousand years and embedding a number of generations were not preserved in their original form but must have suffered some alterations. On one hand numerous new technical innovations must have emerged during the course of neolithization. Furthermore several new cultural influences might have affected the migrating groups, which eventually might have led to a strong transformation of the original Neolithic cultural habits and traditions.

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fig. 2. The Upper Paleolithic, Mesolithic, Neolithic levels of the environment to provide for the needs of human population.

existing in the areas of Fertile Crescent. According to archaeological investigations Neolithic communities belonging to the Central Asian – Aegean – Balkan cultural groups managed to reach as far as the center of the Carpathian Basin. Traces of the Körös–Starčevo culture bearing cultural roots in the Balkans can be found in the NE parts of the Great Hungarian Plain (Alföld), its center and along the shores of Lake Balaton (fig. 3). According to radiocarbon measurements the first appearance of Early Neolithic groups in this area can be dated between the closure of the 7th and opening of the 6th millennia BC. However according to the most recent palaeotemperature reconstructions based on the latest pollen analytical findings.

fig. 3. Sporadic Early Neolithic sites on the limit zone of the distribution

1. Distribution of the Early Neolithic sites,
2. Sporadic Early Neolithic sites on the limit zone of the distribution

this time coincides with the development of the Holocene climatic optimum, thus this climate change must have had a significant role in the settlement of Balkan-type Neolithic groups into the area of the Carpathian Basin.\textsuperscript{13}

But can we justify this above-mentioned theory based on a single Hungarian pollen profile? Or were there similar observable changes in other groups indicative of the palaeoenvironment for this period?

Nevertheless we are instantaneously faced with the question of why did this Neolithization process bearing Mediterranean roots halt in the Carpathian Basin? According to the pollen based palaeoclimate reconstructions this previously mentioned climatic optimum was replaced by a sudden worsening of the climate decelerating the process of neolithization. After this, according to this model, a following improvement in the climate enabled the reactivation of the process of Neolithization and the onward migration of Neolithic groups towards the northern parts of the Carpathian Basin and the western parts of the European continent.\textsuperscript{14}

According to archaeological data however the expansion of Neolithization not only halted in the Carpathian Basin but there has been an important cultural and production transformation as well in the area preceding the onward expansion. According to our findings a very complex interaction must have evolved between the Neolithic and Mesolithic groups in the central areas of the Carpathian Basin, and their surrounding environments. Only a new complex geoarchaeological model was suitable to explain the presence of neolithization in the region, and the complex interactions of humans displayed in such factors as the level of socio-economic and technical development and cultural interaction and the environment.

This new model is based on the following archaeological and environmental evidences:\textsuperscript{15}

1. The earliest Neolithic groups must have migrated to the southern parts of the Carpathian Basin from the Mediterranean. Representatives of this Early Neolithic culture were cultivating Mediterranean crops such as einkorn, emmer, spelt and barley and raised animals with a dominance of sheep and goat but cattle, pigs and dogs were also among the domesticated animals.

The Mesolithic groups (fig. 4) in the northern parts of the Carpathian Basin can be culturally linked to the regions of Western and Central Europe. These Mesolithic groups had a

\textsuperscript{13} Magyari 2002, Sarlóhát.
\textsuperscript{14} Magyari 2002.
\textsuperscript{15} Sümegi – Kertész 2001.
subsistence based exclusively on hunting and gathering, with a dominance of the former. Due
to their mobile lifestyles, these smaller hunter groups established seasonal settlements, with
summer and winter camps. The less expensive and thin occupation layers observed at these
camps indicate a low population density and brief, seasonal occupation.

Every creature, including the plants and animals domesticated by the Early Neolithic
groups, has certain habitat and environmental preferences. As such they can only be cultivated
and bred till their tolerance limits. Environmental factors such as prehistoric temperatures,
prefecitation, solar radiation during the growth season, the length of the vegetation period,
etc. had overall influence on the crops cultivated and the animals bred by the Earliest
Neolithic communities, as well as the prey animals of the hunter-gatherer communities. This
phenomenon is called the minimum limiting factor of Liebig.  

While utilizing the concept of the minimum limiting factor it were not only the
environmental components that have been accounted for but also the possible production
traditions and experiences of the Early Neolithic groups of the Carpathian Basin as well. With
the help of these they might have fundamentally determine and influence the possibilities for
production from the side of the society.

The area of the Carpathian Basin is characterized by large-scale mosaic-like complexity
regarding its climate and natural endowments in all three, micro-, meso-, and macro-scales. The
formation of a macro-scale mosaic patterning or complexity was due to the presence of
an overlap in three major climatic zones (Cf, BS, Df) in the region (fig. 5). This situation
is further complicated with a gently decreasing Continental effect from the east to the west
complemented by an increase in the Oceanic effect in the same direction. Furthermore an
increasing Sub Mediterranean influence from the north to the south and the presence of Sub
Carpathian–Carpathian influence in the hilly areas and mountains can be observed.

One of the most striking characteristics of the growth season in the Carpathian Basin is
its large-scale heterogeneity even in the seemingly homogenous area of the Great Hungarian
Plain (Alföld) as well (fig. 6). Both the length of the growth season as well as the average
temperatures, the accumulated quality of radiation along with the sunshine duration display
a gradual decrease from the south towards the north. These components of the growth season

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16 Liebig 1840.
influence not the limit or geographic boundary of production but rather the crop yields and the safe ripening of the produce. Thus the engagement in a Mediterranean type of agricultural production (growth of Mediterranean type of plants and animals) north of the central parts of the Carpathian Basin poses an increasing uncertainty regarding the possible crop yields and sometimes may lead to yield losses as well.

Nevertheless factors like soil, bedrock and hydrologic conditions are well known to affect fundamentally the possibilities for agricultural production. These latter components further enhanced the mosaic-like complexity of the climate and vegetation through their spatial variance.

Via the application of the minimum limiting factor concept of Liebig17 a theoretical barrier line could have been reconstructed referred to as the Central European–Balkanic Agroecological Barrier (abbreviated as CEB AEB), which fundamentally determined the northward distribution of Balkanic type neolithization during the Early Neolithic of the Carpathian Basin. However, a different type of minimum factor along each and every small segments of this line must have prevented the settlement of the Early Neolithic communities (fig. 7). For example despite the favourable strong Sub-Mediterranean climatic influence in the area of the Danube–Tisza Interfluve (high rates of accumulated quality of radiation and sunshine duration) soil and bedrock conditions (sandy soils) acted as some sort of limiting factors forming a barrier for agricultural production at the level of agro-technology of the period. This is a good example for the emergence of an agro-ecological barrier line. This theoretical line observable in the Early Neolithic was termed as the Central European–Balkanic Agro-ecological Barrier (abbreviated as CEB AEB) in mutual agreement with my archaeologist colleague Róbert Kertész.

The CEB AEB had a decisive influence on the northward advance of the Early Neolithic culture and its production economy in the Carpathian Basin. The Early Neolithic communities with a Mediterranean cultural background found themselves in an ecological trap on the marginal areas under Balkanic-type climatic and environmental influences. As a result their advance in the Carpathian Basin first slowed down and eventually halted along the CEB AEB. What was the effect of this on the Mesolithic communities with gathering–fishing and hunting lifestyles living north of this barrier? In order to get an answer to this question two important things should be pointed out.

17 Liebig 1840.
On one hand the Mesolithic hunters could get really close to the Neolithic farmers in space. This enabled the transmission of the Neolithic culture from one community to the other. On the other hand it is important to emphasize that due to the lack of conditions necessary for the creation of Balkan type agricultural production north of the CEB AEB, the Early Neolithic communities were unable to settle onto these areas. This gave some time to the Mesolithic communities to adopt the Neolithic technical and production innovations without actually assimilating culturally, economically or demographically into the Balkanic Neolithic communities. However, Mesolithic communities south of the CEB AEB fully assimilated into the Neolithic communities undergoing the whole neolithization process except for those places where possibilities for isolation were present for a shorter or longer time (e.g. The Iron Gate). Thus the CEB AEB played a crucial role in the formation of a totally different new Neolithic culture fully adapted and assimilating to the local conditions north of the boundary: the Linienbandkeramik Culture.

Archaeological and palaeoanthropological observations seem to indicate the existence of a secondary neolithization zone, a so-called adaptation zone along the line of the CEB AEB in the central parts of the Carpathian Basin, where the local Late Mesolithic groups could have resided next to the newly arriving Neolithic groups coming from the Balkans.18

However it must be noted, and this factor was not mentioned in our previous paper with Róbert Kertész,19 that this model explains the expansion of the Early Neolithic groups at a

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fig. 8. Early Neolithic sites in the northern boundary of the Balkan-Aegean culture

larger-scale embedding several thousand square kilometres, a scale of 1:1,000,000. Why is this important? Because it has been known ever since the discovery of the phenomenon of chaos that if the magnification or zoom is changed during the analysis of spatial distribution of a feature than we are faced with newer and newer principles and connections related to the different levels of reality. To justify this assumption let me present you a photograph of a piece of textile where you can get a good picture of the fabric from a considerable distance. However when we zoom into the picture only the thread pieces and later on the minor filaments of different colour can be deciphered at greater magnifications. At an even greater magnification we may be able to see the molecules building up the fibers. I think it's quite obvious now that we can see different interrelations at different scales or magnifications between the components of reality, thus the consideration of the scale in our maps for the analysis of the Early Neolithic or any other cultural groups is really important regarding the final outcome and theories of our studies.

The effect of this zooming and the importance of the scale are well observable in a study of the Agroecological Barrier and the spreading of Early Neolithic communities. However if we examine the distribution of Early Neolithic settlements at a greater magnification the previously seemingly unified picture falls apart and we are confronted with minor patches of island-like settlement clusters (fig. 8–9). At this scale the CEB AEB becomes discontinuous as well turning into a diffuse, complex zone of variable width. The same phenomenon can be observed in case of the line of Carpathian Basin Neolithization Zone situated north of the Agro-ecological Barrier. The spot-like distributions of the communities of the Körös and Starčevo cultures are clearly observable in the adaptation zone. In our view this zone enabled the formation of restricted local settlements alone due to the different environmental conditions. Such island or spot-like distribution points are the Starčevo sites of Tihany and Vörs or the Körös settlement sites of Tiszaszőllős, Kötelek.20

fig. 9. Sporadic Early Neolithic (Starčevo) sites on the loess-covered surfaces in the northern boundary of the Balkan-Aegean culture.

Neotectonic depressions and on the Holocene alluvia enabled the formation of such island-like settlements. In case of the site of Tihany we can speak about a real island-like settlement as due to the high lake level of Lake Balaton this peninsula used to form an actual island at the time. An exchange of information maybe groups of people as well might have emerged in the zone of adaptation between the two fundamentally different cultural groups. As a result of this the representatives of the local Mesolithic hunting-fishing-gathering communities by adopting the Neolithic technical innovations, settling permanently and engaging themselves in food production could have started a new cultural and economic wave preserving on one hand their own traditions and yet independent of the Mediterranean type of cultures and economies. The loess-covered Pleistocene lag surfaces, which can be regarded as islands ecologically speaking, must have had a crucial role in the enhancement of this process as they enabled the settlement of Neolithic groups in the green corridors accompanying the rivers and serving as summer hunting sites for the Mesolithic groups; i.e. their zone of infiltration. Thus the adaptation process must have taken place not in the whole of the zone but concentrated to the confined neighborhood of these loessy islands. The newly emerged Linienbandkeramik culture started its expansion from this zone of adaptation reaching further north in Central Europe and as far as the river Rhein, the northern parts of the German-Polish Lowlands and the river Dnester. However, the immigrant groups of the Starčevo, Körös and the Transylvanian Körös cultures underwent some sort of adaptation as well thanks to their different surrounding environment, as these cultural groups bearing Mediterranean cultural roots found themselves on the northern periphery of Balkanic and Sub-Mediterranean environmental influences in the Carpathian Basin and were forced to adapt to the local conditions in order to survive. Thus according to our findings the mosaic-like complexity of the environment in the Carpathian Basin played a fundamental role in the halting of the northern expansion of the culture with Mediterranean roots. Furthermore this highly complex mosaic-like environment must have enabled the development of an interaction between the Mesolithic and Neolithic groups and the adaptation of the technical innovations; i.e. the development of a new Neolithic culture within the Carpathian Basin independent of and totally different from the Mediterranean type.
Finally at the end of my presentation I would like to sum up the most important questions we touched upon and which have arisen in relation to the neolithization of the Carpathian Basin:

1) Did a former climatic change influence the emergence and spreading of the Neolithic civilization?
2) Why was the process of neolithization an expansional one? Could there be any environmental factors behind the expansion of the Neolithic culture?
3) Why did the advance of Neolithic cultures bearing Mediterranean roots halt in the Carpathian Basin? Are there any scientific results, which actually underlie the assumption that the Early Neolithic groups of the Carpathian Basin arrived from the Mediterranean, Balkan–Aegean regions? Can we justify from palaeoenvironmental data that the DVK (Transdanubian Linienbandkeramik) and AVK (Alföld Linienbandkeramik) sites located at the northern parts of the Carpathian Basin developed in a chronologically younger horizon than the Starčevo, Körös sites?
4) Can we identify a transformation in the production types and economy between the northern and southern parts of the Carpathian Basin, i.e. the Early and Middle Neolithic with the help of palaeoenvironmental tools?
5) Can we identify a mosaic-like complexity of the environment in a given area via the application of pedological, archaeobotanical and archaeozoological findings? Could the different climatic, soil, vegetation and hydrologic conditions act as limiting factors forming an ecological barrier in an area lacking any prominent geomorphological boundaries?
6) Must we really account for the scale or magnification of maps as factors influencing the final outcome of our interpretations during the course of investigations on the expansion of cultures and environmental factors?

REFERENCES

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Two different hypotheses exist about the steppe areas of the Hungarian Great Plain and about the generation of sodic soils occurring in these areas. According to the first scientific opinion, the plain territories — such as our sample area (fig. 1), Hortobágy — had become forested in the Holocene, and ancient loess steppe grassland patches occurring on the higher ridges were surrounded by closed forests, but sodic areas had not occurred yet.

The second hypothesis says that the Hortobágy could not have been covered by extended forests for longer times and salinization processes occurred since late Pleistocene, were continuous during the Holocene and pasturing cultures settling on the steppe and river control works of the 19th century have extended and stabilised sodic areas. According to the second hypothesis, salinization developed in the observed area as a consequence of connecting parent material, climatic and special geomorphological reasons.

As a representative of the first opinion, Székely detected a mild and wet climatic character in the Carpathian basin 7000 years ago, as a consequence of which oak became dominant in the forests. This was followed by the blooming period of the forests of the plain, with beech becoming dominant and generation of oak, hornbeam–oak vegetation types. Soils transformed into Luvisol. Neolithic cultures are estimated to have appeared in this period, bringing a sharp extension of anthropogenic effects, which, together with decreasing forested areas, resulted in the development of former Luvisol towards Chernozem soils.

Surveys of Alexandrovsky in a sample area of the North Caucasus also proved that, due to climatic changes during the Holocene, soil generation had also changed. The sample area observed by them may have been a cold, dry steppe or forested steppe around the early

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Holocene. Due to climate change, forest has extended and Chernozem soil, that had generated below the former steppe, has changed into Luvisol. The author says that a similar change also characterized the Great Russian Plain and Central Europe. Based on palaeobotanical data, the steppe period continued until the first half of the Holocene.

In connection with the question of treeless areas, Borhidi\(^3\) states that in the central parts of the Great Hungarian Plain climate in itself is not enough for maintaining forest vegetation. Historical documents suggest that, the rate of forested areas estimated from data from the 15th and 16th centuries could not exceed 30–40 percent. However, the author remarks that the Carpathian basin cannot be evaluated as one landscape unit and globally. He also states that the Great Plain is uniform neither climatically nor in a geological-pedological sense, its current mosaic type may be the mirror image of its postglacial diversity.

Contrary to these opinions, Bodrogközy\(^4\) states that, with steppe vegetation appearing, mainly Chernozem soil generation took place during the Holocene on the Great Plain. He estimates the appearance of sodic areas in the early Holocene, but explains their expansion by river regulations.

Nyilas and Sümegi\(^5\) took sedimentological and malacological surveys in a sample area of the Hortobágy. Based on these they state that the theory according to which the whole surface of the Great Plain – including Hortobágy – was covered by forests in the preboreal ages\(^6\) could not be confirmed by malacological investigations.

Szőör, Sümegi and Balázs\(^7\) took sedimentological and geochemical surveys on upper Pleistocene paleosol samples collected in the area of Hajdúság. Their results defined a kind of a steppe, made diverse by sodic patches. They state that salinization began not in the Holocene, but sodic soils may also have been generated already during the warm and dry interglacial periods of the Pleistocene.

As we could see above, soil generation processes of Chernozem and/or Luvisol in the Hortobágy during the Holocene, causes for salinization and the development of the sodic steppe as well as the transformation of soils are still open questions.

Negotiating between the two different conceptions and further analyses are highly important, considering the appreciation of the soil generation in the Hortobágy, since in the first case the generation of sodic soils can be followed back only for a few centuries, while according to the second opinion, sodic soils have been characteristics of the Hortobágy and the Great Hungarian Plain for thousands of years. Proving the different opinions and confirming the presence of sodic soils in the Holocene pose an extraordinary scientific problem.

The importance of soils in the reconstruction of the palaeoenvironment

Examination of soils could be one of the most important methods to solve this problem. The statement of Dokuchayev that “Soil is the mirror of the landscape” stands for palaeosoils, too. What can we mean by this statement? Soils develop on soil forming factors, under soil generation processes (pair of processes). Soil forming factors – geological conditions, relief, hydrogeology, climatic conditions, biological factors, the period required for soil generation and human effects – form a great overlap with the landscape components. Aggregated operation of soil forming factors, acceleration of some of these effects and the way they

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\(^{3}\) A. Borhidi: Kerner és az Alföld növényföldrajza mai szemmel (Kerner and phytogeography of the Great Hungarian Plain with a current view). Kanitzia 6 (1998) 7–16.


interfere always characterize the landscape formation and environment in a certain period. Based on that, palaeosoils – in case we know their age – can be good bases in reconstructing the palaeoenvironment.

In solving the problem, orientation among time levels (periods) means a difficulty. Archaeological excavations provide us information concerning one or two generations, some descend not more than a few hundred years. Vegetation changes follow the changes of the environment at a same pace or a bit more slowly. Geological changes, however, need much more time than mentioned above, for some processes thousand years may appear as seconds. Soil changes can be placed somewhere between vegetational and geological periods. We do not have enough information about how much time is required for the appearance of a differentiated pedon that can be described with genetical soil horizons.8

According to the current knowledge, simple, quick soil processes (dissolution of salts, initial leaching processes, carbonate moving inside the profile) need only one or two hundred years, while some thousand years are required for the development of a mature soil.9 It also means that short-range changes (climate changes, short time human actions etc.) cannot certainly be reconstructed in soil generation. Besides these, soil serves as a good indicator of long-lasting, constant changes.

A bigger problem is that – although some fixed, buried soils are known from the Pleistocene and earlier times – Holocene soil forms rarely get to the position when soil formation stabilizes and – for example by burying – previously generated soil characteristics engage. Recent soils have been continuously developing since the last loess formation periods and either climate, living beings or other soil forming factors change; soils are altering, continuously adapting to new conditions. According to the above-mentioned facts, one cannot confirm the date of salinization by observing current soils. Buried and intact Holocene soils are needed for deciding questions on soil history, such that have not developed after their generation and changed postgenetically as little as possible. Such buried soil strata can be found in the Hortobágy in the burial sites of Copper Age, kurgans.

Kurgans are also called “mounds of the Kumanian nation”, “mounds of the Tartars” and “mounds of the Turkish” in Hungarian. Kurgans are inestimable treasures of Hungary, are carriers of significant archaeological, landscape, botanical and pedological values.10 Their pedological value means that information can be gained from their observation concerning soil generation processes that passed during the time since their creation, characteristics of buried soil strata, and the environment of soil generation.

Since palaeosoils are also suitable for the reconstruction of the ancient environment, an aim of our work was to present the environment of the buried soil of the kurgan called Csipő mound in Hortobágy with the help of pedological investigations and identify the soil generation processes that took place since the building of the kurgan, and that which soil type suits the original soil stratum. In addition to pedological research, the reconstruction of ancient environment has been completed by malacological investigations.


Methods, materials studied
Coenological investigations\(^{11}\) and soil mapping with a Pürckhauer sampler\(^{12}\) were made on the kurgan selected called Csípő mound and its surroundings several times in 2000 and 2001. Due to the fact that kurgans are nature conservation areas in Hungary, in order to protect the kurgan and its valuable vegetation, samples were collected not from dug profiles, but we made network-mapping drills.\(^{13}\) Borings were made at 5-6 meters depth into the body of the kurgan and at 2 meters depth in the surroundings. The aim of the drillings, started from the top third of the kurgan, was to observe the material of the kurgan and the soil buried by the kurgan. The boring started at the foothill region of the kurgan at the supposed accumulation zone, aimed at reconstructing the area that was destroyed during the building of the kurgan. And the borings at a farther area of the kurgan were supposed to explore the areas that had not been (or had only been slightly) disturbed during the building of the kurgan. Drilled samples were split based on their morphology in accordance with soil strata, then malacological and soil investigations were made. Among soil examinations, CaCO\(_3\) %, total organic carbon (pyrolisis), humus % (Tyurin-method), pH (both H\(_2\)O and KCl), salt % and mechanical analyses were carried out.\(^{14}\)

Results, conclusions
Chernozem, Vertisol and Solonetz mosaics were identified in the area surrounding the kurgan. Mosaic shapes were determined by groundwater and micromorphology characteristics. Specific stratification could be seen within the kurgan.

Calcic Chernozem soil was determined on the top of the mound. Below the recent Chernozem soil, a culture stratum showing differing thickness, but homogeneous colour was found and it was followed in the core by the buried soil and its parent material.

A and B horizons of recent Chernozem soil mean dry habitats and can be characterised by humus and lime dynamics typical for Chernozem soils. Based on the colour and humus content (Table 1) of the culture stratum it can be stated that the kurgan itself was built from the rich organic materials of its surroundings. The high salt content of this spot may refer to the sodic environment equal in age to the building time of the kurgan. Based upon its colour, organic material and lime dynamics, the buried soil below the culture stratum shows a drier environment and slightly sodic, Chernozem type soil generation.

Molluscs were found in the top layer (Chernozem A horizon) of the body of the mound, in the buried soil and its parent material, and in two spots of the surrounding area (C horizon of the ring surrounding the kurgan and A horizon of the surrounding soil). Dry steppe species (Chondrula tridens, Cepaea vindobonensis) were brought to the surface from the buried soil by the cores from the centre of the kurgan. At this point, the humus content (2,3%), slightly alkaline pH and CaCO\(_3\) content (0,5%) of the soil reveals Chernozem soil formation. Species preferring slightly wet or alternating dry environments were found in the cores taken at the edges of the kurgan (Vertigo pygmaea, Helicopsis striata, Chondrula tridens, Vallonia pulchella, Cepaea vindobonensis). According to their characteristics, buried soils found here are similar to the previously presented ones, although, their pH was slightly higher (pH H\(_2\)O 9,4; pH KCl 8,2). As for the morphology, carbonate and humus contents of this soil show Chernozem-like soil generation, the accumulation of salts and parallel appearance of high pH. These may result from the growth of groundwater level that saturated the fixed palaeosoil after the building of the mound.

\(^{11}\) J. Braun-Blanquet: Pflanzensociologie II. Wien 1951.
The importance of pedological investigations

In the parent material, lime content increases (13%) and humus content decreases. In the covering soil of the body of the kurgan, species indicating the driest environment were found (Helicopsis striata, Chondrula tridens, Cepaea vindobonensis). The examined soil horizon corresponds morphologically (animal burrows, lime dynamics etc.) to the B horizon of Chernozem soils, which fact is also confirmed by soil analysis.

Examinations of soil texture during research in recent years have analysed the relation between salinization and parent material\textsuperscript{15}, which are proper indicators of certain soil generation processes (clay formation, lessivage etc.), too. Data of mechanical analysis in the material of the kurgan show a balanced loamy texture, that is, signs for clay formation, lessivage, strong leaching, acidification in pH, altogether forest soil (Luvisol) formation. Contrarily, an environment of steppe type, but mosaic, frequently effected by water and by salinization processes was reconstructed.

By determining the altitude (above sea level) of the drillings made on the body of the kurgan, the determination of the settlement of a loess type sediment, that serves as parent material of the buried soils, also became possible.

Parent material in the centre of the kurgan lays about 30-50 cm higher than in the drillings made at the edges (fig. 2). This supports the pedological and malacological results according to which the buried soil at the centre of the kurgan generated during drier conditions, and going towards the lower edges of the “hump” of the parent material, an area covered by water periodically or edged by wet habitats could generate. Therefore, the kurgan was originally built on a natural mound, not surprisingly, since it was the drier locations that served as proper burial sites in the environment often covered by water.

Species found farther from the kurgan (Planorbis planorbis, Anisus spirorbis, Oxyloma elegans, Chondrula tridens, Cepaea vindobonensis) refer to a water-edged, sodic and steppe type environment, thus mosaic area. Part of the soil samples taken from this area is Chernozem soil covering a slightly higher ridge, which emerges from the mosaic wet and sodic area as an island.

Pedological and malacological examinations can be well compared with botanical results.\textsuperscript{16} The dry loess grasslands harmonise well with the Chernozem soils generated on the top of the kurgan and with the dry steppe mollusc species. However, going towards the foothill region of the kurgan, loess vegetation varies with the species of the sodic pastures along stripes. Those ridges around the kurgan which contain mollusc species preferring both steppe and wet environments are well indicated in the botanical record by the patches of


<table>
<thead>
<tr>
<th>horizon (cm)</th>
<th>pH (H\textsubscript{2}O)</th>
<th>pH (KCl)</th>
<th>salt %</th>
<th>CaCO\textsubscript{3} %</th>
<th>TOC %</th>
<th>humus %</th>
<th>Mechanical analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0-20</td>
<td>7.72</td>
<td>7.06</td>
<td>0.07</td>
<td>2.29</td>
<td>7.19</td>
<td>3.43</td>
</tr>
<tr>
<td>B</td>
<td>20-110</td>
<td>7.8</td>
<td>7.4</td>
<td>0.2</td>
<td>2.31</td>
<td>6.33</td>
<td>2.63</td>
</tr>
<tr>
<td>k1</td>
<td>110-160</td>
<td>7.5</td>
<td>7.71</td>
<td>1.53</td>
<td>0.06</td>
<td>6.36</td>
<td>2.46</td>
</tr>
<tr>
<td>k2</td>
<td>160-320</td>
<td>7.25</td>
<td>6.81</td>
<td>1.35</td>
<td>0.07</td>
<td>6.12</td>
<td>2.82</td>
</tr>
<tr>
<td>k3</td>
<td>320-400</td>
<td>8.47</td>
<td>7.31</td>
<td>0.76</td>
<td>0.15</td>
<td>5.34</td>
<td>2.37</td>
</tr>
<tr>
<td>Ap</td>
<td>400-420</td>
<td>8.86</td>
<td>7.6</td>
<td>0.68</td>
<td>0.52</td>
<td>5.53</td>
<td>2.35</td>
</tr>
<tr>
<td>Bp</td>
<td>420-480</td>
<td>9.49</td>
<td>8.03</td>
<td>0.41</td>
<td>0.14</td>
<td>4.59</td>
<td>1.5</td>
</tr>
<tr>
<td>C</td>
<td>480-580</td>
<td>9.66</td>
<td>8.08</td>
<td>0.16</td>
<td>1.76</td>
<td>3.79</td>
<td>0.6</td>
</tr>
</tbody>
</table>

Table 1. Results of soil analysis from the core sample of the centre of Csípő mound.

A: recent soil A horizon; B: recent soil B horizon; k1, k2, k3: culture strata with anthropogenic origin; Ap: buried (palaeo) soil A horizon; Bp: buried (palaeo) soil B horizon; C: parent material of buried soil
Salvio nemorosae-Festucetum rupicolae Zólyomi ex Soó 1964 association and the protected Phlomis tuberosa. These ridges emerge only by 10–30 cm from the salt affected environment.

A typical plant association of lower areas is Artemisio santonici-Festucetum pseudovinae Soó in Máthé 1933 corr. Borhidi 1996, a sodic pasture plant association.

Based on the pedological, malacological and botanical data gained from the Csipő mound and its surroundings we can state that the kurgan was built in the Copper Age onto an existing loess ridge, which emerged from a wet area under salinization processes. Processes referring to forest vegetation existing in the area and this way referring to forest type soil formation can not be reconstructed during thousands of years passed. Soil generation processes represent processes towards Chernozem types. Current vegetation on the kurgan and in its surroundings show similarity with the vegetation present at the time of the building of the kurgan.17

17 The author thanks Pál Sümegi, Károly Penksza and Katalin Joó for their help during research and making their results available. The research was supported by OTKA T 038272.
SPACE AND GIS TECHNOLOGY IN PALAEOENVIRONMENTAL ANALYSIS
(Old maps, satellite images and digital elevation models in archaeology)

The analysis of the environmental status and the original, natural relief of study areas (prior to the water regulation works) their cartographic reconstruction is a high priority in archaeology. Palaeohydrological studies may support archaeological fieldwork, mainly on flatland areas. The aim of mapping the palaeohydrological status is to determine and locate all factors that have been governing the water transport of the study area, and detecting differences in water supply.

The most important is the absolute elevation of parts in the study area and the local elevation differences. Other important factors are the type and the quality of soil, but this can be hardly investigated by classic geographic information system (GIS) methods: satellite image analysis provides valuable ancillary information on them. Signs of old water channels that were active before water regulation works can be detected even in areas covered now by large cultivated fields, because their water supply is different from that of their surroundings owing to the different soil types. It is for this reason that these channel traces are made visible by their different vegetation type and density. Therefore, the most important databases for our investigations are: the digital elevation models and the medium- and high-resolution satellite images. Besides, it is possible to have a look at the natural status of the study area prior to and at the time of the river regulations on old maps.

In the present study I show the key databases used in constructing a GIS-based analysis of a flatland zone the Great Hungarian Plain in order to reconstruct the palaeohydrology of the study area. The ancient water system is crucial for the settlement and economic system of the civilization investigated by archaeologists: 1 water supply, the possibility of such as inundation, the defence capabilities, the extents of possible agricultural lands are very important factors. 2 Almost all of them are determined by the elevation, and can be studied by the described data sources.

Old maps based on systematic cartography
The reconstruction of palaeoenvironmental often requires old maps that were surveyed before industrialization, the water regulation measures and other major landscape-transforming human activities. The main requirement to these maps is that they have to fit to modern topographic ones without significant error. The very old maps, drawn before the introduction of the field geodesy, seldom meet this requirement. In Europe the 18th century brought about improvement when Cassini started the survey of France. In Hungary some county maps were surveyed by Sámuel Mikoviny between 1730 and 1750 but these maps did not form a contiguous

system. Some detailed maps of different parts of the Great Hungarian Plain have been made by Antal Balia. The first two large-scale map series resulted from the first and second military surveys of the Habsburg Empire, taken by the Institute of Military Geography of Vienna.

The first military survey of the Habsburg Empire was taken between 1783 and 1786, during the reign of Emperor Joseph II, and is often referred to as the 'Josephian survey' (Josephinische Landesaufnahme). The survey has no real geodetic basis albeit in that time a few triangulation campaigns were under way or completed. The colour survey sheets have the scale of 1 : 28 800 and each of them covers a 18206 by 12137 meters area. As the survey has been made for military purposes, the terrain cover signs mainly refer to the possibilities of the infantry and the cavalry; that’s why the riparian forests are mostly signed as swamplands. Fitting the map sheets to the modern topographic maps and thus their GIS integration can be made using similar points (ground control points). The precisition of this fitting varies within a wide range in Hungary: some sheets fits almost precisely (error is under 10 meters) while the neighbouring one may contain significant distortion and its fitting is burdened with an error of around one hundred meters.

The main advantage of this map system is that it is the first to be quasi-precisely fitted to modern maps and still shows the environmental conditions before the main water regulation measures in the Great Hungarian Plain and along the Danube. Regularly inundated areas are clearly marked along with ancient stream channels. This enables investigating the palaeohydrology of the Great Hungarian Plain even for Neolithic times (fig. 1).

fig. 1. Map sheet of Kisújszállás (1784), the Great Hungarian Plain. First military survey of the Habsburg Empire

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4 ibidem 134.
The second military survey of the Habsburg Empire has started in 1806 to the order of Emperor Francis I, so it is also known as the "Franciscan survey" (Franziszesche Landesaufnahme). It lasted till 1869 and most of the Hungarian Plain has been mapped between 1857 and 1863. The survey had a steady geodetic base, and despite of the lack of a standard geodetic equalization process, it can be parameterized for GIS purposes, along with the quasi-Cassini projection of the maps. Using these parameters, the map sheets with a scale of 1:28,800 can be projected to modern systems automatically or semi-automatically, with an error no more than 30 meters.

The survey period coincided with the river regulation works along the Tisza, the trunk river of the Great Hungarian Plain. In spite of this, the original river course of the Tisza is indicated with the planned dykes and cut-offs. The landscape changes between the first and the second military surveys can be interpreted as the result of different survey methodology rather than real differences. The sheets of the second survey are not only more precise from a cartographic point of view but contain also more details than the first one (fig. 2). This makes this map system the main cartographic tool in the palaeoenvironmental and palaeohydrological studies of the Great Hungarian Plain.

Modern databases: satellite imagery and elevation models

Modern topographic maps, aerial and satellite images and digital elevation models also bear some information about the palaeoenvironment. Compared to the old maps, modern ones retain just a few surface elements of the palaeogeography but the contour lines based on precise levelling mean a significant addition. This is almost the only data source available to compile high-resolution elevation models.

The use of aerial photographs in archaeology has a remarkable history. The knowledge of the shadowing effects and the colour changes caused by different soils resulting from the remains of old settlements or different water supply, are well-known among archaeologists, and therefore are beyond the scope of this presentation. Here I only mention that aerial photographs are mostly used to identify possible research sites, rather than to reconstruct the palaeoenvironment.

Compared to aerial photographs, satellite images offer a wide-scale view (of an area) but a worse resolution. As they are in digital format, a computer-based image processing is available to improve some details with great importance to our study. The most relevant palaeoenvironmental elements, well recognisable on satellite images, are the soil differences. Changes in vegetation cover usually refer to different soils, even in an intensive agricultural landscape. Abandoned river or stream channels can be easily mapped on those datasets (figs 3–4). In the following paragraphs, the Landsat Thematic Mapper, the SPOT XS/P and the Ikonos data are described.

NASA first launched a Landsat satellite with a Thematic Mapper (TM) instrument onboard in 1984. The system surveys the Earth’s surface from an altitude of 700 kilometres, the pixel (smallest image element) size on the surface is 30 meters. The instrument measures the surface reflectance in seven different channels (this means 7 independent colours). The size of a full image scene is about 6000 by 6000 pixels, or 180 by 180 kilometres. By now almost a full global coverage of original Landsat TM data, older that 10 years, is available without charge, so this data source is a very cheap method to gather information on the present environment, and

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to study some elements of the palaeoenvironment, too (fig. 3). Compared to the following two data types, it provides information with worse horizontal and better spectral resolution.

The French SPOT satellite system started in 1988. Its multispectral receiver (XS system) provides surface reflectance data on three channels with 20 meters of horizontal resolution. The resolution of the one panchromatic (P) band is 10 meters. As its horizontal resolution is significantly better than that of the Landsat, it provides more effectiveness in searching palaeogeographical elements (fig. 4) but these data can be only purchased.

The Space Imaging Ikonos system has produced a new class in satellite imagery. Its resolution (and also its small area coverage) makes it similar to aerial photographs. The colour resolution of the Ikonos is 4 meters while the panchromatic one is 1 meter (fig. 5). The data are very expensive and usually it is a better choice to buy airplane-based ortophotos for the study area than ordering the Ikonos imagery.

Besides the satellite images, digital elevation models provide a very powerful tool for palaeoenvironmental studies. The digital elevation model (DEM) is a raster image that covers a part of the Earth’s surface like a map, and its pixels contain the significant (usually the average) elevation of the covered part of the terrain. These models can be derived by numerous methods: using the original levelling data, digitizing the elevation contour lines of a map and use the digitized vertices as a model of the original levelling data or using spaceborne radars as the ones onboard of the ERS-1 and 2 satellites and the Space Shuttle (SRTM; see below) or using stereopairs. In the practice the contour line digitalization is the most used but also the most labor-consuming method. Nowadays, as the SRTM dataset is released, it can be used for applications that don’t need high accuracy. In the following these two methods are described.

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fig. 5. Space Imaging IKONOS image (4 meter resolution) of the vicinity of Tiszacsege. The pre-regulation course of the Tisza River is indicated by parallel lines. Three oxbow lakes, cut off prior to water control works, are indicated by letters.

Digitizing the map contour lines, and using the digitized vertices as simple three-dimensional samples, and generating an elevation model after using an appropriate interpolation method is a well known and widely used method. The quality of the resulting DEM is characterized by the scale and the vertical contour interval of the original map, and their horizontal and vertical resolutions. Usually these map properties determine the effective resolution both in a horizontal and a vertical sense.

On a flatland area such as the Great Hungarian Plain, a very fine vertical interval is needed to compile a useful DEM. Even using a contour interval of half meter (this is the maximum available to date), extensive areas remained totally flat on the model. At the areas having just a few meters of internal relief difference, such high-resolution DEMs provide shocking images, telling a whole story of the old stream structure\textsuperscript{15} (figs 6–7). Coupling these datasets with dating methods, e.g. radiocarbon and pollen analyses, even the age of the abandoned channels can be determined, thus reconstructing the palaeohydrology both in space and time.\textsuperscript{16}

Contour-based DEMs are quite expensive and in Hungary it is forbidden to make them from official, state owned maps without permission. They are based upon the country of the study area, and it is a complicated task to fit together DEMs of different qualities from neighbouring countries, using different geodetic bases and national map projection systems.


fig. 6. Contour based elevation model of the Polgár – Tiszadob area. The width of the image is 18 km, the height is 24 km. The relief difference of the Tisza meander belt is below 10 meters. Darker hue indicates lower altitude.

fig. 7. Contour based elevation model of the Köröszug (the confluence of the Tisza and Körös Rivers). Size of the depicted terrain is 24 × 24 km. The elevation difference in the floodplain is below 8 meters.
fig. 8. The central part of the Great Hungarian Plain on the Space-Shuttle-radar-based elevation model (SRTM). The areas of the previously presented elevation models are indicated by small rectangles. Note the abandoned channel system of the plain, even far from the present rivers.

The SRTM (Shuttle Radar Topography Mission) elevation dataset\textsuperscript{17} offers a solution to this latter problem. This data source is the result of a joint mission of the NASA, USGS and the German and Italian space authorities.\textsuperscript{18} The measuring campaign was carried out in February 2000, when a radar instrument onboard of the Space Shuttle Endeavour measured the majority of the Earth’s surface during its 11-days mission.\textsuperscript{19} The data processing took more than two years afterwards, and now the elevation of the area between the 60 degrees of northern and 57 degrees of southern parallels is to be published. The Eurasia data block was released in November 2003 providing a new level of global digital elevation data of the area of the Pannonian Basin, too.

The SRTM elevation dataset has three by three arc second horizontal resolution that equals a raster size of 90 meters. This improves the data quality of the SRTM by a factor of 10 compared to its predecessor, the GTOPO30 data.\textsuperscript{20} The vertical resolution is one meter, but the accuracy is not so good: as a radar-based elevation dataset, its surface model contains the elevation of the forests and buildings, too. It should be also underlined that in the regions of high relief the radar beam response cannot be evaluated from low-lying areas

because of the shadowing effect. Similarly, water surfaces produce non-valuable radar reflection signals, so they appear on the original SRTM images as zero rasters with no elevation. Fortunately, the elevations of water bodies are well known and the original images can be improved using these values.

This dataset covers the surface with homogeneous quality and methodology, not disturbed by national borders. Besides, these data are free and available on the Internet, which is a remarkable advantage compared to the contour-based models. On the flatlands, its resolution provides worse results, but even these images can be used for tracing palaeochannels of abandoned streams (fig. 8).

Summarizing the described methods, it should be underlined that satellite images and DEMs can be used together very effectively. Very flat areas (e.g. the Hortobágy, the central zone of the Great Hungarian Plain) shows no internal differences on a DEM but its soil differences can bee easily detected on a Landsat TM or SPOT image (fig. 4).

Combination of the datasets

The aim of such a combination is to have all the data in the very same map projection system. In case of the satellite images and any data based on modern maps, georeferencing is an easy task. As was mentioned before, some of the old maps can be rectified by ground control points or by estimating the parameters of their projection and geodetic base (if there was any). Moreover, the

knowledge of the used map signs and area coding is also necessary. After converting our data to a common system, it is possible to overlay these maps and satellite images, or even to make bird's-eye-views using e.g. the old maps. In the practice, coupling the second military survey map sheets with the high-resolution elevation models proved to be the most useful combination, resulting in a 'palaeoenvironmental map' (fig. 9).

Conclusions

Although the environment has changed significantly during the very last centuries, some key elements can be found and analyzed in modern databases. The most important environmental factors are connected to the ancient water supply and local elevations: multispectral satellite images and high-resolution digital elevation models are capable to map them. In addition to these databases, the analysis of old maps brings us back some centuries closer to the unchanged 'palaeoenvironment'. Some of these data sources are now partially free and available on the Internet, providing an almost global cover, making the GIS support of palaeoenvironmental studies an extremely low-cost option.22

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22 The presented research activities are supported by the Hungarian Space Office and the Ministry of Informatics and Telecommunication (Project TP094). The author is extremely grateful to Pál Sümegi and Imola Juhász (University of Szeged and Archaeological Institute of HAS) for their patient help to introduce him to the very basics of the archaeological analyses. The digital elevation models on figs 6-7 have been compiled based on topographic maps whose content is owned by the Institute of Geodesy, Topography and Remote Sensing (FÖMI) with its permission.
THE LAST GLACIAL CLIMATE, ENVIRONMENT AND THE EVIDENCE OF PALAEOLITHIC OCCUPATION IN VOJVODINA PROVINCE, SERBIA: AN OVERVIEW

At the end of the last interglacial, over 100 ka ago, Earth’s climate switched into a colder, glacial mode. The last glacial was punctuated by a series of large and abrupt climatic changes. During this, generally cold and climatically unstable period, humans finally occupied the whole European land.

The Vojvodina region is situated in SE part of Carpathian (Pannonian) Basin. This area is a low land of the Danube, the Tisa (Tisza) and the Sava rivers’ interfluve. The largest part of the Vojvodina region has been covered by various types of last glacial sediments. In spite, of their large spreading and considerable diversity of last glacial deposits which represent different environmental conditions until now known evidence of human occupation is very poor and incomplete. This study summarized recent advances in chronostratigraphical, palaeoclimatic and palaeoenvironmental interpretations as a time and palaeogeographical framework for archaeological evidence during the last glacial period in the Vojvodina region.

Chronostratigraphy

Classical Pleistocene subdivisions are based on climatostratigraphic criteria. The basic climatostratigraphic units are glacial and interglacials. High-resolution studies on deep-sea sediments and ice-cores indicate abrupt palaeoclimatic oscillations during the last glacial period. These abrupt climatic changes are interpreted to have affected the Northern Hemisphere as well, and more specifically Europe. Among the available terrestrial sequences likely to register such oscillations, loess sequences, corresponding to eolian deposition in periglacial environments, can provide easily accessible high-resolution records. Signatures of the last glacial abrupt climatic fluctuations provided a reliable basis for a very detailed millennial chronostratigraphy.

During the last glacial period the SE part of Carpathian Basin is known as a periglacial area with intensive loess accumulation. Names of the loess-palaeosol units follow the Chinese loess stratigraphic system. The chronostratigraphy of the last glacial cycle loess-palaeosol sequences of the Vojvodina region based on Amino-acid racemization (AAR), luminescence and radiocarbon geochronology have been presented in several recent studies. According to that chronostratigraphic model, the last interglacial–early glacial palaeosol S1...
fig. 1. Correlation between the low field magnetic susceptibility records of Titel, Stari Slankamen, Irig and Ruma loess-palaeosol sequences and SPECMAP δ¹⁸O series correlates with Marine isotope stage⁶ (MIS) 5. This palaeosol is overlaying by composite loess horizon L1 correlating with MIS from 4 to 2. The structure of the last glacial loess L1 is differently exposed at loess sites in the Vojvodina region. The older loess sub horizon L1L2 is accumulated above palaeosol S1. The Middle Pleniglacial is represented in our region by a weakly developed cheronzem soil L1S1, which appears either as a complete pedohorizon (Ruma and Neštin sites), or as a double (Irig, Petrovaradin, Batajnica) or triple pedocomplex (Stari Slankamen). However, palaeosol L1S1 in several exposures (Mošorin and Titel) is not exposed. The youngest loess layer L1LI accumulated during the Upper Pleniglacial period. Detailed low magnetic susceptibility variations detected in Vojvodina’s loess-palaeosol, support correlation with the delta oxygen variations of SPECMAP palaeoclimatic model (fig. 1). Grain size evidence revealed many episodes of cold-dry and warm-wet palaeoclimatic conditions, indicating a possible relationship with the Daansgard-Ochger cycles.

The generalized chronostratigraphic model of the last glacial cycle loess-palaeosol sequences in the Vojvodina region is shown at fig. 2.

The last glacial loess-palaeosol sequences are also stratigraphically related to the other dominant type of the last glacial deposits in the Vojvodina region, cyclic sediments of river terraces.

**Palaeoclimatic and palaeoenvironmental interpretation**

The reconstruction of palaeoclimatic and palaeoenvironmental conditions during the last glacial period in the Vojvodina region is interpreted on the basis of sedimentological, magnetic and malacological evidence from the following loess exposures: Mišeluk, Petrovaradin, Irig, Ruma, Stari Slankamen, Batajnica, Titel, Mošorin and Orlovat.

The Vojvodina loess-palaeosol sequences accumulated continuously and completely recorded climatic and environmental oscillations during the last glacial period. Generally, Vojvodina was the driest and the warmest part of the Carpathian Basin during the last glacial period. Palaeoenvironmental reconstruction suggests the dominance of a steppe vegetation, ranging from a relatively humid and thick grassland to dry cold steppe environments. A summarized reconstruction of palaeoenvironmental changes during the last about 110 ka is presented in fig. 3.
The last interglacial–early glacial period of investigation area, characterized by continuous pedogenesis of palaeosol S1. Palaeopedological data derived from this palaeosol indicate moderate to warm steppe environment. An early glacial trend of cooling caused palaeoclimatic instability, detectable in five dust peaks correlated to events from C21 to C24 in the North Atlantic region.\(^7\)

Intensive loess deposition began at about 75 ka and terminated during the late Pleistocene-Holocene transition, including two periods of enhanced accumulation at about 70–50 and 30–10 ka. Loess deposition was interrupted by the formation of a weakly developed steppe pedohorizon.

At a number of localities in the Vojvodina loess plateau, the boundary between palaeosol S1 and overlying loess unit L1 is sharp. The colour, granulometric composition, carbonate content and low field magnetic susceptibility change abruptly. The oldest of the last glacial loess layer L1L2 recorded late early glacial and lower Pleniglacial palaeoclimatic oscillations. Grain size distribution of loess L1L2 contains signatures of several periods with intensive air circulation, probably related to Heinrich events (HE) 5 and 6\(^8\) as well as cold periods.

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fig. 4. Morphological map of Vojvodina province with geographical position of Palaeolithic archaeological sites and main loess exposures

C18 and C20. Loess horizon L1L2 is mainly characterized by a dominance of aridity tolerant open vegetation and the temperate land snail species Helicopsis striata, Pupilla muscorum, P. triplicata and Vallonia costata. This is typical assemblage of “warm” loess steppe environment called $H. striata$.\textsuperscript{9} Alternating presence of termophilous species (e.g. Chondrula tridens, Granaria frumentum) and cryophilous taxa such as Vallonia tenuilabris reflected short time palaeoclimatic oscillations. Findings of a woolly mammoth ($Mammuthus primigenius$) skeleton fragments at the base of loess layer L1L2 of Mišeluk and Ruma sites,\textsuperscript{10} add to the palaeoecological picture of Vojvodina’s lower Pleniglacial environment.

The middle Pleniglacial temperate warm and relatively humid climate was detected in the increase of clay content and low magnetic susceptibility values. These palaeoclimatic changes have initiated the pedogenesis of a weakly developed steppe soil complex L1S1. Dependents of local conditions of Interpleniglacial palaeosol L1S1 have been developed as the continuous, double or triple pedocomplex. In the driest parts of the Vojvodina region this palaeosol is not exposed. Loess sub layers intercalated into the L1S1 pedohorizon preserved evidence of a sudden cooling related to HE 4 and 5.1. Land snails detected in weakly developed palaeosol L1S1S1, L1S1S2 and L1S1S3 provided presence of an equivalent of a $Chondrula tridens$ fauna\textsuperscript{11} with some euritermic elements as Euomphalia strigella, Truncatellina cylindrilica and Cochlicopa lubrica. Poor snail fauna of intercalated loess inter-layers L1S1L1 and L1S1L2 presents a dry and relatively cold environment indicated by the presence of the cold loving species Vallonia tenuilabris.

The uppermost loess stratum L1L1 contained detailed evidence of lower Pleniglacial palaeoclimatic fluctuations. Low values of magnetic field susceptibility and clay contacted as well as high values of carbonate content and a dominance of coarse grain size fractions demonstrated the coldest palaeoclimatic event of the last glacial period. The three episodes of prolonged accumulation of the coarsest grain size fractions could be associated with cold episodes related to HE 1, 2 and 3. Composite mollusc of loess unit L1L1 association large diversity of environment from open grassland to closed boreal forest ecotones. Presence of the frigophilus species Columella columella, Vetricina parcecuta, Vallonia tenuilabris and Aegopinella ressmani reflected the coldest palaeoclimatic conditions related to the last glacial maximum period.

\textsuperscript{9} Ložek 1964.
\textsuperscript{11} Ložek 1964.
Fossil mollusc assemblages also provided precise information about local palaeoenvironmental conditions. The land snail assemblage from the loess belt around of Fruska Gora mountain represents sharp environmental differences. The mollusc association from the north slopes of Fruska Gora mountain shows more humid and relatively colder environment than in other sites in Vojvodina region and indicated that the northern slopes of the Fruska Gora mountain played an important role during the late Pleistocene. It was a kind of refugial area; it is one of those rare places on the Southeast part of Carpathian Basin, where the Palaeopreillyrian snail assemblage survived (Aegopinella ressmanni, Ena montana and Euophallia strigella). In the contrast of that composition of mollusc fauna suggest that investigated area, parts of the southern slope of the Fruska Gora mountain range, was a refugium for warm-loving and xerophilus mollusc taxa, where these elements could survive during the unfavourable climate periods of the Late Pleistocene. It is reflected in the continuous presence of Granaria frumentum specimens in the loess samples.

The evidence of middle and upper palaeolithic occupation

Human presence during the last glacial period in Vojvodina is evidenced by Middle and Upper Palaeolithic artefacts found in the several open sites. The Palaeolithic sites are grouped on the Bačka’s and Srem loess plateaus as well as in Vrsac and its surroundings (fig. 3). Only two sites, Crvenka-At and the Petrovaradin fortress were archaeologically investigated. The Palaeolithic finds are also known from the following localities: Kozluk, Balata and Mesić channel near Vrsac, Cigan near Iriš and the site on of river Danube bank under 20 m thick loess cliff near Zemun. General archaeological data about Vojvodina’s Palaeolithic sites are summarized in Tab. 1.

The Middle Palaeolithic of Vojvodina region has been reported only from the Kozluk and Cigan-Iriš sites. This changed at the end of 2003 during the routine protection excavations at Petrovaradin fortress. The investigations included two Middle Palaeolithic layers. About two hundred artefacts were collected at the upper, darker horizon of the initial pedogenesis, that contains mainly chipping products, which include: Levallois flakes, transversal scrapers, denticulated tools, retouched flakes and quartz tools. According to the preliminary stratigraphical interpretation this horizon could be related to the Middle Pleniglacial soil L1S1. In the lower loess stratum which probably is equivalent to loess unit L1L2 correlated with MIS 4 poor Middle Palaeolithic industry was identified with massive bifacial side-scraper and back resembling tools, related to the Micoquian of the Central Europe. However, it is too early to draw precise conclusions about the cultural belongings of these Middle Palaeolithic industries.

The most detailed information about Upper Palaeolithic in the SE part of the Carpathian Basin has been revealed after the excavations of the Crvenka-At site near Vrsac. During the exploitation of the raw material at the local quarry more than two thousand Aurignacian finds were collected. The stratigraphic position of these artefacts was confirmed after systematic excavations made by I. Radovanović in 1984. The Upper Palaeolithic artefacts from the Crvenka-At site could be related to the typical Aurignacian culture from the Krems Dufour site. This kind of Aurignacian industry is also well documented from sites in the Romanian part of the Banat region: Kosava, Tincova, Romanești Dumbravita. The artefacts identified at Crvenka-At include: blades from massive single-

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<table>
<thead>
<tr>
<th>Site Nr. and name</th>
<th>Description</th>
<th>Culture</th>
<th>Stratigraphic position</th>
<th>Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Cigan-Irig</td>
<td></td>
<td>Middle Palaeolithic</td>
<td>Unknown</td>
<td>Unknown</td>
</tr>
<tr>
<td>2. Kozluk</td>
<td></td>
<td>Middle Palaeolithic</td>
<td>Unknown</td>
<td>Unknown</td>
</tr>
<tr>
<td>3. Petrovaradin fortress</td>
<td>About 200 artefacts mainly chipping products: Levallois flakes, transversal scrapers, denticulated tools, retouched flakes and quartz tools from darker layer of initial pedogenesis. Massive bifacial side-scraper and back resembling tools from lower loess horizon</td>
<td>Micoquian</td>
<td>Probably lower part of palaeosol L1S1 and Loess layer L1L2</td>
<td>Loess steppe and temperate grassland</td>
</tr>
<tr>
<td>4. Crvenka-At</td>
<td>About 1500 artefacts: chipping technology tools, single platform cores, carinated and nosed end-scrapers and blades</td>
<td>Typical Aurignacien</td>
<td>Late Pleistocene fluvial sand loess layer depth.</td>
<td></td>
</tr>
<tr>
<td>5. Stara Moravica</td>
<td>Open air site, fireplace with charcoal remains of Pinus montana and Picea excelsa with bone tools</td>
<td>Gravettien and Epigravettien</td>
<td>In the base of the youngest loess layer L1L1 close to contact with interstadial palaeosol</td>
<td>Loess steppe</td>
</tr>
<tr>
<td>6. Pačir</td>
<td></td>
<td>Gravettien and Epigravettien</td>
<td>Unknown</td>
<td>Unknown</td>
</tr>
<tr>
<td>7. Mesić kanal</td>
<td>Several stone tools</td>
<td>Gravettien and Epigravettien</td>
<td>Unknown</td>
<td>Unknown</td>
</tr>
<tr>
<td>8. Zemun</td>
<td>Site on of river Danube bank under the 20 m thick loess cliff near Zemun. About 7 artefacts: backed points and bladelets, shouldered points and numerous short, thumbnail and circular scrapers</td>
<td>Gravettien and Epigravettien</td>
<td>Unknown</td>
<td>Unknown</td>
</tr>
<tr>
<td>9. Vatin</td>
<td>Bone artefacts</td>
<td>Upper Palaeolithic</td>
<td>Unknown</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

Table 1. Overview of Middle and Upper Palaeolithic sites of Vojvodina province

Platform cores, carinated, nosed and core-like end-scrapers, blades and different types of burins. Dufour bladelets and Krems type points were not found at this locality, but several cores for the production of bladelets were collected. Similar Aurignacian industry was also found at the Balata site, near Vršac.21 Evidence of Gravettian and Epigravettian cultures have been documented at the Mesić channel site near Vršac,22 at loess exposures of the brickyards at Pačir and Stara Moravica with traces of fireplaces23 and at the site on the bank of the Danube river under a 20 m thick loess cliff near Zemun with a large number of artefacts that included: backed points and bladelets, shouldered points and numerous short, thumbnail and circular scrapers.24

Human Palaeolithic remains have been discovered from Bački Petrovac, Žitište and in a loess exposure of unknown position in the vicinity of Belgrade. In Bački Petrovac and Žitište, the parts of two mineralized skulls, identified as Homo sapiens fossilis, have been discovered.25 After recent investigations, a human mandibula was found in the loess exposure.

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in the vicinity of Belgrade identified as a *Homo sapiens* probably belonging to the Upper Palaeolithic European population.26

**General remarks**

Sedimentological, pedological, magnetic and palaeontological evidence all suggest the appearance of gradual palaeoclimatic cooling trend during the last 100 ka in the Vojvodina region. This period has characterized by two temperate phases related to the Early Glacial and Middle Pleniglacial glacial as well as two cold stages correlated to the Lower and Upper Pleniglacial. Many of the detected short time climatic oscillations have not changed environmental conditions dramatically. The general palaeoclimatic overview of the last glacial period has demonstrated that Vojvodina was the driest and the warmest part of the Carpathian Basin.

Changes in the Molluscan assemblages refer to mosaic biotopes with a dominance of grass vegetation, ranging from relatively humid and warm to dry and temperate cold environments.

The poorly known Palaeolithic evidence of the SE part of the Carpathian Basin can be regarded as one of the missing links in the understanding of the last glacial human occupation of Europe. However, some initial results of archaeological investigations look very promising. Archaeological evidence from the Petrovaradin fortress and Crvenka-At sites indicates a cultural unity in the Carpathian Basin during the Middle and Upper Palaeolithic. The details of human occupation of the Vojvodina region before the Aurignacian, during the earlier Upper Palaeolithic Szeletian stadium and Middle Palaeolithic cultures related to Micoqian, Jankovichian or Babonyian, are still unsolved. The results of sedimentological and malacological investigations and the measurement of luminescence absolute ages of loess sequences of the Petrovaradin fortress locality will provide more detailed information.

The late Middle Palaeolithic in the Vojvodina region is characterized by Levallois technology with the usage of local materials, same as in the northern parts of the Carpathian Basin.

Some areas, such as the slopes of Vršac’s mountains, were intensively and continuously occupied during the whole Palaeolithic period, from Mousterian (Kozluk) and Aurignacian (Crvenka-At, Balata) to Gravetian (Mesić kanal) times.

The Danube corridor was the main transit route of modern human colonization of Central Europe.27 The special position of the SE part of the Carpathian Basin, between the well-studied western and eastern European Middle and Upper Palaeolithic sites, establishes this region as an important link in the understanding of cultural and chronological relations between central European and Mediterranean intermediate Gravetian and Epigravetian backed tool industries, especially because the investigated area and the north Balkan are characterized by a small number of well studied Palaeolithic sites (Kadar in the north Bosnia, Salitrena cave in Serbia, Climente I and II in Iron Gate, Temnata cave and Bacho Kiro in Bulgaria).28 Because of that, the investigations of the last glacial archaeological sites in Vojvodina province will present a great challenge for scientists, providing significant possibilities in the reconstruction of human occupation in this region as an important fragment contributing to the Palaeolithic mosaic of Europe.

### REFERENCES

<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>Reference</th>
</tr>
</thead>
</table>
CHANGES IN VEGETATION AND CLIMATE IN EASTERN AUSTRIA FROM THE MESOLITHIC TO THE BRONZE AGE: REASONS FOR THE MIGRATION OF NEOLITHIC POPULATION?

One of the most important steps in the history of man was the development from a hunting and gathering lifestyle to agriculture and stock-farming. This only formed the base of our economic system.

The question why people started to cultivate crops and to breed animals is hard to answer. The Greek poet Hesiod understood agriculture as a god’s gift. The opinion of modern archaeologists, archaeobotanists and archaeozoologists is, that this process started with the climatic improvement at the end of the last glacial period in form of an evolution demanding several thousand years. Many questions are still open concerning the reasons the ways of the expansion of Neolithic cultures, the relationship between the Mesolithic population and the migrating earliest Neolithic groups etc. The interdisciplinary symposium “Environmental Changes under the Neolithization Process in Central Europe: before and after” at Budapest tried to find some answers to these questions.

The first groups of the Older Linearbandkeramik (LBK) culture arrived in Eastern Austria not earlier than 5500 cal BC. Are there any environmental factors causing the immigration of these groups to Eastern Austria? The interpretation of palynological data enables us to describe the environmental changes in time and to recognise the relationship between people and vegetation. This paper summarises the development of vegetation in Eastern Austria and tries to find an answer to the above mentioned question.

The distribution of the Mesolithic and the first agricultural cultures in Austria

The Mesolithic period

Mesolithic finds are known from all Austrian provinces (fig. 1). They consist mainly of different numbers of silex; tools of bones and antler are rare. Remnants of Mesolithic sites have been found along the rivers Rhine, Salzach, Kamp and Danube. The summer camps lie in not forested sandy areas nearby the river banks (e.g. Bisamberg [Lower Austria] and Maxglan [Salzburg]). During the winter time the groups preferred places in some distance from the rivers, where they could find refuge in caves (Halbhöhle) and below ledges (Felsöhle, Balmen, Abri sous roche) like at Kobloch (Vorarlberg), Pass Lueg (Salzburg) and Griffen (Carinthia). The finds from Kamegg and Limberg (Kamp valley [Lower Austria]), Hirschbichl and the oldest grave (8000 cal BC) from Zigeunerhöhlen near Elsbethen (both Salzburg) belong to the Early Mesolithic. The sites in Vorarlberg (Kummenbalme and Rheimbalm) are dated to the second half of the 6th and the beginning 5th millennium BC, the time when the first Neolithic groups immigrated into Eastern Austria. Mesolithic people have been also penetrating the high mountains. The sites here, however, are not as numerous as in the Southern Alps. Nevertheless several sites are known between 1500 and 2300 m a. s. l. mainly in pass, saddle or shoulder locations: Hirschbichl in Defreggen (Eastern Tyrol), Ullafels in Fotscher valley and two sites in Rofen valley (both Tyrol) and finally sites in the Klein Walsertal.

3 Urban 2000.
The earliest Neolithic groups immigrated from SE to Eastern Austria (fig. 1). The settlements are located mainly near rivers or lakes. The new population took care that water, fertile soils and appropriate timber for house construction and for tools were present. The distribution area of the older Linearbandkeramik (LBK, so-called Vornotenkopfkultur, 5480–4920 cal BC) coincides with that of loess from the Burgenland to the Kamp valley in Lower Austria. The most important sites are Rosenburg and Stroggen near Horn, Brunn am Gebirge near Mödling (all Lower Austria) and Neckenmarkt. During the younger LBK (Notenkopfkultur, 5280–4520 cal BC) the settled area expanded to the S, N and NW. Beside further sites in Lower Austria (Asparn an der Zaya, Poigen and Gutenbrunn NE Herzogenburg), one site was found in Burgenland: Winden am See. In the second half of the 5th millennium, Neolithic culture expanded rapidly and reached the Drau–Save area in the S and Upper Austria, Salzburg and Bavaria in the N and NW.

The Late Neolithic and Bronze Age
With the beginning of the Late Neolithic period from 4200 cal BC onwards, the population penetrated the inner Alps and colonised the Inn valley up to 1800 m a. s. l., Western Styria and the Drau valley in Carinthia. The density of the population increased continuously and reached a first maximum during the Bronze Age (2000–800/750 BC), when copper ore in the Grauwackenzone of the Central Alps became very important.

Vegetation development (fig. 2–4)
There are several palynologically investigated localities in Eastern Austria. Unfortunately, most of them are without any radiocarbon dates, do not contain the time window in discussion, are not investigated in detail, or they are located too far from the settled area. Moreover, the

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area populated by Neolithic groups is located in the north-eastern and eastern lowlands, outside the previously glaciated area and is therefore poor in sites usually suitable for palaeoecological research.

Consequently only three pollen profiles are at our disposal (fig. 1):
- Längsee (548 m a. s. l.) is located in the Krapp–Feld, Carinthia. The lake is close to the Würmian pleniglacial ice margin and owes its origin to a dead ice block. The results of interdisciplinary investigations have been published by Schmidt et al.\(^7\)
- The pollen profile Rohr-Heugraben (284 m a. s. l.) has been cored in a mire in the Zickenbach valley in Burgenland. The site is influenced by the small river Zickenbach, therefore the sediments are changing several times from clay to sedge peat and back. First results are published by Drescher-Schneider and Wick.\(^8\)
- Lake Leopoldstein (680 m a. s. l.) is located between the Eisenerzer Alps and the Hochschwab massif on the southern border of the Northern Calcareous Alps. Investigations have been carried out in connection with the archaeological excavation of a copper mining place in the Eisenerzer Ramsau.\(^9\) The lake sediments consist mainly of clay during the Late Glacial and of lake marl during the Holocene.

The time scale of the pollen diagrams is based on the \(^14\)C-dates published in the original literature and is indicated on the left side of the diagrams in figs 2–4. The consequence of the calibration\(^10\) is in some cases a greater deviation than the \(^14\)C-measurement indicates. In the

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\(^7\) Schmidt et al. 1998.
fig. 3. Reduced percentage pollen diagram of Rohr-Heugraben
ease of more than one intercept age the time scale of the pollen diagrams, changes depend on
the chosen intercept age. Consequently, the time scales presented here may differ from the date
presented in the original literature.

**LATE GLACIAL**

For the period between the Last Glacial Maximum and the beginning of the Late Glacial
there are no reliable data. In three pollen diagrams from Carinthia (Längsee, Jeserzer See, Stappitzer See) some indications can be found that ameliorated climatic conditions between
17 000 and 15 000 uncal BP initiated a first expansion of shrubs and timber-line tree species
such as pine, stone pine, larch and spruce.

Before the beginning of the Late Glacial Interstadial (12 600 cal BC) alpine meadows and
scrubby vegetation with juniper, dwarf birch and willow were dominant. With the beginning of
the climatic improvement, the vegetation changed for a few centuries into an open birch forest.
At the lower altitudes of Eastern Austria the vegetation during the Late Glacial Interstadial
(± 12 500 – ± 10 700 cal BC) was dominated mainly by pine forests. *Pinus cembra* – the
subalpine stone pine was frequent. *Pinus mugo* probably was present too. The mean value of
the AP (arboreal pollen) is around 85%, a sign of rather open forests.

The climatic deterioration during the Younger Dryas (± 10 700 – ± 9600 cal BC) was not
able to distort the forests, but the timberline was depressed and stands on good drainaged soils
(e.g. sand) were strongly damaged mainly by aridity.

**HOLOCENE**

During the early Holocene (Preboreal, ± 9600 – ± 8000 cal BC) the forests were still quite
open in the whole area. The species composition of the woodland developed in different ways
in the three regions:

11 Schmidt et al. 1998.
12 E. Schultze: Neue Erkenntnisse zur spät-
und frühpostglazialen Vegetations- und
Klimaentwicklung im Klagenfurter Becken.
13 A. Fritz – F. H. Ucik: Klimageschichte der Hohen
Tauern. Spätwürmzeitliche und postglaziale
Klima- und Vegetationsentwicklung in den
dern südlichen Hohen Tauern (Ostalpen, Kärnten).
Ergebnisse der Bohrungen am Stappitzer See bei
Mallnitz. Wissenschaftliche Mitteilungen aus dem
- In the lowlands of Carinthia spruce, hazelnut and elements of the Mixed Oak forests, mainly elm and oak, expanded very rapidly and dominated the forests already a few decades after the end of the Younger Dryas. Beech and fir started to immigrate before 8000 BC.
- In the lowlands of Burgenland, pine and birch were still dominating while spruce, elm, hazelnut immigrated and expanded slowly.
- At lower altitudes of the Northern Calcareous Alps, birch and pine were dominating, but spruce and elm already were frequent.

During the Older Mesolithic (Boreal, ± 8000 – ± 7000 cal BC) the southern and southeastern lowlands were covered by spruce forests characterised by hazelnut as an integral component of the woody cover. Beech started to invade these forest types. In Eastern Tyrol (Hirschbichl, fig. 1), single larches and stone pines reached the high altitude of the Mesolithic site (2140 m a. s. l.) at around 8500 cal BC, but the vegetation cover was still dominated by subalpine grasslands and Alnus viridis and Pinus mugo scrubby woodland respectively. At lower altitudes of the calcareous Alps, the pollen percentages of hazelnut dominate absolutely – as is known from large areas of Central Europe.

During the Younger Mesolithic (± 7000 – ± 5600 cal BC) the woodlands reached their maximum density.
- In the south-eastern lowlands, fir, yew-tree and hornbeam penetrated established mixed lime- or beech-forests.
- In higher altitudes of Eastern Tyrol, spruce-forest with stone pine and larch reached the area of the Mesolithic station at Hirschbichl.
- In the Northern Calcareous Alps, spruce dominated just as in the central Eastern Alps, but was accompanied by elm, lime and oak in the canopy.

The start of the Neolithization in eastern Austria coincides with the dominance of the lime-elm-oak-mixed woodland.
- In the south-eastern lowlands, yew is the characteristic associate of a second shade tolerant tier,
- whereas in the southern part of the Eastern Alps, mixed beech-fir-spruce-forests dominated the montane belt.
- In the Northern Calcareous Alps, spruce-fir-mixed woodlands with associated elm and maple in the canopy were widespread.

During the Early and Middle Neolithic period the diversity of woodlands was the highest during the entire Holocene and pollen diagrams give the impression of most favourable climatic conditions.

From about 3600 cal BC onwards during the Late Neolithic and Bronze Age in the submontane and montane altitudinal zone of the Eastern Alps beech was dominating or at least co-dominating the canopy,
- whereas in the valleys of the central Alps spruce is the dominant tree-species in the woodland.
- In the more continental lowlands of Burgenland and southeastern Styria, oak–hornbeam mixed woodland on deep soils was the dominant forest type, fir- and beech stands were restricted to N-exposed slopes.

**Climatic development (Table 1)**

Beside the Late Glacial climatic changes, known for a long time, Zoller\(^\text{15}\) described Holocene fluctuations in the Canton Tessin (Switzerland). Later on Patzelt and Bortenschlager\(^\text{16}\) published the first summary of Holocene climatic oscillations by interpreting the advances

\(^{15}\) Zoller 1960.
### Table 1: Survey of vegetation and climate development in Eastern Austria

<table>
<thead>
<tr>
<th>Climate Zone</th>
<th>Mediterranean</th>
<th>Atlantic</th>
<th>Continental</th>
<th>Subboreal</th>
<th>Subalpine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Precipitation</td>
<td>High</td>
<td>High</td>
<td>Increasing</td>
<td>Low, slowly increasing</td>
<td>Low, slowly increasing</td>
</tr>
<tr>
<td>Temperature</td>
<td>High but oscillating</td>
<td>Warm, still relatively dry</td>
<td>Warm/hot summers</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Vegetation</td>
<td>Quercus-Fagus-Corylus forests</td>
<td>Fagus-Abies-Corylus-Picea forests</td>
<td>Fagus-Corylus-Picea forests</td>
<td>Fagus-Abies-Corylus-Picea forests</td>
<td>Fagus-Quercus-Corylus-Picea forests</td>
</tr>
</tbody>
</table>

#### Vegetation history in the Southern Lowlands (Längsee, Carinthia)
- Fagus-Quercus-Abies forest with Carpinus and Carpinus with Ostrya
- Opening with Pinus cembra-Pinus forest

#### Vegetation history in the Southeastern Lowlands (Rohr, Burgenland)
- Fagus-Abies-Picea forest with QM and Corylus
- Imm. of Carpinus
- Picea-Corylus-QM forests

#### Vegetation history on the southern border of the Northern Calcareous Alps (Lake Leopoldstein, Styria)
- Fagus-Abies forest with Picea and Acer
- Quercus-Carpinus-Abies-Fagus forest
- Tilia-Ulmus-Quercus-Abies-Picea forest

#### Human impact
- Deforestation and humus erosion
- Reforestation Betula and Pinus
- Forest fires

#### Alpine chronozones (Welten 1982)
- Older Dryas
- Younger Dryas
- Alleröd
- Older Dryas
- Older Dryas

#### Climate oscillations in the Eastern Alps

<table>
<thead>
<tr>
<th>Period</th>
<th>600 BC</th>
<th>500 BC</th>
<th>400 BC</th>
<th>300 BC</th>
<th>200 BC</th>
<th>100 BC</th>
<th>0 AD</th>
<th>100 AD</th>
<th>200 AD</th>
<th>300 AD</th>
<th>400 AD</th>
<th>500 AD</th>
<th>600 AD</th>
<th>700 AD</th>
<th>800 AD</th>
<th>900 AD</th>
<th>1000 AD</th>
<th>1100 AD</th>
<th>1200 AD</th>
<th>1300 AD</th>
</tr>
</thead>
</table>
and regressions of several different glaciers. Wick and Tinner\textsuperscript{17} improved the knowledge of the climatic development by pollen and plant macro rest analyses at high altitudes. Using the $\delta$ $^{18}$O method, it became possible to reconstruct some of these climatic fluctuations also in lowland lake sediments.

During the early and mid-Holocene three periods of climatic oscillations are known:

- The earliest one, the Preboreal-oscillation (the Schlatten-, Splügen-1-, Rion-1-oscillation)\textsuperscript{18} between $\pm$ 8800 and 8400 cal BC, recognisable in the oxygen isotope record from Ammersee (SW Munich, Germany)\textsuperscript{19} has also been found in some lowland pollen diagrams.\textsuperscript{20} Because of the $^{14}$C plateau in the early Holocene,\textsuperscript{21} it is not certain whether these events are synchronous or not. The sample resolution in Lake Leopoldstein is not detailed enough to decide if the oscillation at $\pm$ 10 700 cal BP may be correlated with this Preboreal-oscillation.

- The prominent event in the $\delta$ $^{18}$O record of Ammersee at $\pm$ 7200 cal BC may be synchronous with the Boreal-oscillation (Venediger-, Splügen-2-, Splügen-3-, Rion-2-, Bivio-oscillation) between 7600 and 6900 cal BC approximately. It is tripartite. The main vegetation response at high altitudes is reflected in peaks of the herbaceous pollen curves\textsuperscript{22} and prominent decreases in the macrofossil concentration of larch and stone pine.\textsuperscript{23} The influence of the decreased temperature on the already established lowland forests may have been rather low. Nevertheless, an increase of herbaceous pollen types (Artemisia, Asteraceae, Chenopodiaceae and Urtica) is visible in the diagram of Rohr; at Lake Leopoldstein beech immigration stops and the first pollen grain of Plantago lanceolata appears, while the continuous curve of Pteridium aquilinum starts at both localities. In all three pollen profiles, profound changes in the forest composition are remarkable: spread of alder (Lake Leopoldstein, Längsee, Rohr), decrease of hazelnut (Lake Leopoldstein, Längsee) and spruce (Rohr), spread of beech (Längsee) and immigration of fir (Rohr). On the other hand, human impact by Mesolithic hunters cannot be completely excluded, especially in the diagram of Rohr.

- The climate cooling at 6200 BC cal. is recorded in the oxygen isotope curve of European lake sediments such as samples from Ammersee.\textsuperscript{24} The deterioration started at ca. 6300 BC and reached the maximum at 6200 BC. The period of recovery lasted about 200 years.\textsuperscript{25} According the $\delta$ $^{18}$O curve, we assume a temperature depression of 1.7 °C in the mean annual air temperature in Central Europe.\textsuperscript{26} In the Western Alps this cool and moist period is known as Misox-, Splügen-5- and Rion-3-oscillation.\textsuperscript{27} In the pollen records of the Austrian Alps, there is no clear evidence for this oscillation. Only Vorren

\textsuperscript{17} Wick – Tinner 1997.


\textsuperscript{24} von Grafenstein et al. 1998.

\textsuperscript{25} Tinner – Lotter 2001.

\textsuperscript{26} von Grafenstein et al. 1998.

\textsuperscript{27} Zoller 1960; Wick – Tinner 1997.
& Markved recognise a "cool/moist?" period between 7500 and 7000 $^{14}$C years BP (6200–5600 cal BC) in the pollen record of the Gurgler Alm (Ötztal, Tyrol). However, in the lowlands the vegetation response to this event mostly has gone unrecognised by pollen studies. Tinner and Lotter conclude that increasing precipitation during this cooling favoured the growth of more drought-sensitive species allowing them to outcompete light-demanding species (mainly hazelnut) by forming denser forest canopies. Between 6200 and 5600 BC, no climatic deterioration is recognisable in the lowlands of eastern and south-eastern Austria. Nevertheless, some changes in the canopy are noticeable: beech dominates and fir spreads at Längsee, yew and hornbeam immigrate at Rohr, beech starts to develop and fir immigrates at Lake Leopoldstein. These differences are partly a question of the direction of migration, partly a consequence of probably further increasing precipitation or of a better-balanced distribution of precipitation over the year.

It is evident, that after the end of the Younger Dryas, mean annual temperature was rising rapidly. The limiting factor for immigration and expansion of the thermophilous flora in the early Holocene was not temperature but the periodical droughts (quite frequent till about 7000 BC), retarding at the same time soils formation and the expansion of dense forests. Our pollen records indicate increasing precipitation from 7000 to 5600 BC, without any strong decline in temperature. This interpretation is supported by the results of the investigations concerning glacier fluctuations at Pasterze and Gepatscherferner (Eastern Alps). Nicolussi and Patzelt show that between 8500 and 1700 BC, both glaciers have repeatedly retreated for long time periods behind their present day extension. Nevertheless, there is evidence of a number of advances, dated to – among others – around 6900, 6450 and 5700 BC, when the glaciers were as large or little larger than around ca. 1950 AD, but they never reached the extent attained during the 19th century. Increasing precipitation from 7000 BC onwards, is also postulated by preliminary investigations in the peat bog Capellarowiese (Mürzsteger Alpen, Styria) and by Roos-Barracough et al. for the Swiss Jura Mountains.

**Are there any environmental factors causing the migration of the Neolithic groups to Eastern Austria?**

In Central and South-Eastern Europe, the limiting factor for the development of the vegetation in Early Holocene was the drought. The modification of the precipitation regime occurred in two steps: the first around 7000 BC and the second around 6200 BC. On this occasion the regime could have changed in two ways: either the quantity of precipitation (mm/year) could have increased or the distribution pattern may have changed (with a major part of precipitation during the vegetation period or during winter, spring and autumn respectively) or both. Rossignol-Strick mentions a "Holocene climatic optimum" in the Mediterranean – referring to the time from about 8000 BC (9000 uncal. BP) onwards – and hypotheses that the most element climatic conditions (warmer than at present and with precipitation between 800 and 1300 mm, mainly occurring in spring and summer) at the onset of the Holocene account for the explosion of the Early Pre-pottery Neolithic culture and the human demographic expansion. Together with the still high temperature, the increase of precipitation at around 7000 BC in

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34 Rossignol-Strick 1999.

35 Rossignol-Strick 1999, 528.
Central Europe is the start of the period generally known as the climatic optimum. As there are indications of favorable climatic conditions from 7000 BC on also in Hungary\(^\text{36}\) and in Romania,\(^\text{37}\) we assume that these climatic improvements could be jointly responsible for the migration of the Early Neolithic people to the Balkan Peninsula.

The Neolithization of Eastern Austria was probably indirectly influenced by the second moist period between 6200 – 6000/5900 BC. The climatic deterioration occurred at the same time or shortly after the arrival of the first Early Neolithic groups in SE Hungary (Alföld) and along the shores of Lake Balaton (between the end of the 7th and beginning of the 6th millennium BC)\(^\text{38}\) and some hundred years before the expansion of the Linearbandkeramik (5600/5500 BC) to the area North of Hungary.

In what way did the climatic deterioration go on? Two developments go together: on the one hand, a decrease in temperature that means most probably cooler summer, reduced sunshine duration and resulted in a shorter growing season. On the other hand, there was an increase in precipitation. For the vegetation development the following consequences are probable: areas, tending to suffer periodic droughts, changed to well-balanced hydrological regions, suitable for agriculture. More sustainable resources for food-production might have led to a population increase.

Increasing, more frequent and heavy precipitation causes intense floods and the danger of devastation of the cultivated river plains by the deposition of gravel, sand and mud.

Beside flood disasters, higher precipitation could lead to a rise in the ground water table and consequentially to a wetting and partly oversalinating of the arable soil, as far as to deprive people of the base of living and to compel them to emigrate.\(^\text{39}\)

High precipitation has the tendency to wash out the nutrients from soils. Because manuring did not exist, the fields had to be lain out in shorter time because of depletion.

All these facts may have forced parts of the population to look for new favourable areas.

Beside all these direct climatic impacts, changes in the techno-economic and psychosociological background are to be expected.

**Conclusions and summary**

Neolithization was a very complex process. Climatic deteriorations at around 7000 BC and 6200 BC could have initiated development and probably migration of the Early Neolithic population (first in the southern Balkan Peninsula, later in the Carpathian Basin), although the climatic changes were certainly not the single reason. In order to assess the response of the Neolithization process to climatic changes, we need further information concerning soil development, river dynamics, hydrology etc. and their connections with the history of the settlements, in addition to additional radiocarbon dates.

The climate oscillation at 6200 BC seems to have no direct influence on Neolithization in Eastern Austria. But it could have been one of the reasons for the development in the Carpathian Basin and could have prepared the preconditions (Voraussetzungen) for the extremely rapid expansion of the Linearbandkeramik culture from Eastern Austria to Poland. The wide distribution area and – in spite of some regional differences – the quite uniform appearance of the LBK, can only be explained by intensive contacts between different regions.\(^\text{40}\)

\(^{36}\) Magyari 2002, cit. in Sümegi this volume.


\(^{38}\) Sümegi this volume


\(^{40}\) Urban 2000.
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THE EFFECT OF NEOLITHIC SHIFTING CULTIVATION ON VEGETATION DEVELOPMENT: "LANDNAM" AND SECONDARY SUCCESSION

Pál Sümegi proposes that there is a major boundary between Southeast and Central Europe running across the Carpathian Basin. Southeast and Northwest of this boundary different Neolithic cultures existed, ancient Balkanic cultures to the South and East, and the Linearbandkeramik culture to the Northwest. Sümegi thinks, that differences in the climate contributed a lot to the formation of this boundary. This may be the case, but climatic differences also caused the formation of the south-eastern boundary of Central European woodlands in exactly the same area. Different densities of woodland contributed to the differences in cultures as can be seen in the structure of ancient houses: Southeast of the boundary Neolithic houses were mainly constructed by clay bricks, whereas timber was the most important construction material Northwest of this boundary. In both cases, landscape transformations were necessary to establish agriculture. In treeless or not densely wooded areas on the one hand, and in densely wooded areas on the other, these transformations were certainly very different processes. Dense woodlands had to be cleared before agriculture could be started. This process took place during a so-called landnam-phase. However, timber and wood were not simply waste, that had to be destroyed and removed before agriculture could start. They were really sought-after resources; in the areas Northwest of the boundary mentioned above, timber was much more important in constructing houses than farther to the Southeast, and more wood was needed to heat the houses during cold seasons. Woodlands were, therefore, very important resources for Neolithic people. In the centre of Europe and other places farther to the West and North they could only live at places where timber and wood were available.

But men had to learn how to deal with woodlands, and therefore it is understandable that non-wooded and wooded areas had not been cultivated at the same period of time. There was a delay in the expansion of the Neolithic culture; its expansion was stopped at the limit of the woodlands for some centuries. After that, Neolithic settlements could only be founded at sites, where tall and evenly grown oak trees were available. Even and tall trunks were necessary to timber the characteristic long houses, which are about 30 m long. This is the same length as the dimension of the trunks of large oak trees. Neolithic culture was not a civilisation. Neolithic farmers were not organized into states and complex economic structures. Therefore, regular trade in important resources, such as food and timber, would have been unlikely to occur between settlements. By trading these goods, it would have been possible to fight against shortages of resources. If the one or the other resource was no more available at a site, it was delivered by trade. Inside civilisations a transport of crops and timber guarantees for the fact that human communities can survive at a site when some resource is not or no more available, e.g. when the crop harvest was too poor, or when the woodlands were destroyed.

Both archaeologists and pollen analysts can demonstrate that Neolithic settlements were not complex civilisations. Archaeologists know that not only Neolithic, but all prehistoric settlements were not as stable as later settlements, which existed inside civilisations and

1 P. Sümegi this volume.
4 Küster 2003.
The village names are: Mi - Mintraching, Mo - Moosham, R - Riekofen, S - Sengkofen, T - Taimering. The white areas are located around a Linearbandkeramik or Middle Neolithic settlement, and the size of the areas is about 35 hectares. Possibly such an area might have been cleared around a Neolithic settlement. Please note, that the settlements did not exist during the same period of time. On the white areas, not only a landnam phase took place, when the settlement was founded, but also a secondary succession of woodland, after the settlement had been abandoned.

Therefore were included into trade systems. Hvass excavated some settlements in Denmark and developed a model in which he stated that all these settlements existed one after another. Possibly only the settlements were shifted and not the fields, but it is also possible that not only the settlements but also the fields have been shifting from one place to another. Connected with shifting, new parts of the woodland were cleared so that new settlements could be constructed and new fields could be designed. The old sites and fields were abandoned. It is possible that the major reason for the shifting of settlements was the lack of timber and firewood after the settlement existed for more than some decades. Perhaps it was easier to rebuild the settlement at another site than to transport timber from the growing place of the tree to the site where the timber was needed.

On fig. 1, a map is presented which shows the locations of Linearbandkeramik and Middle Neolithic settlements in Niederbayern. This is the region Southeast of Regensburg in Bavaria, one of the centres of early Neolithic distribution in SE Germany. Not only the localities of the settlements are marked in this map. The sites are surrounded by schematic clearances. They have a size of about 35 hectares which was possibly the area needed for farming activities to produce enough crops for a population of about 70 to 100 people in a Neolithic settlement. Not all settlements existed at the same time; they were founded during a period of more than

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**fig. 1. Map of the loess landscape SE of Regensburg, Germany (after Küster 1998, Schier 1985).**

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5 Hvass 1982.
6 Küster 2003.
7 Schier 1985.
8 C.C. Bakels: Four Linearbandkeramik settlements and their environment: a palaeoecological study of
GÖRBELMOOS

fig. 2. Selected pollen percentage curves from Görbelmoos, Southwest of Munich, Germany (after Küster 1998; details of the pollen analysis: Küster 1995).

Pollen curves are hatched if a 10x exaggeration is shown. The arrows show developments in the woodland succession and human influences. During phase 1, no influence of farming on the vegetation is traceable. *Fagus* is not present. Phase 2 is the period of prehistoric agriculture, in which not only the *landnam* processes but also secondary successions of woodlands took place. *Fagus* expanded. Phase 3 is the period of historic land use and stable settlements. Secondary successions of woodlands did not take place. *Fagus* became rarer.

1000 years. At all sites, woodlands have been cleared at some point of time; and all the sites have been abandoned after a few decades.⁹

From an ecological point of view, this means that again, woodlands could develop on the abandoned sites. The development of shrubs, birch and other trees thereafter was not disturbed any longer by humans after a site was abandoned. After such a so-called secondary succession of woodland, the same tree species could develop again that grew in the woodland before. But it is also possible that different tree species could immigrate more easily during secondary successions. They might have immigrated as well, when secondary successions did not take place. But it is obvious that the immigration of a “new” tree species has been easier, when it had only to compete with young trees of another species; the immigration to a dense woodland with well-developed tall trunks was certainly much more complicated.

Pollen diagrams from many parts of Germany and adjacent areas show, that obviously, there was a special effect on woodland development which was caused by Neolithic and later prehistoric clearances and the following secondary successions (fig. 2). Pollen diagrams from this region can normally be divided into three phases. In the first phase of the pollen diagram, cereal pollen is not recorded. In the second phase, some scattered cereal pollen grains are traced. And in a third phase, a lot of cereal pollen grains can be found. Regarding the radiocarbon dates, it becomes clear that phase 1 is the period when only hunters and gatherers lived in the area. Phase 2, more or less, equals the prehistoric phase, when there were only some scattered and not totally stable agrarian settlements, that shifted some decades after their foundation.

⁹ Küster 1998.
Phase 3 is the historic phase, in which more intensive land-use started; settlements and fields existed permanently, and trade structures functioned to deliver important consumable goods to places where they were lacking.\textsuperscript{10} It is very striking, that there is one tree species which did not occur during phase 1, but was expanding during phase 2, and diminished during phase 3; this is beech, \textit{Fagus sylvatica}. Beech was not present at most sites in Germany and adjacent areas when the first farmers cleared woodlands. But during the phase when settlements and fields were not only founded but also abandoned after some decades, beech could expand at very many sites. It is likely that the expansion of beech was favoured by the fact that secondary successions took place.\textsuperscript{11} Perhaps it was more complicated to the tree to expand in dense oak woodlands, where all trees were already developed but not the immigrating species. The opinion that the beech expansion was favoured by the prehistoric way of founding and abandoning settlements and fields is supported by the fact that the beech expansion took place during a very long period, that lasted for several millennia. Beech was obviously not able to spread very rapidly at many sites in this area.

Looking at other well-dated pollen diagrams from several other sites the same phenomenon is very often visible. Beech immigration did not begin before agrarian settlements were present in the regions. In some cases, the first settlements and the immigration of beech took place at about the same period of time. In other cases, there was a delay between the first agrarian activities and the beginning of beech expansion. But it must be stressed that the connection between beech expansion and agrarian activities was not a general phenomenon. Beech was not furthered by human activities during its expansion to some elevated areas in hills and high mountains such as the Black Forest and the Vosges.\textsuperscript{12} It was also stated, that this connection is not obvious in areas farther to the Southeast.\textsuperscript{13}

Somewhat apart from the excavated prehistoric settlements, Hvass located the medieval settlement.\textsuperscript{14} In contrast to its predecessors, it was absolutely stable since the time it was founded. A stable settlement could only survive through centuries if it was included into a civilisation, which means that it was situated inside a state. This fact guaranteed economic stability. Only inside a civilisation trade could be established, that supported the settlements with goods, which were lacking at special points of time. For instance, when a house or a part of the settlement burnt down, timber could be delivered by transport on stable roads. If the harvest turned out to be poor, crops could be brought to the settlements from elsewhere as well. Christian authorities contributed to the stability of settlements by asking people to give money or goods to poor people.

In the pollen diagrams, an increase of cereal pollen deposition is indicated in the same period when settlements became stable (phase 3 in fig. 2). The intensity of land-use was increasing in total. Not only agriculture was intensified, but also the exploitation of woodlands. Timber cutting and firewood collecting intensified because towns and monasteries had to be supported. Especially in towns, a lot of timber and firewood were in demand, as much more stable houses were constructed there as well as cathedrals and mills; greater rooms were heated by greater ovens. Coppices and similarly exploited woodlands expanded a lot. The more intensively a woodland is exploited, the less beech trees can survive in it. Therefore it is rather reasonable that the pollen percentages of beech in medieval and early modern layers of the pollen diagrams indicate a dramatic decline of this tree in the woodlands. Secondary successions of woodlands did not take place any more, and the expansion of beech came to an end. At the beginning of the Middle Ages, beech had reached its greatest range and the greatest frequency in Europe. Since then, the pollen percentages of beech have been reduced very rapidly.

\textsuperscript{10} Küster 1998, 33; Küster 1995.
\textsuperscript{12} Küster 1996.
\textsuperscript{14} Hvass 1982.
In conclusion, it perhaps can be said, that the expansion of beech was favoured by secondary successions in relatively low-lying areas in some parts of Central Europe. But different ecological processes possibly took place in the hills and mountains, where the stability of woodlands was not as high as in the lowlands. Also, different processes took place in areas where beech was already occurring before agriculture expanded, e.g. in many places of SE Europe.

Pollen diagrams excellently show, how ecosystems change in time. It is very well indicated how humans influenced the development of woodlands. It is very striking that possibly a tree species which is regarded as "natural" or "indigenous" in many parts of Europe, expanded to these areas with the indirect support of man. On the other hand, this component of forest ecosystems diminished when economic pressure on woodlands became more intensive.

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Küster 1996

Küster 1998

Küster 2003

Schier 1985
POLLEN EVIDENCE FOR HUMAN ACTIVITY IN THE SURROUNDINGS OF EARLY NEOLITHIC SETTLEMENTS IN THE KUJAWY REGION (CENTRAL POLAND) BASED ON POLLEN ANALYSIS

Between 7000 and 5000 years ago, farming villages were established in Poland and other parts of Central Europe. The understanding of the earliest European farmers is important since they represent the first use of domesticated plants and animals outside their native region and south of the Carpathians and the Alps.

The Kujawy region of Central Poland has been studied archaeologically since the 1930's.¹

During the last two decades of the 20th century archaeological research has led to the discovery of significant early Neolithic settlements in southern Kujawy.² Wide-area excavations took place at two sites, Brzesc Kujawski and Oslonki lying ca. 10 km apart (fig. 1). These sites are located at the northern frontier of the initial agricultural colonization of Europe.³ Archaeological excavations conducted in Brzesc Kujawski revealed two main periods of early Neolithic occupation: the first by people of the Linear Pottery culture, and the second, when the site was settled by people of the Lengyel culture. Archaeological excavations conducted in Oslonki have revealed a large settlement of the Lengyel culture with well-preserved archaeological remains, the most important of which are dozens of trapezoidal longhouses and circa hundred graves, as well as traces of settlement fortification. Of particular note are graves with extraordinary amounts of copper, including one with a copper diadem.⁴

The settlers in Oslonki made heavy demands on the local environment and probably changed it significantly by land clearance, timber cutting for construction and firewood, crop cultivation, and grazing of livestock. Since Oslonki was occupied at the same time as the nearby settlement at Brzesc Kujawski, paths were cut through the forest. Thus, the early farmers transformed the primeval forest into cultural landscape.⁵

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³ Bogucki 1996a; Grygiel – Bogucki 1997.
⁴ Bogucki 1996a; Grygiel – Bogucki 1997.
⁵ Grygiel – Bogucki 1997.
The Kujawy region was generally covered by black earths. This area is almost lacking of biogenic sediment. In that part of Poland only a few sites were recognized, which were filled by organic material. These sediments were palynologically dated to the Bronze Age. Nowadays this area has been completely changed by human activity.

A palaeoenvironmental study was initiated in 1982 at Brześć Kujawski, but there were no organic sediments carrying plant remains.

In 1994, biogenic sediments were discovered near the Lengyel archaeological settlement at Oslonki. An environmental research project that included pollen and plant macrofossil analyses, as well as archaeozoological (cladocerans and molluscs) and geomorphological investigations was immediately undertaken. The aim of the research was to reconstruct the natural environment during the occupation of the Oslonki region and to investigate its subsequent changes under human impact.

**Palynological investigations**

The Lengyel settlement at Oslonki was situated between a depression of a melt water channel on the west and a kettle hole on the south.

Biogenic sediments in each basin have yielded material for pollen analysis. Three profiles excavated from these areas have been palynologically studied in detail. Two profiles (coring Os 1-2a and outcrop Os 94-5) were obtained from the biogenic sediments of the kettle hole; one profile (coring Os 94-9) was excavated from the biogenic sediments from the depression of melt water channel (fig. 2).

All pollen diagrams (figs. 3–5) have been prepared in POLPAL program. The biostratigraphy of the investigated material is subdivided into local pollen assemblage zones. Local pollen assemblage zones (LPAZ) permitted the correlation of all pollen diagrams (fig. 6). These units are correlated with subdivisions established in Poland and correlated

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fig. 3. Simplified percentage pollen diagram from Oslonki Os 1-2a

Lithology
Chronozone

Quercus
Fraxinus
Tilia
Carpinus
Juniperus
Chenopodiaceae —
Artemisia
Plantago major
Urtica dioica
Cerealia-type — Triticum-type
X Hordeum-type
X Cannabis sativa cf.
A Secale cereale
Centaurea cyanus
Spergula arvensis
Polygonum persicaria-t
Ranunculus arvensis
Polygonum aviculare-t
Plantago lanceolata
Rumex acetosella

corroded
degraded
archaeology correlations
fig. 4. Simplified percentage pollen diagram from Oslonki Os 94-5
fig. 5. Simplified percentage pollen diagram from Oslonki Os 94-9
with a general chronostratigraphic subdivision acc. to Mangerud et al.\textsuperscript{11} Reconstruction of the vegetation near the village was described within these units.\textsuperscript{12}

The synchronicity of anthropogenic processes was established using radiocarbon dates. Radiocarbon dates made it possible to compare all palynological results. Radiocarbon determinations available from profiles Os 1-2a and Os 94-5 have been made by the Radiochemical Laboratory of the Museum of Archaeology and Ethnography in Łódź, using conventional techniques. Radiocarbon determinations obtained from the profile Os 94-9 have been made by the Poznań Radiocarbon Laboratory, using the AMS technique.

<table>
<thead>
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<th>Profile</th>
<th>cm</th>
<th>(^{14}C) BP</th>
<th>Nr</th>
<th>cal BC</th>
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<tr>
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<td>4260 ± 60</td>
<td>Lodz-1179</td>
<td>2850–2620</td>
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<td>6730 ± 70</td>
<td>Lodz-1181</td>
<td>5610–5480</td>
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<tr>
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<td>5590–5300</td>
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<td>3110 ± 35</td>
<td>Poz-840</td>
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<td>344</td>
<td>8440 ± 150</td>
<td>Poz-836</td>
<td>7300–7050</td>
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Tab. 1. Radiocarbon data from the Oslonki profiles

The palynological reconstruction considers the Late Glacial, older and middle part of the Holocene, up to the Subboreal period.\textsuperscript{13} In the uppermost parts of all analyzed diagrams there were only scattered and discontinuous palynological records. They cannot be correlated with any precisely dated archaeological artefacts collected during excavations. Among the analyzed levels hiatuses were recognised. Some of them were visible in the lithology, but a few were discovered during pollen analysis. Without radiocarbon data (conventional and the AMS) it would be almost impossible to interpret pollen diagrams in detail.

The article presented is only focused on the diagram sections including indicators of anthropogenic changes (figs. 3–6), which are considered as the late Atlantic and part of the Subboreal periods. These sections, extracted from 3 diagrams, are combined according to their mutual correlations (fig. 6). Hiatuses, that existed in the source diagrams are included in them.

Local vegetation on the basis of LPAZ

Bottom parts of the Os 1-2a, Os 94-5 & Os 94-9 (figs. 3–5) diagrams (Al-Co-Qu LPAZ) correspond to the late Atlantic period. The relatively high presence of pollen indicators of forested areas (Corylus, Ulmus, Quercus, Tilia, Fraxinus), proved that the area was covered by mixed deciduous forests on fertile soils. On poorer sandy soils, Pinus woods were developed. Some open areas with heliophilous herbs (NAP summary curve) must also have existed nearby, but it cannot be determined whether they were caused naturally or anthropogenically.

The appearance of the first cereal pollen grains (Cerealia, Hordeum, Triticum), segetal weeds (Spergula, Polygonum, Ranunculus arvensis), single grains of pastures (Plantago lanceolata, Rumex acetosella) and continuous but low presence of ruderals (Artemisia, Urtica) reflect a very weak farming system in a forested environment.

The younger sections of two (figs. 3, 5) diagrams (Al-Ul-Co-Qu LPAZ) are characterized by similar to the lower LPAZ level in composition of pollen taxa, although their quantities differs in small amount. Deciduous forests still dominate. Herbaceous communities, sediments from a small mire (in Polish with English summary). Materiały Muzeum Archeologicznego i Etnograficznego w Łodzi. Seria Archeologiczna. in print; M. Gąsiorowski – D. Nalepka: Reconstruction of palaeoenvironment of fossil lake in Oslonki (Kujawy, Poland) based on cladoceran and pollen analyses (in Polish with English summary). PMMAE in print.


\textsuperscript{12} Nalepka et al. 1998.

\textsuperscript{13} D. Nalepka: Vegetation and its changes in the neighbourhood of archaeological site at Oslonki (Kujawy region) in the light of pollen analysis of
including plants of fields, meadows, fallow lands, and pastures suggest not much stronger agricultural activity than before.

The upper section of the Os 1-2a (fig. 3) diagram (Art & Co-Qu-Art LPAZ), where the quantity of tree pollen diminished and herbaceous increased, reflects reduction in forested area and stronger agricultural, mainly pasture, activity (Rumex acetosella & Plantago lanceolata).

In the upper section of the Os 94-9 diagram (fig. 5, Car-NAP LPAZ), where the quantity of tree pollen diminished and herbaceous pollen increased, Carpinus pollen grains have been appeared as continuous curve.

**Human correlations**

The palaeoecological interpretation of pollen diagrams carries a lot of difficulties particularly in that it is almost impossible to interpret any events in a human context. The palynologically identified activities of Neolithic farmers could be referred to individual cultures only on the basis of radiocarbon dates and detailed correlation with the results of archaeological studies in the Ostonki region.

AL-Co-Qu LPAZ. Only a few pollen grains of farming indicators (Triticum, Hordeum) and field weeds (Spergula, Polygonum, Rammeculus acris) as well as single grains of pasture plants (Rumex acetosella and Plantago lanceolata) indicated agriculture and cattle keeping. Those indicators, in such small quantity, could be correlated here with the Linear Pottery culture. According to archaeological knowledge, Linear Pottery settlements in this region are generally scarcely represented. In a sense, they represent pioneer food-producing communities that carried out the initial forest-breaking and the identification of promising settlement locations. Their settlements appear to have been relatively short-lived.14

Upper level contains strongly destroyed pollen and charred organic particles in the examined sediment. This damage of the sediment was caused probably by the Lengyel settlers, which used larger areas for farming and exposed soils to strong erosion, bringing about the increased input of mineral matter to the basin. Pollen grains were thus destroyed because of the poor conditions of preservation. It can be suggested that the hiatus previous to the Al-UI-Co-Qu was caused by low ground water levels during the Lengyel culture. Some confirmation for this suggestion can be the high percentage of Stipa pennata remnants found in archaeobotanical

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14 Bogucki 1996a.
materials from that region. The custom of making wells by the Lengyel settlers at the nearby Lengyel site of Konary could be postulated as additional evidence supporting this theory.

Until now, the detailed botanical interpretation of that period has been based on plant macrofossils collected directly from the archaeological sites. The level in Os 94–9 diagram, which is covered by Al-Ul-Co-Qu LPAZ, may include pollen remnants from the Lengyel Culture. This statement is based on the $^{14}$C data only. But on the basis of pollen indicators, the vegetation is almost the same as the older section, recognized as correlated with the Linear Pottery culture. This level has been under more detailed analysis.

In the younger level, Co-Qu-Art LPAZ (fig. 3), the traces of agricultural activity include pollen grains, which indicate that animal breeding becomes more important than during the previous periods. According to $^{14}$C and archaeological data they may be correlated with the late Neolithic, which probably means the Globular Amphorae culture here.

In the upper level of the Car-NAP LPAZ of Os 94-9 diagram (fig. 5), the presence of percentage amounts of Carpinus pollen and $^{14}$C data suggest connection with the Bronze Age.

**Conclusions**

The vegetation history in the Oslonki region could not be characterized on the basis of pollen data as continuum of processes but only as episodes interrupted at times when the sediments were destroyed during the Holocene. This destruction was caused firstly by the early Neolithic settlers, and in the later periods by the late Neolithic groups. Before the development of the early Neolithic occupation, primeval mixed deciduous forests with Quercus, Tilia, Ulmus, Fraxinus and Corylus covered the landscape in the vicinity of Oslonki. Only small, open areas with heliophilous herbs were present. The first farmers appeared in a forested environment. Cereals along with vegetal weeds and ruderals reflected the spread of agriculture. Triticum and Hordeum were cultivated. The inhabitants of Oslonki exploited wild vegetal resources, which were available in the neighbourhood. They used wood, first of all oak and pine, but also of other trees and shrubs such as birch, poplar, and hazel, although probably in smaller quantity. Fruits and seeds of a few wild plants (e.g. hazel nuts, and Vaccinium vitis-idaea fruits) may have been collected for food.

The landscape around the Lengyel settlement must have been exploited quite heavily; in the immediate vicinity of the houses and beyond, timber requirements of the longhouse construction would have resulted in substantial timber cutting, to which the constant requirements for fuel, tool use, and house repair could be added. In all, there is a picture of a very intensive local landscape use.

Using archaeological and palynological information, we still could not say that there was a sharp boundary between foragers and farmers across this area, suggesting that small "islands"
of agricultural settlement existed among the forager groups. We only know that finally the foragers of the North European Plain adopted agriculture shortly after ca. 4000 BC.

After the end of the Lengyel settlements at Oslonki, then at Brześć Kujawski, the settlements of the late Neolithic (Globular Amphorae and Funnel Beaker culture) of this area are found. But they are located on different soil types, often some distance back from the stream channels. The Late Neolithic pattern in this region represents a completely different system of land use from that developed by the Lengyel culture.

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21 Palynological investigations have been funded or supported by the W. Szafer Institute of Botany, Polish Academy of Sciences, State Committee for Scientific Research (Project No 6PO-F 07921), Museum of Archaeology and Ethnography in Łódź, the Wenner-Gren Foundation for Anthropological Research, Inc., the American Institute of Polish Culture in Miami and the W. Szafer Foundation for Polish Botany.
A NEW QUANTITATIVE METHOD FOR THE PALAEOBOTANICAL DESCRIPTION OF LATE QUATERNARY ORGANIC SEDIMENTS (Mire-development pathways and palaeoclimatic records from Southern Hungary)

Before quantitative pollen analysis was invented by von Post in 1916 peat stratigraphy was the main source of evidence of palaeoenvironmental investigations. Layers of scarcely humified Sphagnum peat were taken as indicators as fast peat growth and therefore of wet climatic conditions. Layers of humified peat with wood fragments were taken to indicate a dryer mire surface and so an arid and warmer climate.

Lakes, fens and bogs have different vegetation depending upon the water level and nutrient status, and produce characteristic sediments in these different environments. The Troels–Smith sediment description system is designed for a quick, logical and simple description of such sediments in the field, which accurately reflects their composition. This sediment description method is commonly used in Quaternary palaeoecology. Fig. 1 presents the different Troels–Smith sediment types deposited under oligotrophic and eutrophic conditions. The problem is that in some cases the same sediment type accumulated under different environmental conditions and vegetation type, hence a detailed plant macrofossil description is recommended.

The pioneer palaeobotanical studies on Quaternary sediments in the 19th century were the plant macrofossil analyses. But this method later was overshadowed by quantitative pollen analysis. At this time the plant macrofossil record emerged only in association with pollen diagrams. The methodical developments of the eighties (Birks, Janssens, Rybníček, Grosse–Brauckmann, Wasylikowa etc.) made this method essential in Quaternary palaeoecology.

The invention of QLCMA technique (semi-quantitative quadrat and leaf-count macrofossil analysis technique) in Southampton opened the door to detailed quantitative data processing. Why is the macrofossil analysis so important? Plant macrofossils provide at last three types of important information in palaeoecological investigations: (1) identification may be more detailed than for some pollen taxa because of the distinctive morphology, which provide good ecological interpretation (e.g. Gramineae, Cyperaceae, Bryophytes); (2) taxa not found or rarely found as pollen may produce good macrofossils; (3) for the assessment of local presence or absence the heavier macrofossils give a better clue than the easily transported pollen.

A further advantage is the use of plant macrofossil analysis in the reconstruction of past mire vegetation. So that macrofossil analysis helps to refine and amend palaeoenvironmental interpretations made from pollen analysis alone.

3 Troels – Smith 1955.
5 Birks – Birks 2000.
6 Barber et al. 1994.
fig. 1. Sediment types deposited with increasing water depth under oligotrophic and eutrophic conditions (Birks – Birks 1980)

By comparison recent plant associations and fossil plant assemblages we can reconstruct past plant associations. Plant associations (units of vegetation) under some strong ecological influence (e.g. salty soil, water) possess uniformity in geographical space and permanency in geological time. Rybińczek\(^\text{10}\) proved the permanency of mire vegetation during the Holocene in Central Europe. So we can reconstruct the vegetation of former (drained and destroyed) peatbogs, or the local succession (hydroseres). We can detect climatic and hydrological changes as well. By this way, we can establish the nature conservation plans with the determination of optimal water level and quality. With the use of modern vegetation science,\(^\text{10}\) Rybińczek 1973.
A NEW QUANTITATIVE METHOD FOR THE PALAEOBOTANICAL DESCRIPTION

plant macrofossil analysis could provide the most detailed description of local environment in Quaternary palaeoecology.

There are some considerable problems with this method. Normally there are only relatively few macroremains in 1–5 cm³ sediment (e.g. seeds), therefore large samples are needed (50 – 100 cm³) for detailed analysis. Some sediment, like oligotrophic lake sediments are poor in macroremains.

On the other hand, the most common remains, the vegetative plant tissues, are not identified commonly. The identification of rizodermal tissues is not popular in Quaternary research, because the lack of detailed manuals and keys.

Most palaeobotanical studies do not deal with the description of moderately humified, unidentifiable material even though these can provide important palaeoenvironmental information.

Plant macrofossil analysis is particularly used in oligotrophic, acid Sphagnum peats (oligotrophic environment), but in Central Europe sedge peats and lake sediments (eutrophic environment) are much more common and important.

To resolve the above detailed problems, we describe in this paper a new quantitative method for the palaeobotanical description of organic sediments. We present the so called Peat Component System for the holistic description of organic remains, and the modified QLCMA technique for the quantification of these components. In second part of this article the use of these methods are illustrated with an example.

Methods

Plant macrofossil analysis

The Peat Component System

The term “peat component” is used by us to describe the macroscopic organic matter of the sediment that retain on a 300 μm sieve. Peat components occure in peat, but of coarse in smaller quantities in lake sediments as well.

Peat components cause the characteristic physical features of peat. One physical feature is elasticity. This means that the sediment has an ability to regain its shape after deformation. Another feature is the ability to absorb large volume of water.

The peat components can be devided into two main groups (Table 1). In the specific peat component group identification can be made on species level. The three main components of this group are the seeds, mosses and rizodermal tissues. We can use many manuals and keys for the identification of seeds and mosses.11 The number of manuals dealing with the determination of rizodermal tissues is limited.12 Most of these keys use macroscopic features, so that large samples are needed. The most useful manual was recently published by Jakab and Sümegi.13 The keys and descriptions are based on the microscopic features of tissues. The use of these manuals is essential in the method described below.

Table 1. The main categories of peat components

The second group is the non-specific peat components. In this group identification is not possible on species level with this method. The main non-specific peat components are as follows.

**Unidentifiable monocotyledons** (Monocot. Undiff.): Mostly translucent tube-like rootlets or epidermis fragments with elongated cells. The young rootlets of Phragmites with hardly differentiated cells often got into this category.14

**Unidentifiable leaf fragments** (U. L. F.): Moderately humified deciduous tree leaf fragments. They are easily recognisable by the remains of weblike veins.

**Unidentifiable organic matter** (U. O. M.): Strongly humified fragments with irregular shape. They are insufficient for any further identification.15

**Unidentifiable bryophyte fragment** (U. B. F.): In humified peat, only the stem remains of bryophytes can be found that are insufficient for further identification. They are easily recognisable by their tube-like form and brown colour. The nerve of the leaf frequently remains on the stem.

**Unidentifiable Sphagna** (Sphagnum stem): In less humified peats the stems of Sphagna occur in high quantity. These do not have any characteristic features that would allow specific identification.

**Charcoal**: Charred wood fragments larger than 300 µm (mostly between 1–3 mm). The origin of charcoal of this size is presumably terrestrial (allochton), so it makes possible to correlate multiple corings in a location.

**Wood**: Uncharred wood fragments larger than 300 µm. Presumably terrestrial elements (allochton) in lakes and smaller peatbogs.

**Mollusc shell fragments**: It is not possible to identify Mollusc with this method, because most of them break into pieces during the extraction, but we can detect the volume of shell fragments.

The specific peat components help us to reconstruct past plant associations, but the non-specific peat components also contribute to the reconstruction of environmental and hydrological changes.

The nomenclature of bryophytes follows Düll,16 vascular plants Tutin et al.,17 and syntaxons Borhidi.18

**QUANTIFICATION OF PEAT COMPONENTS**

For the quantification of peat components we modified the QLCMA method (semi-quantitative quadrat and leaf-count macrofossil analysis technique) developed by Barber et al.19 With this

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14 Barber et al. 1994 used this category in a similar context.
15 Barber et al. 1994 used this category in a similar context.
19 Barber et al. 1994.
method we can determine macrofossil concentrations from small samples (1–3 cm³) with the use of poppy seeds as marker grains (0.5 g = 959 ± 52) under dissecting microscope. Barber et al. determined the volume of *Sphagnum* leaves with this method, and then identified *Sphagna* under biological microscope.

In our version we took 3 cm³ samples and strained them on a 300 μm screen. The retained material was stored in water. Wet residues were then transferred to jars for storage, and covered by water. We also added a few drops of glycerol : etanol : formaldehyde mixture to discourage bacterial and fungal growth.

![Fig. 2.](image)

**fig. 2.** The identification and quantification of Monocotyledons with scanning under biological microscope

Subsequently we placed the residues under dissecting microscope and removed all seeds. In the diagrams the total number of seeds were marked in 3 cm³.

After that we mixed the poppy seeds (it must be soaked before) and the residue. When the poppy seeds were spread evenly, we counted all the peat components and the poppy seeds in a 1 cm² large quadrat (10 × 10 mm) in ten different parts of the material. It is not possible to identify the rhizoms and bryophytes under dissecting microscope, so that we counted them as Bryophytes and Monocotyledons.

Hereafter, we took randomly 100 moss leaves and 100 tissue remains, and mounted them water on microscope slides. We identified the mosses and the tissues under biological microscope (fig. 2). The tissues are often quite long, so it is hard to determine the exact number of remains. We decided to scan the whole slide and count as much as is seen. In this way we got the species composition of these peat components.

The next equation shows the calculation of macrofossil concentrations.

\[
\text{macrofossil concentration} = \frac{\text{counted macrofossil (average) } \times 960 \text{ (total poppy seed)}}{\text{counted poppy seed (average) } \times \text{volume (cm³)}}
\]

**fig. 3.** Quantification of peat components

The macrofossil diagrams were prepared using PSIMPOL. Ver. 2.25. Principal components analysis (PCA) was used to highlight the ecological characteristics of peat components in some core. PCA were carried out using SYNTAX 2000.

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20 Barber et al. 1994.
Pollen analysis

Samples for pollen analysis were collected using a 1 cm³ volumetric subsampler at 4 cm intervals. Pollen samples were prepared following the method described by Berglund – Ralska-Jasiewiczowa23 with Lycopodium spore24 added to each sample in order to determine the pollen concentration. Pollen samples from peat were prepared with the same method, but prior to the acetylation, samples were treated with 2% NaOCl in water bath for 2 minutes.

Pollen and spores were identified with the aid of keys.25 Minimum 300 terrestrial pollen grains were counted in each sample. Since the aim of our investigation was the reconstruction of the mire forming vegetation and its relation to changes in the terrestrial vegetation, pollen percentages were calculated in two different ways. For the description of changes in the terrestrial vegetation the percentage calculation is based on the sum of all terrestrial taxa. The other pollen diagram depicts the curves of the peat-forming and water plants. The percentage calculation is based on their sum plus the terrestrial pollen sum and includes Pteridophyta spores.

The pollen diagrams were prepared using PSIMPOLL Ver. 2.25.26 Zonation of both the terrestrial and aquatic diagram was performed using statistical procedures, from among the results of optimal splitting by information content27 were used to guide decisions as to the number and position of the pollen assemblage zone (LPAZ) boundaries.

Mollusc analysis

Only the corings CSTII and HPII contain sufficient mollusc shell for further studies. The cores were cut into 10 cm long pieces, and strained on an 800 μm sieve. The cores were analysed in 20 cm long sections because the amount of mollusc specimens did not exceed the sufficient number (100 specimens) in the 10 cm samples.

The species have been assigned to different palaeoecological groups:28

In addition the species have been assigned to palaeoclimatic groups: cold resistant (Valvata pulchella, Bythinia leachi, Succinea oblonga, Oxyloma elegans), thermophilic

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A NEW QUANTITATIVE METHOD FOR THE PALAEOBOTANICAL DESCRIPTION

We arrange the species on the bases of habitat requirements. Although the Mollusc species not sufficient for the reconstruction of past plant associations, some recent investigations show the possibility of reconstructing general vegetation units (e.g. woodland, ecoton, steppe).

The aquatic species has special habitat requirements as well. The samples dominated by aquatic species, therefore the analysis has been focused on the changes of aquatic environment (e.g. oligotrophy, vegetation density).

Chronology

From the Holocene layers four bulk samples were submitted for radiocarbon dating at the Nuclear Research Centre of Hungarian Academy of Sciences, Debrecen, Hungary. All samples were unfiltered peat. The radiocarbon dates of Hajós-Kaszálók presented in fig. 2. The radiocarbon dates from Császártöltés (CSTH core) were published later by Cserny.

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Depth below peat surface (cm)</th>
<th>δ13C(PDB) [%e]</th>
<th>14C age years BP</th>
<th>Calibrated range years BC/AD (2σ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hajós-5</td>
<td>95-100</td>
<td>-28.17±0.02</td>
<td>1650±80</td>
<td>320-500 AD</td>
</tr>
<tr>
<td>Hajós-6</td>
<td>160-65</td>
<td>-28.73±0.01</td>
<td>1770±80</td>
<td>180-350 AD</td>
</tr>
<tr>
<td>Hajós-7</td>
<td>215-220</td>
<td>-26.84±0.04</td>
<td>3960±70</td>
<td>2560-2360 BC</td>
</tr>
<tr>
<td>Hajós-8</td>
<td>265-270</td>
<td>-27.58±0.07</td>
<td>7310±80</td>
<td>6230-6900 BC</td>
</tr>
<tr>
<td>Hajós-9</td>
<td>291-296</td>
<td>-28.03±0.02</td>
<td>9130±130</td>
<td>8510-8230 BC</td>
</tr>
</tbody>
</table>

Table 2. Radiocarbon dates from the Holocene sediments of Hajós-Kaszálók

Site description

The Great Hungarian Plain, called “Alföld” in Hungarian, is the biggest sedimentary basin in Europe, filled with Neogene sediment of great thickness. The geological evolution of the Pannonian basin started in the Miocene, thus in this basin 2000-3000 m thick marine and 1000-2000 m thick lake sediment deposited during Late Tertiary.

Fluvial sedimentation started at about the beginning of Quaternary. As a result of fluvial activity, 200-300 m, maximum 700 m thick Quaternary sedimentary series accumulated in the deepest parts of the Great Hungarian Plain. Rivers entering the Great Hungarian Plain built extensive alluvial fans in the Quaternary Age and behind these alluvial fans some lowland within subsidences intersected on the surface by innumerable rivers and brooks. The analysed lowland, Solt-Baja alluvial Plain consists of two Late Quaternary neotectonic catchment subbasins. From the point of view of evolution, the western part of the Great Hungarian Plain is one of the most specific regions in Hungary. The relief conditions and network of rivers suffered the most dramatic transformation during the Late Pleistocene. All the watercourses

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29 Lősek 1964; Meijer 1985.
36 Ronai 1985.
37 Sümeghy 1944.
coming from the northern part of Carpathians and Alps had a role in the evolution of the alluvial fan plain whose name is Kiskunság. The Danube River with its tributaries used to flow across the Kiskunság alluvial fan during the first phase of Quaternary then during the Weichselian glacial time a subsidence, more intense than ever before, started in the Solt–Baja Plain. As a consequence of the subsidence, a completely new network of watercourses developed, which in the course of their erosion and deposition, transformed the sinking area into floodplain. This subsidence was, for a time, counterbalanced by the aggradational work of the river. Thus, changes of the riverbeds were frequent in this plain.39

The Vörös-mocsár Mire and the Hajós–Kaszálók Mire (46°23′40″ N, 19°09′30″ E) are the southern unit of the mire system of the Danube–Tisza Interfluve ("Turján, örjeg, Vörös-mocsár") running south in the former watercourse of the river Danube (fig. 4). The mires situated at the border of two significantly different regions on an area. The Solti Plain belonging to the Danube floodplain is covered with the network of abandoned watercourses of the river Danube. The watercourses are in different step of infilling. The Solti Plain and the adjoining Sand Dunes of the Danube–Tisza Interfluve are separated by an approximately 10 meters high, steep loesswall. Groundwater springs rise from the base of the loesswall. The Sand Dunes of the Danube–Tisza Interfluve are actually underlain by loess that in places.40

The Danube–Tisza Interfluve lies in the warm temperate zone. It is characterised by January mean temperatures higher than −2°C and the duration of the winter is only three month. The climate of the region is semiarid, and dominated by submediterranean rather than cool continental climate influence. The region is poor in precipitation. The total annual precipitation varies between 500 and 600 mm most over the region.41

The natural vegetation of the Sand Dunes was Junipero–Populetum scrub and sandy grasslands, formed by Bromus squarrosus, Secale sylvestre, Stipa borystenica and Festuca vaginata. Well-drained areas were occupied by oak forests (Iridi variegatae–Quercetum

40 Marosi – Somogyi 1990.
robóris, Polygonato latifolii–Quercetum robóris). Recently most of the area is cultural landscape with ploughlands and vineyards and some patches of natural vegetation. The Solti Plain was a widespread peatland with patches of Fraxino pannonicae–Alnetum forests.42

Water regulations started in 1873 destroyed the original vegetation of this peatland. The artificial Danube Basin Channel (“Abzugskanal”), finished in 1929, drained the mires. Only some patches of the natural vegetation survived.43 After the water regulations peat-cutting altered the former landscape. Most areas (and sediments) of the Vörös-mocsár destroyed by peat-cutting. One exception is that, Hajós–Kaszálók Mire remained intact. There is only a little information about the original vegetation of these areas. Menyhárth44 in 1877 reported widespread Carex elata stands (“Zsombék-formation”-hummock) from the mire, and mentioned the occurrence of Stratiotes aloides, Ranunculus lingua, Caltha palustris, Nuphar lutea, Dianthus superbus, Hippuris vulgaris, Galium palustre, Menyanthes trifoliata, Nymphoides peltata etc. Nowadays the peatlands are covered with secondary vegetation: meadows, reedswamps and sedgeswamps. The most important problems of nature conservation are the lack of water and the invasion of Solidago gigantea.

Field sampling

Peat cores were retrieved using a 5 cm diameter Russian corer.45 The position of the boreholes is shown on fig. 5. In the Hajós–Kaszálók Mire the boreholes were placed along a transsect. Borehole HPI was gained from the deepest part of the basin and was used for pollen analytical

44 L. Menyhárth: Kalocsa környékének növénytényezete [Cultivation of plants in the environs of Kalocsa]. Budapest 1877.
fig. 6/1. Percentage pollen diagram of HPI core (LPAZ: local pollen analytical zones)
and radiocarbon analysis. All other cores were used for plant macrofossil analysis. Only cores CSTII and HP1I contained mollusc shells. Mollusc analysis was made only on these sequences.

Detailed description of the peat cores follow the system described by Troels – Smith.46

<table>
<thead>
<tr>
<th>Local pollen zone</th>
<th>Zone description</th>
</tr>
</thead>
<tbody>
<tr>
<td>HPIP-7.</td>
<td>20-92 cm</td>
</tr>
<tr>
<td>Oak-hornbeam forests.</td>
<td>The principal tree species in this zone are <em>Quercus, Carpinus betulus</em> and <em>Alnus cf. glutinosa</em>. Total arboreal pollen accounts for 35-40%. Mixed oak and oak-hornbeam forests are typical. Strong anthropogenic signal and extensive forest-steppe area was detected in this zone. <em>Cyperaceae</em> pollen grains are frequent.</td>
</tr>
<tr>
<td>Extensive steppe area.</td>
<td></td>
</tr>
<tr>
<td>HPIP-6.</td>
<td>92-138 cm</td>
</tr>
<tr>
<td>Oak-hornbeam and hoarnbeam-beach forests.</td>
<td></td>
</tr>
<tr>
<td>Steppe area increasing!</td>
<td></td>
</tr>
<tr>
<td>HPIP-5.</td>
<td>138-210 cm</td>
</tr>
<tr>
<td>Oak-hornbeam and hornbeam-beach forests.</td>
<td></td>
</tr>
<tr>
<td>Steppe area increasing!</td>
<td></td>
</tr>
<tr>
<td>HPIP-4.</td>
<td>210-270 cm</td>
</tr>
<tr>
<td>Mixed forest-steppe with <em>Pinus sylvestris</em> and <em>Artemisia</em> steppe.</td>
<td></td>
</tr>
<tr>
<td>HPIP-3.</td>
<td>270-326 cm</td>
</tr>
<tr>
<td>Boreal woodland with <em>Pinus abies</em> and <em>Ulmus</em>.</td>
<td></td>
</tr>
<tr>
<td>Gallery forests.</td>
<td></td>
</tr>
<tr>
<td>Grasslands.</td>
<td></td>
</tr>
<tr>
<td>HPIP-2.</td>
<td>326-402 cm</td>
</tr>
<tr>
<td>Boreal woodland with <em>Pinus sylvestris</em>, <em>Betula</em>, and tundra vegetation.</td>
<td></td>
</tr>
<tr>
<td>HPIP-1.</td>
<td>402-412 cm</td>
</tr>
<tr>
<td>Boreal woodland with <em>Pinus sylvestris</em>, <em>Betula</em>, and tundra vegetation.</td>
<td></td>
</tr>
</tbody>
</table>

Table 3. Summary of the pollen stratigraphy of core Hajós–Pincék 1.

**Results**

**The pollen record**

The reconstruction of the terrestrial vegetation development is based on the pollen analytical study of core HPI. The results of the pollen study are presented in fig. 6.

In the samples between 92–138 cm and 326–402 cm the pollen concentration was insufficient for further study with this treatment. The pollen concentration between 156-250 cm was however optimal.

Between 326–402 cm the pollen concentration is extremely low (6000–29000 pollen/cm³), only the pollen grains of *Pinus sylvestris* were encountered in the samples that suggests selective fossilisation.

The sediment between 92–138 cm contained large number of organic particles smaller than 250 μm. The use of the NaOCl treatment proved insufficient to dissolve these particles. Initially we supposed that the large amount of organic particles is responsible for the low pollen concentration. However, the sufficient number of *Lycopodium* spores found on each slide suggests pollen sterility rather than imperfect pollen preparation.

The pollen stratigraphy is summarized in Table 3.

46 Troels – Smith 1955.
fig. 6/2. Percentage pollen diagram of HPI core (LPAZ: local pollen analytical zones)

fig. 7. Mollusc diagram of CSTII core
The malacological record

Only the corings CSTII and HPII contain sufficient mollusc shell for further studies. The results of the malacological study are presented in fig. 7. The number of Molluscs in HPII core was insufficient to draw histograms. The Mollusc stratigraphy is summarized in Table 4–5.

<table>
<thead>
<tr>
<th>Mollusc zone</th>
<th>Zone description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–95 cm</td>
<td>No Mollusc remains</td>
</tr>
<tr>
<td>HPII Mo-3.</td>
<td>Valvata cristata shells are frequent (more than 70%). The frequency of aquatic (Pisidium spp. Armiger cristat, amphibious (Succinea oblonga, Oxyloma elegans) elements is the highest in this zone.</td>
</tr>
<tr>
<td>HPII Mo-2.</td>
<td>Some stagnant water environment favourable Mollusc (Planorbarius cornuus, Lymnaea palustris, Segmentina nitida) appeared in this layer. This palaeoassociation suggest that a shallow lake developed in the analysed palaeochannel during this phase with emerged and submerged vegetation.</td>
</tr>
<tr>
<td>HPII Mo-1.</td>
<td>No Mollusc remains</td>
</tr>
<tr>
<td>200–220 cm</td>
<td>Some rheophilous Mollusc elements (Valvata piscinalis, Lithoglyphus naticoides, Lymnaea stagnalis), but only their few specimens can be found in this layer. This poor malacofauna is similar to malacofauna from CSTIMo-1. level and it indicates fluvial phase in the analysed palaeochannel.</td>
</tr>
</tbody>
</table>

Table 4. Summary of the mollusc stratigraphy of core Hajós–Pincék II.

<table>
<thead>
<tr>
<th>Mollusc zone</th>
<th>Zone description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSTI Mo-4.</td>
<td>Dry mire surface. Valvata cristata shells are frequent (more than 50%). The frequency of aquatic (Lymnaea palustris, Pisidium spp., Segoncina nitida), amphibious (Succinea oblonga, Oxyloma elegans, Carychium minimum) and strongly hygrophilous terrestrial elements (Vertigo antivertigo, Vallonia enniensis) is the highest in this zone. On the basis of radiocarbon dating the first agricultural human populations occupy the territory at this time. Presumably the high quantity of sediment and terrestrial mollusc shell got into the channel derived from the shore, because of human impact.</td>
</tr>
<tr>
<td>CSTI Mo-3.</td>
<td>Shallow eutrophic water with floating aquatic vegetation. The Valvata cristata shells are frequent (more than 50%). The frequency of aquatic (Lymnaea palustris, Pisidium spp., Segmentina nitida), amphibious (Succinea oblonga, Oxyloma elegans, Carychium minimum) and strongly hygrophilous terrestrial elements (Vertigo antivertigo, Vallonia enniensis) is the highest in this zone. On the basis of radiocarbon dating the first agricultural human populations occupy the territory at this time. Presumably the high quantity of sediment and terrestrial mollusc shell got into the channel derived from the shore, because of human impact.</td>
</tr>
<tr>
<td>CSTI Mo-2.</td>
<td>Deep and fluctuating stagnant water. Oxbow lake with decreasing oxygen level. The rheophilous elements decline and disappear. The first terrestrial elements (Succinea spp., Vertigo spp.) emerge in this zone. The Valvata cristata – Bithynia leachi – Bithynia tentaculata paleoassociation developed in this zone. Elements with different ecological requirements (deep/shallow water, open/dense aquatic vegetation) emerge in the same quantity. This phenomenon is explicable with the periodic flood of River Danube.</td>
</tr>
<tr>
<td>CSTI Mo-1.</td>
<td>The number of rheophilous elements (Valvata piscinalis, Lithoglyphus naticoides, Lymnaea stagnalis, Planorbis cf. carinatus, Unio cf. crassus, Pisidium amnicum) is very high. This was the so called Valvata piscinalis – Lithoglyphus naticoides palaeoassociation (Sümegi, 1996; Sümegi Krolopp, 2001) include cold resistant (widespread in the Pleistocene) (eg. Valvata pulchella, Bithynia leachi) and thermophilic (widespread in the Holocene) (eg. Lithoglyphus naticoides, Bithynia tentaculata) elements as well. The palaeochannel could have been a spillstream of River Danube.</td>
</tr>
</tbody>
</table>

Table 5. Summary of the mollusc stratigraphy of core Császártöltés–Vörös-mocsár II.

The macrofossil record

The results of macrofossil analyses are shown in figs 9–14. Within the macrofossil diagrams unlinked histograms present only lower values. Local macrofossil assemblage zones have been labelled using the following system: HP (Hajós–Pincék: Hajós–Kaszálók) or CST (Császártöltés–Vörös-mocsár), 1–IV (number of core), M (local macrofossil zone), -zone number.

The macrofossil stratigraphy is summarized in Table 6–7.

The small charred wood fragments (larger than 300 μm, but mostly between 1–3 mm) are presumably terrestrial (allochton) elements in the macrofossil records. By comparing the charcoal histograms of the multiple corings with each other (fig. 8) the next statements can be made.

The concentration of charcoal decreases from east to west (from the sand dunes towards the river Danube). This phenomenon can be easily explained by the geographical features. The arid sand dunes could be burned down much more easily than the humid floodplain with its marshes and watercourses. So the winds blow the charcoal (scale) from the arid Sand Dunes of Danube–Tisza Interfluve towards the floodplain. The sudden decrease of charcoal
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<th>Site</th>
<th>Zone description</th>
<th>Detected plant community</th>
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<tr>
<td>Hág–Pincék I.</td>
<td>HPIVM-6 (20–115 cm). Carex elata is the major and nearly the only peat component, with in combination of Phragmites australis. Water tables somewhat higher.</td>
<td>Caricetum elatae</td>
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Table 6. Summary of the zonations for Hág–Pincék I–IV.
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Site | Zone description | Detected plant community
--- | --- | ---
Császár-töltés I | CSTIM-7 (30–70 cm). Carex elata and Phragmites australis are the major peat components. Water table is somewhat lower. | Carexetum elatae
CSTIM-6 (70–100 cm). Macrofossil concentration is higher. Phragmites is the major peat component, with in combination of Carex elata and Equisetum remains. Remains of pioneer mud vegetation detected in this zone. Water table is higher and fluctuating. | Phragmitetum
CSTIM-5 (100–170 cm). Phragmites is the major and nearly the only peat component. | Cypero-Junceetum bifurcati
CSTIM-4 (170–210 cm). Macrofossil concentration is higher. Typha, Phragmites are the major peat components, with in combination of Carex elata remains. Remains of water-lily communities detected in this zone. Water table is higher. | Nymphaeetum albo-luteae
CSTIM-3 (210–290 cm). Macrofossil concentration is low in this zone. Phragmites and Equisetum are the major peat components. | Phragmitetum
CSTIM-2 (290–308 cm). Macrofossil concentration is higher. Peat accumulation starts. Phragmites is the major peat component, with in combination of Amblystegiaceae mosses, Comarum palustre, Menyanthes trifoliata. Sparganium minimum etc. | Menyanthetum
CSTIM-1 (308–420 cm). Macrofossil concentration is low in this zone. | Equisetetum fluitantis

Tab 6. Summary of the zonations for Császártöltés – Vörös-mocsár I–II.

concentration suggests short range transport of this size of charcoal. The distance could be some hundreds of meters.

The amplitude of the same charcoal peaks is different in the distant sites. For example the first peak is higher in the HPIV and CSTI cores than in the CSTII core. But the second peak is higher in the CSTII core than in the HPIV and CSTI cores. This phenomenon can be explained with the short range dispersal as well. Probably the intensity and spread of fire was different in the different parts of the sand dunes.

The position of charcoal peaks together with the radiocarbon data suggest that all important vegetation changes have taken place at the same time in the whole channel (fig. 8), but local environmental factors and the geomorphological position modified the main trend of hydroseral succession. In the following the main trend of succession has been discussed. The hydroseral succession of Hajós–Kaszálók Mire is presented with vegetation maps and drawings as well (fig. 15).

Mire vegetation development

RIPARIAN PHASE
The radiocarbon and palaeoecological data suggest that the analysed filled up palaeochannel cut down from active river system of Danube under one of the neotectonic subsidence processes thus a long, uncommon oxbow lake developed at the transition phase of Pleistocene/Holocene boundary. This long canal-like oxbow lake fragmented under the filling process of Holocene. The 47 km long peatland is fragmented by small alluvial fans.47

fig. 8. Correlation of macrofossil diagrams

Jaskó – Krolopp\(^48\) and Scheuer et al.\(^49\) proved intensive neotectonic subsidence processes from the near Paks–Sárköz Depression. They proved that the river Danube appeared in the area only at the Early-Holocene (10,800 ±150 \(^{14}\)C age years BP). The neotectonic subsidence processes continued in the Holocene.


The bottom sediment of the cores was fine sand rich in muscovite and small gravels. After the deposition of the coarse grained sandy riverbed, the palaeochannel (spillstream) separated from the river Danube, and parts of it filled in differently. Different vegetation types developed because of the introduced terrestrial sediment, the different geomorphological position and the springs of the loess wall that had different chemical composition.

Therefore different palaeoassociations and different sediments developed in the palaeochannel from the Late-Pleistocene and Early-Holocene. Wide range of hydrophyte vegetation and habitat emerged in the channel from the living water to the rich fen communities depending on the water supply and geomorphological position.

The first phase of mire succession took up to 7310 year BP, when living water communities and riparian habitats dominated the channel. Even though the influence of surface waters decreased gradually, because of intensive neotectonic subsidence processes, the importance is certain up to 7310 year BP. According to the radiocarbon dating the first part of this phase can be assigned to the Late Glacial, and the second to the Early-Holocene (after 9130 year BP). The first charcoal peak at 9130 ±130 14C age years BP in the macrofossil record marks the beginning of Holocene (fig. 8). It coincides with a sharp decline in Pinus sylvestris pollen, and so most likely indicates that the loose pine forest burnt down around the palaeochannel belt, most probably as a consequence of relatively dry winters and springs followed by warm summers. The water level of the palaeochannel was high, with living and stagnant water.

The living water was without macrophytes, well oxygenised and relatively nutrient rich. This is indicated by the number of theophilous molluscs (Valvata piscinalis, Lithoglyphus naticoides, Lymnaea stagnalis, Planorbis cf. carinatus, Unio cf. crassus, Pissidium amnicum).

The living water was fringed with horsetail marsh (Equisetum fluviatile) palaeoassociation. This association emerged in almost every cores (HPIM-1, HPIIM-2, HPIIM-1, CSTIM-1 and CSTIIM-1 zones).

In the embayments of the palaeochannel poorly oxygenised oxbow lakes developed without macrophyte vegetation and mollusc associations.

On the margins of these lakes rich macrophyte vegetation emerged. Floating and submerged aquatic vegetation with Hippurietum vulgaris and Myriophyllum verticillati associations. This association emerged in the HPIV core (HPIV-I zone).

Peat formation started in the near-shore zone of these lakes, with rich fen associations (Menyanthetum, Sparganium minium – Utriculariatum). The most important vascular plants were Menyanthes trifoliata, Comarum palustre, Sparganium minimum, Phragmites australis and Carex vesicaria. This community was very rich in bryophytes. The most important bryophytes were the Calliergon richardsonian, Warnstorffia sarmentosa, Calliergon giganteum, Drepanocladus aduncus, Pseudotrechmerum nitidum and Hamatocaulis vernicosus. This is the so called “brown moss carpet”, that is frequently reported from Pleistocene sediments in Hungary, but has not been reported form the Early Holocene till now. This community is very similar to the Late Pleistocene moss assemblage of Nagy-Mohos Peat Bog in NE Hungary. This associations emerged in the HPI, HPII and CSTI cores (in HPIM-2, HPIVM-1 and CSTIM-2 zones).

The pollen concentration in the first part of this phase (402-412 cm) is extremely low that suggests selective fossilisation. The principal tree species in this zone was Pinus sylvestris.

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50 A. Boros: Pleisztocén mohák Magyarországon [Pleistocene moss in Hungary]. Földtani Közlony 82 (1952) 294–301.
Small quantities of *Pinus cembra*, *Pinus mugo*, *Larix decidua*, *Betula nana*, *Hyppophaë rhamnoides*, *Ainus cf. glutinosa* and *Selaginella selaginoides* were also found. Probably extensive bare surfaces with patches of tundra vegetation and boreal woodlands dominated the terrestrial vegetation.

The second part of this phase (326–402 cm) is devoid of pollen. The lack of sufficient pollen can be explained with erosion. In the macrofossil diagram of HPIV and CSTI cores (HPIV 215 cm, CSTI 285 cm) there is a conspicuous decrease in the macrofossil concentrations (U.O.M. and Monocot. Undif. histograms) that suggests the peat degradation, probably as a consequence of the low water table. The HPIV and CSTI cores are on the margin of the marsh, so the lack of water affected mostly this part of the channel and the peat decomposed.

In the third part (HPIP-3 zone) of this phase the pollen data suggest development of a gallery forest around the study site made up of willow and abundant liana. Well-drained areas in the vicinity of the meander must have supported mixed stands of spruce (*Picea abies*) and elm (*Ulmus*); however, we can also surmise a spread in grassland dominated by *Poaceae*, *Umbelliferae* and *Aster* species.

Although the pollen sterile sediment layer (between 402 and 326 cm) has not yet been dated by absolute techniques, judging from the radiocarbon data above it (291–296 cm: 10460–10180 cal. BC), it certainly represents the final stadial of the Late Glacial, that is the Younger Dryas (YD: ~12 680–11 590 cal. BP). Pollen evidence from this period is rather scanty in the southern part of the Danube–Tisza Interfluve. The only sequence with well preserved YD pollen assemblages is Ócsa.52 Here the stadial pollen spectra are characterised by the dominance of Gramineae and *Artemisia*, arboreal pollen declines sharply with *Pinus* and *Betula* effected on the first place. Járai-Komlódi argued that cold continental *Artemisia* steppe with parkland boreal forest characterised the landscape in the area of Ócsa. Temperate deciduous tree taxa (*Quercus*, *Ulmus* and *Corylus avellana*) that were presented in the preceding Allerød interstadial did also survive the YD, but their frequency decreased. The palaeochannel at Ócsa is situated in extensive wetland area that is a former floodplain of the Danube. Sand dunes and sand formation are in a distance from floodplain, whereas Hajós is located on the fringe of the sand dunes of the Danube–Tisza Interfluve, therefore the YD vegetation must have differed remarkably. Lake Kolon and Bócsa are located in the heart of the blown sand area. Their palaeoenvironmental records53 go back to the YD. In both lakes the sediment contains large quantity of wind blown sand in this phase hinting at the intensification of sand movements. The pollen preservation is poor in these levels, therefore we have no information on the terrestrial vegetation. However pollen assemblages from the Allerød interstadial abound in Gramineae, *Artemisia* and *Chenopodiaceae*; NAP frequencies attain 70–75% suggesting that the area was predominantly treeless, cold continental steppe. Similarly to Bócsa, pockets of warm temperate deciduous trees occurred,54 however, the vegetation must have been predominantly treeless as opposed to Ócsa. On the basis of the YD blown sand movements55 we can assume that during this phase large areas lost their vegetation cover became barren in the vicinity of Hajós as well.

**REED SWAMP PHASE**

The sediment composition and the fossil assemblage changed at about 7300 year BP. Peat accumulation started in every part of the channel. The 2nd charcoal peak marks the beginning of this phase in the macrofossil record.

The onset of the reedswamp development coincides with a dramatic change in the terrestrial vegetation. The thick *Salix* scrub fringing the wetland in the vicinity of HP-I in


54 Löki et al. 1995.

the Early Holocene disappears; *Quercus, Corylus, Ulmus* and *Tilia* expands, whereas *Pinus sylvestris* and *Picea abies* withdraws from the area. This change to a predominantly deciduous canopy is accompanied by the occurrence and immediate increase of Aster-type and *Artemisia* pollen. Both taxa attain frequencies near 20%; their increase takes place in the expense of *Gramineae* species suggesting a major change in the steppe vegetation. Instead of the elsewhere characteristic afforestation or forest expansion (e.g. Báb-tava, Ócsa, Tiszagyulaháza, Pocsaj), in the area of Hajós we witness the expansion of warm continental loess and sand ‘pusztas’ rich in *Artemisia, Compositae* and *Umbelliferae* species. The increase of these taxa suggests increasing aridity in this area around 8000 cal. BP (fig. 6) that is the end of the Boreal chronozone. *Artemisia* and Aster-type pollen retains high values throughout the Atlantic chronozone and arboreal pollen frequencies decline gradually. If we assume that sedimentation was continuous throughout the Atlantic phase in HP-I, then we can conclude that the sand area to the east of Hajós must have remained open throughout the mid Holocene with only pockets of mixed-oak forests.

The mollusc palaeoassociation (*Planorbarius corneas, Lymnaea palustris, Segmentina nitida* in HPIMo-2 zone) suggests that a shallow lake developed in the analysed palaeochannel during this phase with emerged and submerged vegetation.

The vegetation of the channel became uniform. Reed swamp covered the entire basin. The occurrence of *Thelypteris palustris* remains suggest the presence of floating reed swamps (*Thelypteridi-Phragmitetum, Thelypteridi-Typhetum*) in the deeper part of the basin. This fossil plant association is very poor in species. The macrofossil record not suggests submerged vegetation in this phase.

This sedimentary phase can be traced everywhere in the basin with different thickness, 20 cm at HPII, but 80 cm at CSTI. The later (CSTIM-3 zone) contains large quantity of inorganic material (aleurit) washed into the basin by the near stream come from the Sand Dunes. The increased erosion activity can be explained with the continuing neotectonic subsidence processes. The changing relief caused increased sediment infilling through the loess-canyons. The large amount of terrestrial material infilled some parts of the channel and separated the embayments near the loess wall. The result of erosion activity of this period can be seen in fig. 5. The infilled northern part of the Hajós–Kaszálók Mire is shown as an important, and nearly the only crossing point across the peatland in the medieval military maps.

The Hajós–Kaszálók Mire separated from the inundations of the river Danube. After this event, this part of the palaeochannel could have been supplied with poorly oxygenated underground water. The connection with the river Danube must have remained continuous at the northern part of the Vörös-mocsár (CSTII), where reedswamp, water-crowfoot and water-lily communities dominate the whole sequence, with in combination with different mollusc communities.

**INITIATION OF “ZOMBÉK”-FORMATION**

After 3900 year BP the climate became much more favourable. The 3rd charcoal peak signs the beginning of this phase in the macrofossil record. Oak-hornbeam and hornbeam-beach forests emerged, but steppe area increased to 75–80% as well. Presumably, beach forests increased on the floodplain of the river Danube, and grazed meadows, crop-fields and hay meadows replaced the mixed forest-steppe on the Sand Dunes. Although the climate must have become more humid in this phase, the strong anthropogenic signal suppresses the arboreal vegetation change.

Mollusc remains were found only in HPII (HPIMo-3 zone). *Valvata cristata* shells are frequent (more than 70%), and the frequency of aquatic (*Pisidium spp, Armiger cristata*) and amphibious (*Succinea oblonga, Oxyloma elegans*) elements are the highest in this zone. Due

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56 Magyari 2002.
57 Járai-Komlódi 1996.
58 Magyari 2002.
to the wetland vegetation succession that entailed a decrease in pH, mollusc shells are missing in the upper part of the sediment in Hajós–Kaszálók Mire.

The water table became higher and diverse mire vegetation developed in the channel of the Hajós–Kaszálók Mire. The tussock-hollow formation (‘zsombék-semlyék’) becomes the dominant vegetation type. Large tussocks of Carex elata standing in shallow, fluctuating water (the ‘zsombék’-formation of Tuzson61) is a typical mire vegetation type (Caricetum elatae plant association) of the Hungarian Lowlands. This association frequently form complex with hollow associations (pioneer mud and floating aquatic associations) and very rich in species. The joint occurrence of pioneer mud (Cypero-Juncetum bufonii) and floating aquatic (Nymphaeetum albo-luteae) associations suggest high, but fluctuating water table. High water table was in spring and early summer, but low water table and bare mud surfaces likely prevailed in late summer.

This association emerged in almost every cores (HPIM-4, HPIIM-4, HPIIIM-3 and HPIVM-4 zones).

PCA was used to highlight the ecological characteristics of the different taxa in the HPI, HPII and HPIV cores. The principal component biplots (figs 16–18) provided a sharp ecological gradient from eutrophy on the left to oligotrophy on the right. The changing position of Equisetum fluviatilis in the PCA biplots can be explained with the changing water supply, living water in HPI and HPII cores (Early Holocene) but ground water in HPIV core (Late Holocene).

BREAKING DOWN OF “ZSOMBÉK”-FORMATION

In the first part of this phase, between about 1700 and 1650 years BP (92–138 cm) high amplitude charcoal peaks in the macrofossil record suggest intensive burning in the area. Pollen preservation in this part of the sediment was poor that is most likely related to the high charcoal content. Since the pollen record below 138 cm points at intense human disturbance of the natural vegetation (crop production, grazing, trampling, hay cutting), it is conceivable that the charcoal peak represent fires of human origin, but its natural origin can not be excluded.

The first part of this phase is between the 4th and the 5th charcoal peaks. The increase of wood in the macrofossil record (emerging willow swamp) suggests low water table. According to historic data62 and some pollen diagrams that have high resolution pollen spectra representing the 1st millennium AD,63 there was a period between ca. AD 700 and 1100 when the climate of the Charpathian Basin became more arid. This is indicated by a gap in sedimentation in the Tapolca basin that was accompanied by high Pinus pollen frequencies and poor pollen. Similar changes were found in the pollen record of the Sarló-hát sedimentary sequence in the NE part of the Great Hungarian Plain.64 According to the radiocarbon data this period occurred in this area between ca. AD 200 and 500.

The water table in the channel became lower. The diverse tussock-hollow vegetation complex degraded. Carex elatae became the dominant plant association. Pioneer mud and floating aquatic (hollow) associations disappeared. Willow swamp (Calamagrostio-Salicetum cinereae) emerged in the deeper part of the channel (HPIM-5 and HPIIIM-5 zone). This way of hyroseral succession is common in recent mires under anthropogenic influences (water regulations).65 The structure of the hummock-hollow complex become much more dense, and the bare mud surfaces disappear. This association emerged in almost every cores (HPIM-6, HPIIIM-4, HPIIIM-6 and HPIVM-5 zones).

In the second part of this phase, after 1650 year BP (20–92 cm) the climate became favourable, warm and moderetaly arid. Mixed oak and oak-hornbeam forests emerged. Strong anthropogenic signal and extensive forest-steppe area was detected in this zone. The hollow associations and

64 Magyari 2002.
Equisetum fluviatilis return in the HPIV core (HPIVM-6 zone) that suggests the importance of periodic springs at the bottom of the near loess-wall. This springs were fed the marshes with ground water in humid periods. One of this springs is very close to the HPIV borehole.

Altermative Pathway in the Vörös-mocsár Mire

The connection with the river Danube remained continuous at the northern part of the Vörös-mocsár and the inundations reached the area. The larges flood reported in 1873, but smaller in 1941, 1945 and 1956 as well.

The oxigene, nutrient and carbonate rich waters altered the main direction of hidroseral succession. *Phragmites* dominated plant associations emerged in the whole sequence. For example at 3960 year BP (3rd charcoal peak) when the shift of *Caricetum elatae* community was remarkable in the Hajós–Kaszálók Mire, the humid climate results the shift of *Phragmitetum* associations in the CSTI core. In this core the shift of *Carex elata* was only a periodic event (CSTIM-4 zone). At last *Carex elata* presents remarkable quantity only in CSTIM-7 zone after 1700 year BP.

It is highly important to remark, that there is a hiatus in the upper part of CSTII core. The absence of younger charcoal peaks (3rd -5th peaks) in this core and the radiocarbon data suggest this hiatus. This can be easily explained with the water regulations and peatcut in this part of the peatland.

**Conclusions**

A new quantitative palaeobotanical method for the description of organic sediments (lake sediments and peat) is presented by the authors. The Peat Component System with the palaeobotanical description of macroscopic organic material allowed us to reconstruct the hydroserai succession and hydrological changes. The modified “semi-quantitative quadrat and leaf-count macrofossil analysis technique” (QLCMA of Barber et al.) was used to quantify the peat components. The specific peat components help us to reconstruct past plant associations, but the non-specific peat components also contribute to the reconstruction of environmental and hydrological changes (water level changes). The small charred wood fragments (larger than 300 µm) are mostly allochton elements in the macrofossil records. By comparing the charcoal histograms and radiocarbon data of the multiple corings with each other it is possible to describe the hydroseral succession in space and time (figs 8, 15).

This quantitative plant macrofossil technique together with pollen, molluscs, and radiocarbon analyses have been used to reconstruct the postglacial mire development of an eutrophic peat bog in S Hungary. The analysis of the Holocene peat sequence was used to reconstruct the development of a filling up spillstream of River Danube. The reconstructed palaeohydrological and hydroseral changes were compared with the coincident terrestrial vegetation alterations.

The Vörös-mocsár Mire get well oxigenised, nutrient and carbonate rich surface water since the sediment accumulation have started. *Phragmites* dominated plant associations emerged in the whole sequence. The rise of *Carex elata* was only a periodic event. At last *Carex elata* emerged only after 1700 year BP. The Hajós–Kaszálók Mire isolated from the flood waters of the Danube and got only underground water since the Early Holocene, when the increased erosion activity, caused by the Holocene neotectonic subsidence of the Solti Plain, got large amount of inorganic sediment to the cannal. *Phragmites* dominated plant associations emerged only in the Early Holocene. Tussock-hollow forming *Caricetum elatae* plant association emerged in the fragmented channell, because of the increasing oligotrophy and improving climate after 3900 year BP.

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66 Barber et al. 1994.
67 This research was supported by the Hungarian Science Fundation (OTKA) under Grant No. T 034392 and T 45947. We thank Kiskunság National Park Directorate for granting permission to core the study site and for funding this research. We also thank Csaba Biró, Zoltán Vajda and Zoltán Sebestyén for providing maps and data of the site, Róbert Vidéki and Zsolt Molnár for recent botanical data.
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fig. 9. Macrofossil diagram of HPI core (1: seed, 2: rizodermal tissue, 3: epidermal tissue)
fig. 10. Macrofossil diagram of HPIL core (1: seed, 2: rizodermal tissue, 3: epidermal tissue)
fig. 11. Macrofossil diagram of HPIII core (1: seed, 2: rizodermal tissue, 3: epidermal tissue)
fig. 12. Macrofossil diagram of HPIV core (1: seed, 2: rizodermal tissue, 3: epidermal tissue)
fig. 13. Macrofossil diagram of CSTI core (1: seed, 2: rizodermal tissue, 3: epidermal tissue)
fig. 14. Macrofossil diagram of CSTII core (1: seed, 2: rizodermal tissue, 3: epidermal tissue)
fig. 15. Hydroseral succession of Hajós–Kaszálók Mire. Wetland plant communities:
1. living water, 2. Equisetetum, 3. stagnant water, 4. Myriophylletum, 5. Menyanthetum,
6. Thelypteridi–Phragmitetum, 7. Caricetum elatae, 8. Calamagrostio–Salicetum cinereae,
9. Nymphaetetum and Cypero–Juncetum
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fig. 16. Principal component biplots of selected macrofossil spectra of HPI core

fig. 17. Principal component biplots of selected macrofossil spectra of HPII core

fig. 18. Principal component biplots of selected macrofossil spectra of HPIV core
Before the beginning of the Neolithic, several radical changes took place in the life of Late Mesolithic groups of Europe. As a result of these, Mesolithic communities left behind much more signs of their activities, which are more easily distinct than sediments and palaeontological finds. Archaeologists have previously regarded the uniform transformation of stone tools during the Late Mesolithic as an unambiguous sign of a process determined as preneolithization. Preneolithization forms an important component of the process through which cultivation and the productive economies emerged.

With the help of my research I was trying to elucidate something about the effects of the Preneolithization process in a base profile of the Holocene age bearing a high importance for future environmental historical reconstruction and studies. The other thing I was seeking an answer for: what was the exact timing of this process – if present at all – in the profile? Furthermore, I wanted to clarify what can exactly be regarded as the outcome of this phenomenon from an environmental historical point of view.

fig. 1. The location of the site
The study area

The site of Zalavár is located west of Lake Balaton (fig. 1), in the proximity of the Kis-Balaton Natural Conservation Area. The Kis-Balaton (Little Balaton) is a continuous swampy area, which has been artificially drained several times during history. The major interventions took place during the 1950's when the area was totally drained out and used for agricultural purposes. Reinundation started at the beginning of 1990's when serious environmental problems emerged concerning the water quality of Lake Balaton and the importance of this swampy area in filtering the water going to Lake Balaton was recognized.

In fig. 2, the digital landscape model of the surrounding area is shown. The western part of this region is characterized by the so-called meridional valleys of the Zala-hills. One of these valleys is the Hahót-basin, from where I have also studied several pollen profiles.1 This basin is surrounded by the ridges of the rolling hills of Zala which run north to south with their characteristic streams: the Szévíz and the Principális-channel (constructed by the Romans), whose valleys run in a meridional direction from a joint basin. This Digital Landscape Model (prepared by Gábor Timár) is based on a satellite image from 1990, when the Kis-Balaton was not yet inundated. Nowadays, the entire area west of Lake Balaton is covered with water.

To help in the understanding of the archaeological history of the area west of Lake Balaton I would like to present a drawing (fig. 3) from Sándor Jaskó.2 That figure presents the cross-section of the north of Kis-Balaton area with a typical terrestrial island: Island Páhok. The archaeological site of Zalavár together with those of the Hahót-basin and the archaeological site of Vörös–Mária asszony-sziget are situated also in such a terrestrial island, some meters above the present day water level (104.5 m) around 110–115 m a. s. l. protected from inundation.

The vegetation around Kis-Balaton

In the meridional valleys one can find the typical flora of the Preillyricum between the Illyricum phytogeographical province of the Western Balkans and the Pannonia region of most of modern day Hungary. The vegetation is characterised by a mixture of beech and pine forest. The typical tree species are the following: Fagus sylvatica L., Pinus sylvestris L., Carpinus betulus L. and Quercus petraea L.

There are also numerous Illyric, Mediterranean and Alpine flora elements which inhabit the undergrowth of oak forests. One can find large stands of alder trees (Alnus glutinosa L.) which grow in wet meadows whose water table is constantly high. In the more open parts, close

2 Jaskó 1947.
to the Kis-Balaton, around the mires are farmlands, cultivated areas can be found. Nowadays, most of the surroundings of the coring point are un cultivated; the level of the underground water is high with tall sedge vegetation. In the surroundings of the coring point typical aquatic vegetation is found.3

Coring, treatments and age determinations

The mire was explored by the National Peat Cadastral Survey. The coring point was pointed out by Hervé Richard and his colleagues of the Laboratoire de Chrono-écologie of Besançon during a field trip in 1992, based on a 1 : 2880 scale map and on the advice by Miklós Szabó and Zoltán Czajlik that was put at my disposal in 1998. The palynological analyses were made in the Laboratory of IMEP, in Marseille during my PhD studies. The borehole was deepened using a so-called Russian peat sampler, which excludes younger pollen contamination and guarantees the acquisition of an intact sediment core.

During the chemical treatments I followed the standard laboratory method of Erdtman4 completed by the dense media separation method using Cd-12 (Thoulet).5 If it was necessary I used an additional step of sieving on the organic material to remove the additional coarse debris to facilitate the pollen counting.

Four samples from the 4 m long sediment core were sent for AMS dating to Gif-sur-Yvette with the cooperation of Martine Pattern. Unfortunately, one of these data is in inversion and the base date was considered to be also too young compared to the results of the palynological analyses and both were rejected. Later new samples were sent for bulk sample dating. The results of this second dating justify our previous hypothesis and seem to be in good correspondence with each other, with the previous, accepted ones (fig. 4).

In fig. 5. there are the accepted dates concerning the lower section of the sequence (380–205 cm). All of the dates are drawn on a calibrated calendar year (cal. BC) scale which shows the existence of an almost linear sedimentation rate.

Results of the palynological analyses

The results of the pollen analyses (fig. 6) show a continuous sequence from the end of Late Pleistocene/the very beginning of the Holocene until approximately 700 year BP. In

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3 Hortobágyi - Simon 1981.
fig. 4. The radiocarbon dates concerning the beginning of Holocene, the Mesolithic–Neolithic transition (using atmospheric data from Stuiver et ál. 1998; drawn by OxCal v. 3.5, Bronk Ramsey 2000)

this paper I only would like to discuss the results of the analysis of the first 4 local pollen zones, from ZV-a to ZV-d, covering the period from 10 000 BP to 7000 BP, the Palaeolithic, Mesolithic and Neolithic.

ZV-a (380–345 cm)
The dominant taxon is Scots pine (Pinus sylvestris) with frequencies around 60% of the total pollen sums which shows that the vegetation in the beginning of the Holocene was dominated by pine forests. The pioneer taxa: birch (Betula) and hazel (Corylus) can be found at the marginal sides of the forest. One can only find very low percentages of the thermophyous tree taxa. The forest is surrounded by a dry steppe-like environment with mugworth (Artemisia) and a great variety of taxa. This type of environment is typical for the very beginning of the Holocene which is supported by the radiocarbon date: 9550±60 BP. The presence of other herbaceous taxa such as Filipendula, Lamiaceae and Ranunculaceae shows a relatively humid environment. The members of the local vegetation, Cyperaceae, Typha/Sparganium are abundant and the aquatic taxa (Alisma–plantago aquatica, Myriophyllum spicatum, Nuphar lutea, etc.) show low, but constant water levels on the site and the proximity of Lake Balaton.

ZV-b (345–325 cm)
The most important alteration is the sudden augmentation of Scots pine frequencies until a maximum of 90% while birch has an important decline. Other mesophile forest taxa such as Quercus (oak) and Ulmus (elm) have their regular occurrences.

Other coniferous species such as spruce (Picea) and fir (Abies) rise and have their transitory maxima.

fig. 5. The accepted radiocarbon dates on a calibrated BC scale
The herbaceous vegetation is dominated by *Artemisia*, such high percentages of this taxon have never been found in any other pollen sequence in this region. The other steppe elements, such as goosefeet and the grasses (*Chenopodiaceae, Poaceae*) are also well represented. The steppe-like environment is persisting but the typical elements of the wet-mesophile prairies are also spreading (*Apiaceae, Filipendula, Rubiaceae* and *Ranunculaceae*). The palynological richness is very high in this local pollen zone.

**ZV-c (325–255 cm)**

Because of two periods of different sedimentation during which the pollen grains are very poor preserved, we have to distinguish during this zone 4 sub-zones. The palynological richness is very variable during two of the sub-zones having taphonomic problems, the richness is decreasing, but the elevation of the frequency values during this period is evident.

**ZV-c1 (325–305 cm)**

At the beginning the rate of *Pinus* is lower and is parallel to the high value of *Betula* (birch). The continuous curve of the trees of the mixed oak forest is observable, oak (*Quercus*), lime (*Tilia*) and elm (*Ulmus*) are very abundant. *Corylus* (hazel) is the second dominant taxon after *Pinus*. There is the beginning of the elevation of *Picea* and *Abies* curves. Among the herbaceous taxa, *Poaceae* are well presented, the steppe species, as well as the wet-meadow species are very sporadic. *Alnus* (alder) is regularly present, the *Pteridophytes* are at their highest level, *Typha* and *Cyperaceae* are continuously at a high level.

**ZV-c2 (305–290 cm)**

The sediment is filamentous peat. *Pinus* pollen reaches the highest level and dominates the pollen assemblage; *Abies* and *Picea* are also preserved due to their highly resistant pollen grains. The values of mesophyle taxa have a sudden drop contemporaneous to the presence of the filamentous peat sediment.

**ZV-c3 (290–270 cm)**

Like during the first sub-zone, the percentage of pine is less elevated. The birch is almost missing. The members of the oak forest (*Quercus, Tilia, Ulmus*) are present again with high values. *Corylus* is raising and remain the co-dominant taxon. Among the herbaceous species, *Poaceae* increase and steppe species are very sporadic, *Artemisia* has totally disappeared. The wet-meadow species are rare, but present.

**ZV-c4 (270–255 cm)**

The second filamentous peat section is presented in the sediment. Similarly to the first sub-zone grown poor in pollen, *Pinus* has a maximum and dominates the pollen assemblage, *Abies* and *Picea* are also preserved. The values of the mesophyle taxa have again a sudden drop contemporaneous to the presence of the filamentous peat sediment, except to some grains of *Ulmus* and *Corylus*. The curve of grasses (*Poaceae*) raises.

This is the appearing/initiating period of the thermophylous oak forest; the very beginning of the zone is dated to 8950±60 BP. There are two trenches of that zone in which the pollen preservation is erroneous. The taphonomic problem is attached to the presence of filamentous peat. The pollen spectra associated with this sub-zone are very poor in *Corylus*, it can not be ruled out that this reduction is attached to a problem of different pollen conservation.

**ZV-d (255–200 cm)**

This part of the sequence is the most important from the viewpoint of neolithization. During this period a strong forest cover with a species rich mixed oak forest is present dominated by hazel. One can notice two or three distinguishable peaks of *Corylus* pollen. The first peak is dated to before 7530 ± 110 BP (6380 cal. BC) at 245 cm; the second right after this date and the third at 7260± 120 BP (6120 cal. BC) at 205 cm depth. These sudden raises in the pollen percentage (from 10% to 20%, from 10% to 30% and latter from 20% to 50%) are referring to the collection of hazelnut (*Corylus avellana*). There seems to be a strong correlation between the increase of hazel pollen grains and the strategies applied during gathering.

Almost all taxa of the oak wood are present with high frequencies. A coniferous forest of *Picea* and *Abies* also appears not far from the site either indicating a mosaic like environment following the exposures, or a real mixture of the different taxa that one can find currently
fig. 6. Pollen diagram with the most important taxa
in the region. Although Fagus (beech) is already regionally present with sporadic pollen occurrences in the sequence as early as the beginning of the previous zone, it settles down definitively in the forest during this phase, associated with the Atlantic period. The continuous presence and periodic rise of Fraxinus (ash) and less clearly detectable rise of Tilia (lime) may show the utilization of the shoots and foliage of younger ashes (Fraxinus) and lime (Tilia) for animal feeding.

In the humid zones we can remark a modest progression of Alnus, which is probably associated to the gallery forest (ripisylvae) on the margin of mire, dominated by Pteridophytes. Among the herbaceous taxa Poaceae is dominant but the presence of some anthropogenic plant species is also remarkable. The rise of those taxa is focused around the depth when the hazel peaks are also present. The third elevation of the different arboraceous and herbaceous species is the most important around 7260±40 BP (6120 cal. BC) when the Neolithic population is already settling down in the region.

The neolithization process in Central Europe
The central part of the Carpathian Basin seems to be one of the most important areas in the process of European neolithization. This area forms the northern boundary of expansion of the Körös-Starčevo cultures. Sümegi and Kertész proposed a new agroecological model for the whole of the Carpathian Basin based on palaeoecological, climatological and pedological research as well as the results of the latest archaeological data. Previous models treated the environmental and social factors, which influenced the expansion of the Early Neolithic communities bearing their cultural roots, agricultural production experience in the Balkans and Mediterranean areas. In the new model – in contrast to the previously offered theories – a fundamentally different approach is present, offering an explanation on the past relationships between man and the environment, the spreading of neolithization at a macro-scale (at thousands of square kilometres).

The palynological sequence of Zalavár gives signs of the effects of the palaeoenvironment during the neolithization process on a local scale (fig. 6).

The role of loess covered terrestrial islands on flood-plains in the Central European neolithization
The appearance and settlement of the new cultures originating from the Balkans and Asia during the Early Neolithic, had a highly important role in the evolution of the environment of the Carpathian Basin. This is the time when such an anthropogenic impact started that finally led to the transformation of the original natural conditions of the Great Hungarian Plain. In fig. 7, the distribution of the archaeological sites with Mesolithic finds and tools marked with black and the excavated Mesolithic archaeological sites marked with white can be seen. Before the beginning of the Neolithic, several radical changes took place in the life of the Late Mesolithic groups of Europe. As a result of these, Mesolithic communities left behind many more signs of their activities which are more easily distinguishable in the composition of the sediments and the palaeontological finds. The uniform transformation of stone tools during the Late Mesolithic have been previously regarded by archaeologists as an unambiguous sign of a process identified as preneolithization. Pren eolithization forms an important component of the process through which cultivation and the productive economies have been developed.
During the Early Neolithic settlements of the Körös culture were clearly connected to alluvial plains of the rivers (fig. 8). According to several authors, hydromorph soils of the alluvial plains must have had an important role in the economies of the Körös culture. Sümegi examined this process at a local and regional scale and found no signs of homogenous geomorphologic conditions neither around the area of the Körös culture (in the river valleys), nor in the territory of the Starčevo culture (in the lake and brook systems). He found very different subsoil water level, base-rock, soil and vegetation conditions around the Early Neolithic settlements and distinguished two settlement types – on an environmental basis – within the Körös culture.

We can found such settlements in the Körös and in the Tisza valley. In the Körös valley the Holocene along with the Pleistocene alluvial surfaces, loess covered rest-surfaces with backswamps, levees and river channels can be clearly separated. In the Tisza valley loess covered terrestrial island- and peninsula-like Pleistocene relict-surfaces developed on the alluvia during the Holocene riparian process. Several differences in settlement strategy caused by the regional and micro-scale mosaicity can be clearly seen.

Two different types of economies seem to have been established on the two major surfaces with different geological histories and different landscape as well as hydrological conditions. These differences in settlement properties raise a very important question for consideration. During the Early Neolithic, groups living in the Carpathian Basin on the northern periphery of their expansion had to undergo an adaptation process earlier. During this adaptation process their landscape use and settlement strategies had to be changed as they moved from a predominantly alluvial area towards elevated loess covered surfaces. This

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17 Sümegi 2000.


provided an excellent opportunity for the extension of the previously acquired productive economies to the loess-covered "heights". These micro-mosaics of the river alluvia and the loess covered relict surfaces probably had an important role in the neolithization process of the Carpathian Basin. It seems that these loessy alluvial island-like surfaces were primarily chosen by the Neolithic communities for settling.20

In the central parts of the Carpathian Basin, Mesolithic communities lived and migrated on the alluvia which was covered with closed forest.21 It means that the Mesolithic hunters lived in the proximity Early Neolithic farmers even although they lived on and used different habitats in the riparian environments.

**The importance of south-western Transdanubia in the neolithization process**

Very similar geological conditions developed in the neotectonic basins of Lake Balaton where several of the Starčevo communities22 chose the small loess covered islands (fig. 3)23 or loess covered meridional hills for their sites of settlement during the Early Holocene. The Early Neolithic sites around and west of Lake Balaton (fig. 9) are the following: Bebesheley, Szentgyörgyvölgy, Zánka and Tihany.24

We have traces of the activities of local productive communities from as early as 7000 BC in the Carpathian Basin, which can be interpreted as "preneolithic human influence" resulting in the emergence of open vegetational areas and the extension of marginal vegetation in several localities.25 The emergence of more open vegetation might show direct links to the

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20 Sümegi 2000.
21 Kertész et al. 1994.
23 Jaskó 1947.
settlement of Mesolithic hunting cultures and the development of Mesolithic camps during the active growth period in a woodland setting.

Although no archaeobotanical signs referring to the collection of hazelnut (Corylus) have come to light from Hungarian Mesolithic sites so far, there seems to be a strong correlation between the increase of hazel pollen grains and human induced forest burnings as well as strategies applied during gathering clearly observable in case of the Western European Mesolithic sites. A similar process resulting in the expansion of hazel following a forest fire can be observed in several pollen profiles of Western Transdanubia and the area adjacent to the Kis-Balaton region and the Hahót-valley.

As the results of palynological research on different Holocene radiocarbon dated profiles (fig. 10) indicate several, small and less important, anthropogenic changes in the vegetation took place between 6000–7000 cal. BC. These alterations seem to display direct connections (fig. 11) with a more massive gathering of hazel-nut, the utilization of the shoots and foliage of younger ashes (Fraxinus) and linden (Tilia) for animal feeding, the formation of hunting trails and camp sites, on the whole a more permanent settling and possibly the early adaptation or imitation of certain techniques and methods of production and the archaeologically proven inner developments of Mesolithic communities. Data gained through the application of natural sciences seem to further justify the previous assumptions of archaeologists, according to which right before the appearance of Early Neolithic cultures in the Carpathian Basin, an independent preneolithic phase must have developed around 7000 BC. This phase survived in the foothill areas of the Carpathians during the settling of the Körös culture.

Summary
During recent years it has been made clear that the central part of the Carpathian Basin represents a very important transitional region between the environments of the Balkan Peninsula and the western part of Europe. These two for-mentioned regions are significantly different from each other, even at the macro-scale. These environmental differences were most probably already present during the Holocene and determined the life of Mesolithic and Neolithic groups. The Central European–Balkan Agro-Ecological Barrier–CEB AEB, determined the settlement and

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expansion possibilities of the Early Neolithic Körös culture in the Early Neolithic and probably also had an essential part in the neolithization process of Late Mesolithic communities in the Carpathian Basin, and in the establishment of the Neolithic groups which are already independent of their cultural roots, and in the development of the Linear Pottery complex. A so-called infiltration zone along the main river valleys played an important role, because the Late Mesolithic and Early Neolithic communities had their contact with each other. In these transitional areas – from the aspects of morphology, climate, vegetation and soil conditions – we have to consider an environmental shift because of the effects of a micro-scale mosaicity. These different micro-environmental resources must have significantly altered and modified the settlement strategies of the Körös culture in the Neolithic and led to the establishment of settlements which are bearing alternating functions. The palynological sequence of Zalavár gives signs of the effects of the palaeoenvironment during the neolithization process on a local scale and seems to further justify the fore-mentioned processes.
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THE HUMAN PRESENCE IN POLLEN DIAGRAMS FROM ROMANIAN CARPATHIANS

Evidence for the influence of human activity in Romanian Carpathians was identified for very early times, the area constituting an important centre of civilization and culture.

The available regional archaeological information indicates the Neolithic communities belonging to Gura Baciului, Oenă Sibiului, Starčevo–Criș III–IV Cultures, estimated at 5900–5400 years BP\(^1\), as first proofs for human presence in Transylvania. More recent dating at Gura Baciului\(^2\) indicates even an older value as presumed before, of 6400 ±90 years BP (7300 cal. years BP).

Archaeological data confirming the palynological ones have been also found in some other sites from Transylvania. Remnants of Boian Culture (Middle Neolithic), dated to 5500–6000 years BP have been found at Brădet (690m altitude) and Turia.\(^3\) Four \(^{14}C\) datings were obtained at Malnaș–Bâi (5349 ±40 BP; 5407 ±20 BP; 5497 ±100 BP; 5663 ±42 BP) for the Cucuteni ceramic.\(^4\) Albiș, Peteni and Zoltán settlements were attributed to the Bronze Age (3500–4000 BP).\(^5\)

The study of the pollen diagrams in 7 sites from Romanian Carpathians, dated by using \(^{14}C\), shows the presence of taxa representing anthropogenic indicators (Table 1). Most of these indicators are present in all the diagrams, at different times. Sites from Western Carpathians (Apuseni Mts.), Southern Carpathians (Rețezat Mts.) and from Eastern Carpathians (Harghita, Căliman, and Gutăi Mts. respectively) are presented (fig. 1). These results can be considered only orientative, further studies being needed in the future for the occurrences in areas with low and moderate altitude.

The Atlantic

Recent palynological investigations in the Apuseni Mountains\(^6\) demonstrated that evidence of human impact appeared during the 7800–7425 cal. years BP period, and for the first cultivations at ca. 6820 cal. years BP. Two sequences from the Ponor karst area, in the peat


bog with the same name (1040 m altitude) evidenced the first signs of extremely early human impact. Pollen zone 1, on the basis of sequence was dated by $^{14}$C in its basal part (sequence 1). The age determined was 8990 ±80 years BP and corresponding to Boreal.

Based on $^{14}$C data on sequence 2, the following pollen zone was dated as starting at 8770 ±90 years B.P. (Boreal) and ending about 7000 years ago (6870 ±90 years B.P. in sequence 1, and 6980 ±90 years B.P. in sequence 2 respectively), thus in early Atlantic. The increase of the participation of Poaceae and the synchronous presence of some grains of Rumex, in both analyzed sequences, are considered by the author as representing the first human indicators in the region. At that time, Chenopodiaceae and Asteroidae became also more frequent.

Based on $^{14}$C data (6980 ±90 years BP, and 6400 ±110 years BP respectively) on sequence 2, next zones belong to middle Atlantic. It is better represented and on a higher thickness in sequence 1. The end of this stage is marked by the presence of Chenopodiaceae, Asteroidae, Urticaceae, Rumex, and Plantago. As in the case of the first isolated walnut tree ($Juglans$) grains (sequence 2), they are an argument for the neighbouring human communities.

Zone 5: the upper part of sequence 1 is dated at 6190 ±90 years BP Relative increase of Poaceae, Artemisia (in both sequences), Ranunculaceae (sequence 1), and Plantago lanceolata (sequence 2) pollen was noticed. Towards the end of this zone, the relative decrease of the spruce fir ($Picea$) values and the synchronous increase of hazel should be interpreted as the consequence of clearances.

Zones 6–8: in sequence 1 they are delimited by two $^{14}$C data, of 6190 ±90 years BP, and 5680 ±110 years BP respectively, thus belonging to late Atlantic. Towards the middle part of sequence 1, and the end of sequence 2 respectively, the same trend as mentioned in zone 6 was recorded. It consists in the steep decline of the spruce fir ($Picea$) curve, synchronous with the hazel ($Corylus$) peak, as a possible consequence of previously mentioned causes. Concerning grasses, the Poaceae pollen shows a slight increasing trend, and sequence 1 records an isolated occurrence of the cereals ($Cerelia$) pollen.

In both sequences from Ic Ponor a coal layer was identified, as a proof of previous fires.

Căpățâna complex (Apuseni Mountains) consists of two oligotrophic peat bogs (located at 1220 m altitude) covering a small area protected by law. First palynological and geochemical study was performed by Mitroescu et al. More recently, a new sequence was probed (Fărcaș et al., unpublished), and 7 samples were dated by $^{14}$C. The age determinations were used for separating local pollen zones. The dynamics of pollen taxa was of interest. The $^{14}$C data document a stage of the vegetation history in the Apuseni Mts. It begins with Atlantic, as suggested by the presence of the hazel ($Corylus$) pollen that is about 50% in zone 1.

The indicators of human impact in the 6 first pollen zones are scarce, and they do not seem to change the pollen spectra of trees. A relatively constant presence of the Poaceae, Chenopodiaceae, Apiaceae, Rhamnaceae, Asteraceae, Fabaceae, Brassicaceae, Urticaceae, Rumex and Plantago pollen can be attributed to modest human activities in the area. This is supported by their relatively constant low values also in the upper pollen spectra.

Rösch and Fischer (2000) obtained by drilling a peat sequence of 1.6 m from Semenic Mountains, in a site of 1400 m altitude, on which they performed complex studies (pollen and macrofossils). The results obtained show the unexpected old age of the sequence (Preboreal), due to the high degree of compression of the sediment. Based on 14C data and the results obtained, the authors divided the pollen diagram in 9 local pollen zones, each corresponding to a certain time interval of the Holocene.

First evidence on human impact was attributed to the pollen zone 5a. If we compare this diagram with the others 14C dated diagrams from Romanian Carpathians, we consider that this evidence is older in Semenic Mountains (zone 2), and we can argue this opinion.

Zone 2 (b, c): marks the middle and the late Atlantic and it was dated by using 14C at 6780 ±60 years BP. The diagram shows as a major event the decrease of the pine (Pinus) curve until almost his disappearance, correlated with the hazel (Corylus) curve increase. Concerning the human impact evidence, a great number of indicator families and taxa are present in the pollen diagram of this zone: Chenopodiaceae, Artemisia, Urticaceae (nitrophile taxa showing human habitats), Plantago lanceolata, P. major, Poaceae, Rumex, Centaurea, Apiaceae, Asteraceae, Brassicaceae, Cichorioideae, Ranunculaceae. All these indicate the first farming cultures, like forest grazing, the rotation followed by fallow, the clearance, the ruderalization etc.

The palynological study on the peat bog from Mohoș (1050 m altitude, Harghita Mountains) by Tanțău et al. 2003 based on the comparison of two sequences marked as M1 and M2 lead to the separation of 19 local pollen zones. Sequence M1 starts in the Late Glacial with three pollen zones showing no equivalency in sequence M2. Evidence of the anthropogenic impact in the region is present in the pollen diagrams starting with zone 11.

Zone 11: a decrease of the relative amount of hazel (Corylus) is compensated mainly by the relative increase of spruce fir (Picea) (M2h). In sequence M1 the presence of cereal pollen indicates that the human activity in the crater zone directly affected the broad-leaved trees formations, by favouring the development of spruce fir (Picea). This event took place 6230 ±240 years BP ago, thus during Atlantic.

The recent complex studies of the ancient crater from Şteregoiu (800 m altitude, Gutăiuului Mountains) performed by Feurdean et al., Björkman et al., evidenced aspects of the local history of vegetation starting with Late Glacial till nowadays. Based on 14C data, 19 pollinic zones were established. Human evidence in the region was noticed within zones 14–19.

Zone 14: started about 6600 years ago (near the base of zone we have a 14C data at 6425 ±75 years BP) and 7500 cal. years BP, respectively. Some peaks of Poaceae, Cyperaceae, Artemisia and Chenopodiaceae, probably caused by a human influence, characterize it. The pollinic diagram is dominated by hazel (Corylus) and spruce fir (Picea), and it was noted as belonging to middle Atlantic. The previous zone marked a decrease of the ratio A.P./T., in the favour of grasses, which was present in this zone too.

The Subboreal

In zones 3, 4 and 5 in Câpățâna, the Fabaceae pollen appears in the spectra, while Artemisia pollen disappears. Singular presence of the walnut tree (Juglans) pollen is worth to mention. Concerning the arboreal taxa, Picea registers some abrupt oscillations. Carpinus shows an increasing trend, while Corlylus a decreasing one.

In Semenic 1, zones 3, 4 and 5 (a, b) represent the Subboreal age (early, middle and late Subboreal). Zone 4 has a $^{14}$C data at 3880 ±60 years BP. The forest dynamics marks significant changes, induced by climate and other factors, possible anthropogenic. First evidence of the carrot (Daucus carota) and of the hemp (Cannabis type) pollen appears in zone 3, while the walnut tree (Juglans), cereal crops (Cerealia), wheat (Triticum), barley (Hordeum), Polygonum aviculare and Conti pollen appears in zone 5. All these show the presence of different farming types and of the culture weeds. The other herbaceous families and taxa which were pointed out in the previous zone were maintained in zone 5, too.

Tâul Zănoagutii (1840 m altitude, Retezatului Mountains) represents a reference site for palynological studies in Romania. It was first investigated by Pop et al. Recently, Fărcăș et al. who obtained new data supported by accurate $^{14}$C ages. Based on the 11 age measurements and on pollen spectra, the authors separated 9 pollen zones. Due to the high altitude in the sub-alpine level, as well as to the specific mountain landscape, the anthropogenic indicators are not very evident and abundant in the diagram. They are present only in the three uppermost zones.

Zone 7: Its base was dated at 6645 ±65 years B.P. (uncalibrated age). The first signs of human impact can hardly be noticed within the 5730 ±60 years B.P. and 5275 ±55 years B.P. interval, after the debut of the hornbeam (Carpinus) expansion, that was typical for Subboreal. Several peaks of various grass taxa such as Poaceae, Asteroideae, Rumex and Apiaceae can be noticed in the pollen diagrams.

Some cereal taxa were noticed in the spectra from Mohos, starting with the optimum stage for hornbeam (Carpinus) and during the whole beech (Fagus) phase. Their pollen is usually accompanied by Plantago pollen, lanceolata type (local zones 17, 18, and 19), which is another anthropogenic indicator taxon.

Iezerul Căliman (1650 m altitude) is the most representative palynological case study in Căliman Mountains (Fărcăș et al.). Its location is significant for the postglacial dynamics of trees, their occurrence and expansion, as well as for the interpretation of their migration from the glacial refuges. The diagram from Iezerul Căliman was separated into 8 pollen zones, based on the curves of the main taxa and on the $^{14}$C data. As in the case of other investigated sites, the human impact becomes visible starting with pollen zone 4, attributed by using $^{14}$C (4200 ±100 to 4010 ±90 years BP, uncalibrated age) to Subboreal.

Zone 4: the first anthropogenic proofs occur at this level, being represented by the sporadic presence of the walnut tree (Juglans) pollen, by the Poaceae pollen that registers a modest peak, as well as by a more significant evidence of the Rumex pollen.

At Steregoiu, zone 15 has an uncalibrated radiometric age of 3680 ±70 years BP (4000–4,500 cal. years BP), indicating the middle Subboreal age. Some sparse grains of Plantago lanceolata begin to appear in this zone.

The Subatlantic

In Apuseni Mountains (Ic Ponor), in the rest of pollen zones (9 towards the surface), an increase in amount of pine (Pinus) and birch (Betula), pioneer species that follow the massive clearances of spruce fir (Picea) forests, can be noticed. Hornbeam (Carpinus) and beech
(Fagus) register in this area their absolute maxima within the analyzed sequences, while towards the surface their curves decrease. In the pollen diagram of sequence 1 the first grains of walnut tree (Juglans) pollen are also present. The end of this zone registers the strong decrease of the A.P./T. ratio in the favour of grasses. The relative regression of trees reflects the anthropogenic destruction of forests at all the altitudes.

The Poaceae and Chenopodiaceae pollen registers an increasing trend in both sequences. The pollen of Artemisia, Centaurea cyanus, Rumex, Cannabis tip, Urticaceae, Plantago lanceolata (very characteristic in sequence 1), and P. coronopus, as well as some cereal grains (Cerealia) and one single, isolated occurrence of rye (Secale) are present in sequence 1. It is worth to mention the sudden occurrence and the peak of Onobrychis pollen, a fodder leguminous plant.

In Câpatâna, zone 7 has an uncalibrated radiometric age of 2080 ±90 years BP, indicating the early Subatlantic period. Single occurrences of the walnut tree (Juglans) and cereals pollen are compensated by constant values of pollen belonging to various herbal families with anthropogenic significance. As an exception, the Poaceae pollen registers a slight increase.

The base of zone 8 indicated a 14C age of 2180 ±200 years BP, which is doubtful in our opinion. The dynamics of competition between arboreal taxa is characterized by coupled evolutions of spruce fir (Picea) and fir tree (Abies), in opposition with beech (Fagus). The presence of the walnut tree (Juglans) pollen becomes more noticeable, while cereal pollen is totally absent in this local pollen area.

In zone 9, the decline of the fir tree (Abies) and beech (Fagus) curves, correlated to the increase of pine (Pinus) and birch (Betula) ones suggest more intense anthropogenic processes connected to forest grazing and clearance. The increasing trend of the Poaceae, Cyperaceae and Ranunculaceae curves plead for the same factor.

Zone 10 was dated at 290 ±120 years BP in its base (Late Subatlantic). The reversed ratio between the decline of the spruce fir (Picea) curve – due to economic activities, and the increase of the birch (Betula), pine (Pinus) and alder (Alnus) curves – due to human impact is clearly visible in the pollen spectra. In the surface horizon the revival of spruce fir (Picea), favoured by anthropogenic plantation is worth to mention. In the same area, the pollen of cereals becomes more significant, as a result of agricultural activities, but also of the presence of the Rumex and Plantago lanceolata pollen.

In Semenic 1, zone 6 (a, b, c, d) covers the early and middle Subatlantic, based on 14 C data at 2560 ±110 years B.P. and 1260 ±20 years BP. Families and taxa of grasses and herbs remain the same as in the previous zone.

Zones 7 (a, b, c), 8 (a, b) and 9 (a, b) belong to the late Subatlantic age. In zone 7 the carrot (Daucus carota) pollen disappears completely; the rye (Secale) pollen shows its first evidence; the Poaceae curve increases almost until the end of this sub-zone.

In zone 8 the pine (Pinus) curve shows a slight increase that will continue in the next zone, too; the beech (Fagus) pollen reaches a new maximum; Plantago lanceolata curve marks a slight increase, while the Poaceae curve shows its maximum in the pollen diagram of this zone.

A strong human influence on the arboreal taxa appears in the pollen spectra of zone 9. The pine (Pinus) and hazel (Corylus) curves intensely increase, as compared to the previous zones. The mixed oak (Quercetum mixtum) and spruce fir (Picea) curves show a slight increase. All these increases are correlated with the regression of the beech (Fagus) and fir tree (Abies) curves in the latest sub-period (9 b).

Concerning the herbal taxa, some of them gradually disappear in the pollen diagram of zone 9 (e.g. some cereal crops, Urticaceae, Rumex, Plantago major, Apiaceae, Brassicaceae etc.). On the contrary, other taxa mark their maximum percentages (e.g. Plantago lanceolata and Cichorioideae), while the Poaceae pollen maintains its high values.

In Täul Zänogutii, the base of zone 8 is marked by the increase of the beech (Fagus) curve. The rapid changes suggest the presence of a hiatus, confirmed by the ages for the 150–155 cm level. A lack of sedimentation for about 2000 years made dating of regional
spreading of beech (*Fagus*) impossible. Here it is associated with a low but continuous curve of fir tree (*Abies*). Concerning anthropogenic indicators, they continue pollen zone 7 with the previously mentioned taxa. In addition, a slow but continuous increase of the pine (*Pinus*) curve, that will register a significant peak in the basal part of next zone, can be interpreted as a human contribution.

Zone 9: The radiometric age (315 ±50 years BP) corresponds to the late Subatlantic, and it marks the beginning of the decline of the beech (*Fagus*) curve in the pollen diagram. This corresponds to a peak of spruce fir (*Picea*). The pine (*Pinus*) revival is noticeable till the surface levels, where a slight birch (*Betula*) maximum can be also recorded. Hornbeam (*Carpinus*) progressively decreases towards the surface. This dynamics of arboreal taxa is clearly determined by anthropogenic factors, as a consequence of broad-leaved trees clearance for economic purposes, and their replacement with spruce fir (*Picea*) and pine (*Pinus*). In the same time, birch (*Betula*) can be considered as a pioneer species on the areas submitted to clearance. Additionally, human impact is documented in the region by the presence of walnut tree (*Juglans*), and chestnut tree (*Castanea*) pollen; even if isolated and relatively scarce, it indicates the presence of plantations at significantly lower altitudes.

Among grasses, *Rumex*, as well as *Asteroidaeae*, *Apiaceae* and especially *Poaceae* families show a pronounced development in this local pollen zone. Constant amounts of *Artemisia* and *Chenopodiaceae* were also recorded.

In *Mohos* in zone 17, the absolute domination of beech (*Fagus*), exceptionally decreasing below 50% can be mentioned. The beech (*Fagus*) optimum lasted at least 20 centuries, between around 2910 ±90 years BP, till at least 900 ±150 BP. As in other parts of Europe, human activities caused the successful evolution and the propagation of beech (*Fagus*). Grasses are less abundant in this pollinic zone, but the local agricultural impact is proved in M1m by the regular occurrence of cereal pollen (mainly *Secale*) and *Plantago lanceolata* type.

Zone 18: The age of the base of this zone (M1n) was estimated at 540 ±160 years BP, synchronous with the first records of the walnut tree (*Juglans*) pollen. After that, the regional perturbations became evident, proved by the sharp relative decrease of the beech (*Fagus*) percentages in zone M2o (or by fluctuating relative amounts in zone M1n), accompanied by the sensitive increase of the pine (*Pinus*) percentages. Beech (*Fagus*) decline starts to be noticed at the end of this zone. The modest increase of the pine (*Pinus*) curves is a consequence of the anthropogenic clearances, which favour the occurrence of this opportunistic pioneer taxon at a regional scale. The walnut tree (*Juglans*) and cereals pollen is regularly present.

Zone 19: signs of agricultural optimum mark this modern zone. The corn (*Zea*) pollen is present in all the spectra of M1o zone, as well as the walnut tree (*Juglans*), various cereals, and *Secale* pollen. The proportion of beech (*Fagus*) brutally decreases sometimes below 20%, that of birch (*Betula*) and spruce fir (*Picea*) showing a slight increase. It is the only zone where the relative amount of A.P. (arboreal pollen) is always below 80%.

In *Iezorul Căliman*, zone 5, dated between 3240 ±100 and 2780 ±200 years BP, the decrease of the hornbeam (*Carpinus*) curve is correlated to the increase of the beech (*Fagus*) curve and to the decrease of the spruce fir (*Picea*) curve. The correlation between the hornbeam (*Carpinus*), and spruce fir (*Picea*) sharp decline with the steep increase of pine (*Pinus*) and the relatively moderate one of birch (*Betula*) towards the end of this zone can be interpreted as a result of human impact due to forest grazing and clearance. Another argument is also the A.P./T. ratio, which shows an increase of N.A.P. values. However, the whole zone is characterized by the increase of the *Poaceae*, *Asteroidaeae* and *Rumex* curves.

The last three zones, 6, 7 and 8 belong to Subatlantic, as proved also by the age of 2780 ±200 year BP measured in the base of local pollen zone 6. The main feature of zone 6 is the increase of the pine (*Pinus*) curve, with the corresponding change of the A.P./T. ratio in the favour of A.P. The cause is probably the development of *Pinus mugo*, favoured by the clearance of the spruce fir (*Picea*) forest in the view of pastoral usage. Not only the spruce fir curve, but also those of beech (*Fagus*) and hornbeam (*Carpinus*), and that of *Poaceae* seem to be affected by the *Pinus mugo* peak.
Zone 7: is differentiated from the previous one by a pronounced decline of *Pinus mugo*, correlated to the relative increase of other arboreal taxa (beech, hornbeam, spruce fir, and alder), and that of the grasses, represented by *Poaceae, Asteroidae* and *Cyperaceae* families. It may be that the intended destruction of *Pinus mugo* (probably by firing) took place for extending the subalpine pastures; a similar process happened in Căliman Mountains also close to nowadays, this time for the medical-pharmaceutical usage of *Pinus mugo* by extraction of its etheric oils. The relative decrease of *Pinus mugo* curve allows a better distinction of the participation of other trees, located at lower altitudes (mountain and hill stages).

Zone 8: the transition between zones 7 and 8 was dated by using 14C at 1710 ±240 years BP. The pollinic trends are similar to those in zone 6, the *Pinus mugo* curve showing a sharp increase up to about 50%, correlated to a relative decline of all the other arboreal taxa. Towards the surface (at 40 cm depth) in the last analyzed horizon, a new regression of *Pinus mugo* is accompanied by the relative increase of spruce fir (*Picea*) and fir tree (*Abies*) – the latest recording here its maximum, even if represented by low values (about 5%). Walnut tree (*Juglans*) sporadically shows low values starting with zone 4.

The A.P./T. ratio changes according to the evolution of the *Pinus mugo* curve, from a decrease in the transitional zone to an increase towards the surface. This involves also a slight increase of the curves of *Poaceae* family and the restoration of the *Artemisia* and *Chenopodiaceae* pollen, with syncopated curves even in these last local pollen zones. However, the landscape suggested by the pollen diagram of the last analyzed horizon (40 cm depth) matches the present-day image in the surroundings of Iezerul Căliman, where among clusters of *Pinus mugo*, flocks of sheep accompanied by shepherds can be frequently seen.

In Șteregoiu zone 16 was delimited on the base of two 14C data (3130 ±75 years BP and 2100 ±75 years BP), which reveal the Subboreal – Subatlantic transition. The strong decrease in the spruce fir (*Picea*) and hazel (*Corylus*) curves is accompanied by an increase of the beech (*Fagus*) and hornbeam (*Carpinus*) curves. Single pollen grains of *Plantago lanceolata*, *Rumex acetosa/R. acetosella* and *Urtica* can be interpreted as signs of local human influence on the vegetation.

Zone 17: was dated towards its ending at 1180 ±75 years BP (1270–950 cal. years BP), corresponding to middle Subatlantic. The beech (*Fagus*) curve reveals an increasing trend, while the hornbeam (*Carpinus*) one decreases. Human influence in this zone becomes strongly evident by the *Poaceae* peak, as well as by the first evidence of the rye (*Secale*) pollen.

Zone 18: marks the maximum value of the beech (*Fagus*) pollen. As pioneers of deforested lands, birch (*Betula*) and hazel (*Corylus*) manifest a slight increase, anthropically induced. *Secale, Plantago lanceolata* and *Artemisia* become more frequent in this zone.

Zone 19: started about 200 years ago, as indicated by the 14C data of 90 ±75 years BP and 280–170 cal. years BP, respectively. A dense forest developed, dominated by beech (*Fagus*) with more than 75% participation. Some changes are noticeable in the structure of the forest in this zone. Hornbeam (*Carpinus*) becomes less common, hazel (*Corylus*) shows a slight increasing trend, being probably favoured by the human influence. This represents the first stage when the pollinic spectra from Șteregoiu reflect a more significant anthropogenic impact.

The first proofs of cultivated cereal crops (*Hordeum* and *Secale*) are relatively minor, but the diagram contains other typical anthropogenic indicators pleading for the presence of various cultivated lands, pastures and fallow lands (*Juglans-type, Poaceae>40μm, Plantago lanceolata, Chenopodiaceae, Rumex acetosa/acetosella, Artemisia, Cannabis-type, Urtica)*.

As shown by the authors, some of these pollen types were present also in earlier stages in the pollen diagram from Șteregoiu but in minor amounts, while in the latter one, they show an increasing trend. Thus, the relative increase of the *Poaceae <40μm* and *Artemisia* pollen may signify an open vegetation in expansion, used for grazing. Even nowadays, as mentioned by the authors, this open vegetation – including forest is used for this purpose, while the vegetation of mires dominated by *Poaceae* provides the hay used as food for animals.
The authors conclude that around 1000 cal. years BP the forest grazing practice was introduced, as suggested by the regular presence of *Plantago lanceolata*, while around 300 cal. years BP evidence for arable lands at lower altitudes can be found.

**Conclusions**

Even man was present in the studied regions since the beginning of the Atlantic period, his influence on the environment in this period was quite weak and hard to identify by pollen analyses.

As mentioned in Table 1, the earliest signs of human impact on the studied sites can be dated at about 7000 years BP (Ic Ponor). Chronologically, these palynological data are consistent with the numerous archaeological data for the 8000–6000 years BP interval in the Balkans\(^{15}\), as well as with the oldest \(^{14}\)C data for the Neolithic age in northern Balkans (7500–7000 years BP).\(^{16}\)

During Subboreal, the human intervention multiplied without an amplification.

In Romania, as in many other regions in Europe, human activity was one of the factors that favoured the beech expansion and propagation during Subatlantic.\(^{17}\) The last part of the Subatlantic is the optimum period for agriculture and grazing.

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FOSSIL INSECTS AND THE NEOLITHIC: METHODS AND POTENTIAL

The *Insecta*, or *Hexapoda* (= 6 legs), belong to the phylum *Arthropoda*, characterised by having an external skeleton composed at least in part of chitin, a complex polysaccharide, which can be remarkably resistant to decay. They are found in all habitats from the edge of the sea to snow patches on the highest peaks, often in profusion. It is therefore not surprising that they are the most frequent fossils of multicellular animals found in terrestrial and fresh to brackish water deposits belonging to the last two million years, the Quaternary. Their multifarious forms mean that the fossils often show a wide range of diagnostic attributes, which allow identification, often down to the species level. Such would not be important but for the facts that many individual species have unique habitat requirements and that there is little evidence for evolutionary change, both morphological and physiological, during the Quaternary. Faced with the stresses of changing climate and environment, species have shifted their distributions, unless trapped in the isolation of mountain top or oceanic island, where change or extinction was the only option. The identifiable parts of insects, found fossil, range from the head capsules of larval midges (*Diptera, Chironomidae*) through individual mandibles of the larvae of the alder fly (*Sialis* sp.), the puparia of flies (*Diptera*) to the robust exoskeletal units of the true bugs (*Homoptera*) and beetles (*Coleoptera*). Because of the accumulated knowledge of morphology, habitat and distribution, it is the latter group which has been most exploited in archaeological interpretation, although the *Diptera* have recently been shown to have considerable potential, particularly in the archaeological context.

Any anaerobic context is likely to preserve insect remains and preservation can be equally good within high latitude and high altitude frozen ground as within the thoroughly desiccating conditions of deserts and the desert fringe. In temperate Europe, however, faunas have mostly been recovered from peats and other natural organic sediments, from alluvial silts to lacustrine deposits, or from waterlogged archaeological contexts, either wells or pits. The one neolithic well so far examined for its insect fauna, at Kolhorn in the Netherlands, has produced a rather restricted fauna. Occasionally charring, as the

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5. Panagiotakopulu, in press
7. Panagiotakopulu 2001a
assemblages from beneath the tephra of Santorini (Thera) in the Aegean or in the disposal of stored product residues may lead to preservation of insect remains, and in situations of high free phosphate content, as in cesspits specimens may be ‘calcified’. Casts within voids in deposits may also occur. Research upon insects from natural Quaternary and archaeological deposits has largely been developed in England, and it is inevitable that this discussion will focus upon work carried out there.

**Recovery of insect remains**

Until the development of an efficient paraffin (kerosene) flotation technique by Coope and Osborne, insect remains were recovered either by splitting sediment along bedding planes and searching surfaces for identifiable sclerites or by complete disaggregation of samples and sorting under a low power binocular microscope in either water or alcohol. Splitting inevitably leads to bias in favour of the larger and/or more colourful individuals, and sorting of entire samples, even if disaggregated beforehand, can be particularly time consuming. Coope and Osborne's technique, sometimes with slight variations, has become standard for the recovery of insects from waterlogged samples, although it has the disadvantage that sclerites become disassociated, increasing the difficulties in identification. In the field, samples of at least 5 litres are recovered from each suitable stratigraphic context into polythene bags and labelled and sealed. Sample size may vary as to the nature of the deposits, and a single kilogram of deposit from a well may be sufficient to produce an extensive fauna. Stratigraphic successions with little apparent change are usually sampled in 50 or 100 mm slices, depending upon the degree of resolution required. Well sealed samples will survive in storage for several years in a cold, dark room, but storage at +3°C in a cold store is recommended, since materials slowly dry out and algal growth occurs in daylight. Processing has the advantage of being cheap in terms of materials, if sometimes slow. Samples are disaggregated in hot water and washed out over a 300 μm mesh sieve. The more indurated sediments may need breaking down with a suitable deflocculant, usually washing soda (sodium carbonate) or calgon (sodium hexametaphosphate), although occasionally hot caustic soda (sodium hydroxide) solution may be employed for the most intransigent materials. Insect remains, however, may be corroded by strong alkalis, and their use must be carefully monitored. There is often a trade-off between care in initial sample processing and ease of identification of the recovered remains: the more fragmented through rough handling the more difficult the identification. Having thoroughly desegregated the material and picked out large items from stone and pottery to twigs and hazelnuts, the material on the sieve is drained of surplus water, returned to the bowl or bucket in which the sample was first broken down, and ordinary commercial paraffin (kerosene) added, sufficient being employed to wet thoroughly the material. The light oil adsorbs onto the surface of the insect cuticle, and when cold water is added and the mix vigorously stirred, a flotant is formed, which is rich in insect remains. The float is then poured off into the sieve, washed with liquid detergent and alcohol, and stored in alcohol. The process of flotation

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is usually repeated three times, although if the final float still has significant numbers of identifiable fragments, it may be necessary to repeat the additions of water until no further insects are recovered. Unfortunately floats are rarely purely of insect sclerites, and it usually necessary to sort the fragments out from a mass of plant remains. Occasionally, this has the advantage that a reasonable, if unquantifiable sample of identifiable plant macrofossils, largely seeds, is also obtained. Long term storage in alcohol is usually acceptable, but corrosion of sclerites has been noted where methanol has been used, and the material added to industrial alcohol to make it unpalatable can also result in erosion of chitin. Drying, however, often results in specimens curling up or breaking along lines of thinner chitin, although freeze-drying may alleviate these problems.

Insects either preserved by desiccation or by charring, do not respond well to wetting, and will fragment. This means that such samples cannot be treated by the paraffin flotation method. Both require sorting of the entire sample, and storage in dry conditions. This material has the advantage that individual sclerites may remain articulate, easing some of the problems of identification.

Whilst there are good keys for the identification of European Coleoptera, and Diptera, these normally require complete specimens, often utilising elements such as variations in antennal or tarsal segment length to differentiate species. In addition, many species, particularly of the smaller taxa, such as the commonly occurring aleocharine staphylinids amongst the Coleoptera, require careful examination of the genital armature (aedeagus) to secure identification. Fossil material is usually identified by direct comparison with modern reference material, and this requires access to full collections for the region involved, although it should also be noted that even on the historical timescale species may have substantially changed their distribution. The development of the BUGS database provides habitat and distribution data on much of the European coleopterous fauna, as well as listing the Quaternary fossil record for each species. It has made the processes of site interpretation somewhat easier, but the work is still time consuming and, in comparison with palynology and plant macrofossil studies, there are few practitioners. The combination of these techniques with the study of the contemporary insect fauna makes them much more powerful tools.

**Insects and climate**

The first modern studies of fossil insects from Quaternary sediments were carried out by Russell Coope and F. W. Shotton of the University of Birmingham, England. They had noticed well preserved beetle remains on the bedding planes of a thin layer of peat within mid-Weichselian (Würm) sands and gravels at Upton Warren in Worcestershire, and Shotton had immediately seized upon these as a possible means of zoning the Pleistocene. His reasoning was that most entomologists believed that insects belonged to a rapidly evolving group and would show rapid morphological variation through time. Coope was more circumspect and doggedly matched the material with existing species, a process which he repeated at the Early Weichselian site of Chelford in Cheshire. One species defied identification, a dung beetle, *Aphodius* sp. A, which was later recovered from several mid-Weichselian sites over then years later was matched with a species, *A. holdereri*, found on the high Tibetan plateau.

The Upton Warren faunas defined a temperate interlude in the middle of the last glaciation, and the contrast between a relatively thermophilous beetle fauna and an open landscape as

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Inferred summer temperature from beetle faunas in N Europe

fig. 1. Climate curve as derived from the GRIP Ice Core in Greenland, compared with the Lateglacial to Early Holocene North European Coleopteran curve

indicated by the pollen provoked some discussion. The controversy was further fuelled when beetle evidence from sites at Red Moss, Lancashire, Rodbaston, Staffordshire, Church Stretton, Shropshire in England and Glanllynnau, Gwynedd, in Wales all indicated that the climatic transitions during the Lateglacial and into the Early Holocene were not gradual processes of warming over hundreds if not thousands of years, but were abrupt changes from high arctic to warmer than present day at ca. 13 500 BP. It had been cooling to subarctic and then arctic conditions, followed by precipitate warming at ca. 10 000 BP to at least as warm as present day at the opening of the Holocene. Osborne’s well dated and closely sampled succession at West Bromwich, near Birmingham, indicated that the last abrupt change into the present interglacial took less than the standard deviation of a radiocarbon date, and in less time than sample resolution would allow, probably less than forty years. This pattern has been repeated at several sites, not only in the British Isles but also in Scandinavia. Initially greeted with much scepticism, to the extent that one leading palynologist, who would perhaps now wish to remain nameless, talked about having to differentiate between ‘pollen’ and ‘beetle’ interstadials, the evidence from the Greenland ice cores, resolved to at least an annual record, firmly placed the interpretation on the side of the Quaternary entomologists (fig. 1).

The evidence from Stage 3, the period before the maximum expansion of ice sheets during the last glacial, is particularly striking. With its frequent swings from cold to temperate in the ice core record matched closely by the beetle evidence, it should be a cause for concern.

27 Osborne 1972.
32 Coope 2001.
for the complacency of the oil lobby and right wing governments everywhere. The Holocene interglacial has been remarkably stable since its last, short cold event at ca. 8200 BP, but there is no guarantee that it will continue under increased anthropogenic pressure.

More recently the closer sample resolution available from study of the remains of the aquatic larvae of chironomids, non-biting midges from lake sediments has further refined the evidence for the precipitate nature of climate change. This is well illustrated in the multidisciplinary study of the Late-glacial succession from the lake on Kråkenes in southwest Norway, although sample size from cores somewhat limits the utility of the beetle evidence.

Although the ice core evidence indicates a relatively stable climate for the present interglacial between ca. 8200 BP and the onset of the post-medieval Little Ice Age, this does not mean that oscillations between regimes dominated by westerly and a more continental circulation pattern did not have impact. Annual average temperatures do not indicate seasonality, distribution of rainfall and storminess, all of which can have significant impact upon both insect and human communities. The record of Holocene climate available from the proxy of insect fossils has been discussed by Osborne, Wagner and Buckland and Wagner, often with differing conclusions. Wagner felt that the scale of human interference in the Late Holocene landscape was such that it was virtually impossible to dissect any climate signal from the insect record. Whilst Osborne saw a swing towards more oceanic conditions in the Late Holocene, perhaps at the sub-Boreal sub-Atlantic transition ca. 850 BC, where van Geel and others have indicated a worldwide climatic event, although its synchronicity can be doubted. The overall patterns of extinction from the British insect fauna, with a south-eastward retreat of most species, do suggest that conditions at least as late as the Middle Bronze Age, ca. 3000 BP, were significantly more continental than the present day, and this applies as much to open ground assemblages, like that from Wilsford in Wiltshire as still forested localities like Thorne Moors in south Yorkshire.

The Wilsford shaft, inevitably a ritual feature to archaeologists, but with the ritual bucket and remains of the rope for hauling up buckets of water in the bottom and an extensive dung fauna from the animals being watered at the top, has a remarkably thermophilous coprophagous assemblage with large numbers of Onthophagus spp. and Aphodius quadriguttatus. The latter now extinct in Britain and most species of the former very rare. A hide beetle, dermestid, from the site, Dermestes laniarius, which presently has an east European and Russian steppe distribution, is either a survivor in gaps in the mid-Holocene forest from the even more continental climate of the Early Holocene, when low sea level engendered continentality, or an

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37 Wagner 1997.


40 Osborne 1997.


43 Osborne 1969.

44 Buckland 1979.

45 Bell et al. 1989.

46 Osborne 1969.

Rhysodes sulcatus (F.)

Holocene Fossil Localities:

D = Church Farm, Davenham, Cheshire -9200 BP (Hughes et al. 2000)
B = Baker Site, Somerset Levels >=4950 BP (Girling 1980)
NS = North Sea Floor ?Early Holocene (Blair 1935)
S = Shustoke, Warks. ~4830 BP (Kelly & Osborne 1965)
T = Thorne Moors, S. Yorks. ~3000 BP (Buckland 1979)

fig. 2. The declining distribution of the Urwaldrelikt Rhysodes sulcatus (revised from Speight 1989). Climate change, destruction of old growth forests (Urwald) or both?

accidental import. Even in the latter case, the site lies sufficiently far inland to suggest that the species was able to establish viable populations in the climate of Bronze Age southern England. Fossil evidence shows that over thirty species of beetle have disappeared from Britain during the Holocene.48 Most of these are associated with declining woodland habitats (fig. 2), but the list is sufficiently varied to implicate climate change.

The Elm Decline, an almost synchronous event across much of northern and western Europe, marks the boundary between pollen zones VIIa and VIIb in Britain. Its origin has perhaps occasioned more discussion than any other aspect of the Holocene, largely because it is co-incident with the first clear evidence for settled agriculture in the British Isles at about 5200 BP (= ca. 3900 cal BC). Interpretation, recently reviewed by Parker and others,49 has vacillated between climate change, disease and human impact. At West Heath Spa, London, the finds of the bark beetle, scolytid, Scolytus scolytus, the chief vector in the spread of the fungus responsible for Dutch Elm Disease, which has devastated elms across Europe over the past few decades, in deposits across the VIIa/b boundary has occasioned much discussion50 and helped to revive interest in the disease hypothesis. Rowley-Conwy51 had, however, already dispelled the simple model of human collection of fodder for animals by calculating the necessary population densities of humans and domestic stock for the scale of impact on the elms of mid-Holocene Denmark. Recently Bonsall and others52 have

48 Buckland, in press
resurrected the climate change model as explanation for final phase of neolithic expansion which took agriculture north-westwards to the most remote islands of Scotland, after an 800 – 1300 year falter at the English Channel. Using evidence largely drawn from around Oban on the west coast of Scotland, they have suggested that a short phase of drier conditions around 4000 cal BC facilitated expansion onto soils previously too wet for cereal cultivation. Such a model is likely to be appropriate on the local scale, but it ignores the fact that much of lowland Britain has well drained soils, often based on well drained loess,\textsuperscript{53} similar to those across the Channel in France and the Low Countries, and unlikely to be adversely affected by waterlogging. In addition, the insect evidence from the Somerset Levels, which they adduce to support their case,\textsuperscript{54} can only be used to show that a more continental climate existed at least until the time of their deposition, and not only at that period. In fact, similar elements in the biota are still present much later. Of the two freshwater littoral ground beetles, which provide the best evidence, \textit{Oodes gracilis} is still present in the Iron Age at Goldcliff across the Severn Estuary,\textsuperscript{55} and \textit{Chlaenius sulcicollis} occurs in the deposits around the Bronze Age Meare Heath trackway.\textsuperscript{56} The implication of this and other fossil insect evidence is that the climate of the Holocene was more continental until some yet to be determined event, at the sub-Boreal sub-Atlantic transition, if not as late as the beginning of the Little Ice Age. This does not mean, however, that minor oscillations, insufficient to cause major extirpations from the beetle fauna, did not have effects upon agricultural productivity, leading to fluctuations in the degree, nature and density of human settlement. It is a truism of the farming community that what affects them is weather and not climate. In the subsistence economy, long term change can be adjusted for, the one disastrous poor summer leading to insufficient fodder for overwintering core stock and poor grain and other crop yields cannot, and starvation may be inevitable.

The Elm Decline remains enigmatic. The presence of the relevant vector is no guarantee of the presence of a sufficiently virulent strain of the disease to cause a widespread decline, and as Clark\textsuperscript{57} has shown in north east Scotland, like other scolytids, \textit{S. scolytus} is one of the many bark beetles, which form part of the natural forest assemblage through the mid-Holocene; it was not an accidental neolithic introduction to north west Europe. One point, however, is particularly relevant in that scolytid attack is not a random process and the adult beetles actively search out trees under stress, those damaged by wind throw drought or bark stripping by herbivores. Increase the level of stress, either by climate change, increased grazing pressure or other opening up of closed forest cover, and the numbers of bark beetles will increase exponentially and apparently healthy trees overwhelmed. Which species will be given the selective advantage may be purely stochastic, but its impact may be dramatic. In North America, in the absence of evidence for a significant human presence in the forests, hemlock, \textit{Tsuga} sp, shows a precipitate decline in the mid-Holocene, apparently the result of insect attack.\textsuperscript{58} In Europe, we still do not know who held the gun. Did drought open up the forest to human expansion, or did human expansion put the forest under stress leading to catastrophic insect attack? Perhaps before this question can be answered, the nature of the pre-neolithic forests themselves needs to be examined in more detail.


\textsuperscript{56} Girling 1982.


The natural 'climax' vegetation of Europe, outside the aridity of the Mediterranean zone and Steppe and below the cold of the high mountains and Arctic, is forest. Whilst there is no doubt that an overall regional picture of the composition of the vegetation is best obtained from pollen,\textsuperscript{59} insects in particular provide levels of resolution not available from palynology. Osborne,\textsuperscript{60} for example, had pointed out the relative frequency of the lime bark beetle, \textit{Ernoporus caucasicus} in mid-Holocene deposits before Greig,\textsuperscript{61} also working at the University of Birmingham, had re-evaluated the pollen and plant macrofossil record and suggested that much of the primary lowland woodland of western Europe had been dominated by \textit{Tilia} rather than \textit{Quercus}. Recent work by Frans Vera\textsuperscript{62} has raised doubts over another aspect of the primary forest, the \textit{Urwald}. His model essentially puts large herbivores back into the landscape and has implications for conservation as much as for interpreting the past. He sees a cycle in which grazing pressure leads to semi-permanent natural clearings in the woodland and a succession of pasture woodland through to mature forest with regeneration largely taking place in the margins protected from animals by the development of thorn scrub (fig. 3). It has much to commend it over the mechanistic model of progressive tree immigration from Lateglacial refugia once favoured by many palynologists,\textsuperscript{63} and more recent work has re-opened the debate over just where the refuges from glacial cold and ice lay.\textsuperscript{64} The idea that herbivores had a significant role in the

\textsuperscript{59} Moore et al. 1991.
\textsuperscript{62} Vera 2000.
\textsuperscript{64} e.g. K. J. Willis: Where did all the flowers go? The fate of temperate European flora during glacial periods. Endeavour 20 (1996) 110–114;

\begin{center}
fig. 3. The Vera Model of forest succession driven by large herbivores, as modified by Kirby 2003.
\end{center}
FOSSIL INSECTS AND THE NEOLITHIC: METHODS AND POTENTIAL

The gaps in the sequence reflect phases in which peat growth expands across the pine forested bog after extensive fire (from G. Boswijk: The buried forests of Thorne Moors. Thorne and Hatfield Moors Papers 6 [2003])

maintenance of mid-Holocene forest diversity has provoked an often hostile response, although there have been some attempts at compromise. The fossil insect record provides an independent check upon models derived from other palaeoecological evidence. Not only can individual species be monophagous, restricted, like E. caucasicus, to a single host plant, but also a succession of species tracks the death and decay of trees. Whilst these elements in the fauna may not be host specific, they chart the progress from death of terminal twigs to incorporation in the forest litter layer. Much of this fauna has suffered extensively at the hands not only of forest clearance but also of tidy forestry, in which dead wood was not suffered to remain on the forest floor. Species, like Rhysodes sulcatus (fig. 2), which lives in damp, decaying wood on the forest floor, were common in the mid-Holocene but are now approaching extinction, not regionally but totally. Pre-neolithic forests were perhaps different from anything that survives today and both Peterken and Vera, for different reasons, have stressed that even those few places, like the Bielowski Forest on the Polish-Byelorussian border, held up as examples of pristine forest habitats, have not escaped some impact, be it virtual elimination of predators on the large herbivores or selective logging. Yet, viewed with the perspective of the Quaternary, the Holocene is from the beginning an atypical interglacial. The old forest fauna, having evolved in a landscape of fairly contiguous woodland in the mid-Tertiary, is broken up and re-assembled at the end and beginning of each glacial interglacial cycle. Mid-Holocene faunas, before significant neolithic impact contain the same Urwald elements as previous interglacials, be they Marine Isotope Stage 5e (= Eemian, Riss/Würm), 7, 9 (= Hosteinian, Mindel/Riss), 11 or older, but there are differences in other elements of the faunas, which cannot be simply ascribed to biogeographic accident or climate. As Rackham has remarked, the last interglacial (Riss/Würm) at sites like Trafalgar Square in London and Deeping St. Gamo...
James in Lincolnshire look like temperate savannah rather than forest. It is probably 3 °C warmer and with increased summer aridity, the London site perhaps did approximate to that of its host institution — it lay beneath Uganda House. The last interglacial in Britain also had other similarities with East Africa. The fauna included elephant, rhinoceros, hippopotamus, buffalo, hyena and lion, none of which returned to Central or Western Europe after the last glacial maximum. This fauna is reflected in the extensive dung beetle faunas of Stage 5e, which not only include the alleged Sicilian endemic *Onthophagus massai*, but also an unidentified species of *Heptalaucus* of north African affinities and a *Drepanocerus*, a genus widespread in sub-Saharan Africa, but whose closest match to the beetle faunas of Stage 5e, which not only include the alleged Sicilian endemic *Onthophagus massai*, but also an unidentified species of *Heptalaucus* of north African affinities and a *Drepanocerus*, a genus widespread in sub-Saharan Africa, but whose closest match to the fossils comes from the lowland valleys of Nepal. The last interglacial was clearly a very different world, and such an assemblage of large game would have a major impact upon vegetation cover, not least upon floodplains. By the time neolithic farmers came to make inroads into the forests of Central Europe, earlier human impact had already had a profound impact upon its vegetation. If the floodplain forests were as dense as both the pollen and insect evidence would seem to indicate, it was because a very significant proportion of the large grazers and their predators had already been eradicated. The question posed by Vera’s reassessment of the nature of the Holocene forest cycle. Whether their place was taken by increased numbers of the resident large to medium sized herbivores, of aurochs, horse, elk, red deer, roe deer, wild boar and beaver, and whether these were the creators and maintainers of clearings in the forest, which the first neolithic colonists were able to move into. In Skåne, southern Sweden, Lemdahl has already pointed to the diverse nature of the Holocene forest and assessment of the British evidence suggests a similar picture. However there are serious spatial problems with the sampling — most samples come from the structurally complex closed forests of floodplain and lowland fen, and only Osborne’s study of the Church Stretton valley in the Welsh Borders, on the edge of the uplands of the Longmynd, indicates an essentially open, grazed pre-neolithic landscape. Part of the problem is also taphonomic, if pollen from wetland hollows in forest provides a clear view of the immediate closed woodland, the attenuated nature of these successions leads to poor insect preservation. In addition, insect dispersal of those taxa, which do not form part of the aerial plankton, is not random. A point made emphatically by the failure of insect samples from the heart of raised mires at Thorne and Hatfield Moors in south Yorkshire to register the processes leading to complete forest clearance on the surrounding higher ground evident in pollen and aerial archaeological evidence. It is evident, however, from the limited amount of insect data available that neolithic penetration was probably not along the floodplains of the major rivers, which look to have been particularly densely vegetated.

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78 e.g. Buckland 1979; Girling 1982.
79 Vera 2000.
81 Buckland, in press.
82 Osborne 1972.
if occasionally and locally broken up by flooding. As Bogucki has remarked on other
evidence, may be Gradmann’s hypothesis was not all bad, although the mechanisms for
maintaining openness were perhaps large herbivores, particularly herds of aurochs, rather
than drought.

Despite their opposing views, neither Rackham nor Vera seems prepared to include
fire as part of the natural sequence in lowland forest. In the uplands, beginning with Simmons, fire, if largely (if not entirely) anthropogenic, has been seen as a natural element in Holocene
vegetation succession, and even in the lowlands, charred trees are a familiar feature of the
stratigraphy of most bogs. At Thorne, Boswijk was able to show a return period of about
400 years for serious fires across many square kilometres of pine forested raised mire, and
the basal wet, deciduous forest, largely of oak, was similarly fire-scarred, although the return
period could not be calculated. Microscopic charcoal, either from domestic or forest fires is
a consistent feature of Lateglacial and Holocene sediment profiles. There are elements in
the European insect fauna which show that fire has been an integral part of forest history long
before there were any significant human impacts, although there can be no doubt that human
activities, both deliberate and accidental, have significantly pushed up fire frequency. The
classic example of a pyrophilic species is provided by the jewel beetle, buprestid, Melanophila acuminata. This is able to locate fires from at least one kilometre away and oviposits in burnt
birch or conifers whilst the wood is still in excess of 40 °C. In Britain it has declined to
the edge of extinction, surviving only on the Surrey heaths, west of London. Elsewhere in Europe it is restricted to those areas where fire suppression by foresters is less than complete.

Several ground beetles, carabids, are also attracted to burnt ground, and Whitehouse and Eversham (2002) have used the presence of Pterostichus angustatus, previously regarded as a
recent immigrant to Britain, in samples from Hatfield Moors to argue for continuity of
fire generated habitats. Two species of Agonum show similar attractions. A. quadripunctatum,
also increasingly restricted to lowland heaths in England, is known from Middle Pleistocene
deposits at Waverley Wood in Warwickshire, and A bogemanni appears to have been
associated with slash and burn cultivation in Scandinavia, although its primary habitat must
have been on naturally burnt ground. Whether these and several other pyrophilic species show
a similar if temporary rise in frequency during neolithic landnam remains to be seen.

88 Rackham 2003.
89 Vera 2000.
90 Simmons 1969; most recently Simmons 2002.
93 e.g. K. J. Edwards – G. Whittington: Multiple charcoal profiles from a Scottish lake: taphonomy, fire ecology, human impact and inference.
100 C. H. Lindroth: Changes in the Fennoscandian Ground-beetle fauna (Coleoptera, Carabidae) during the twentieth century. Annales Zoologici
Fennici 9 (1972) 49-64.
Insect communities and reaction to some human events

Events and reactions (absolute pop. n. changes)

<table>
<thead>
<tr>
<th>Insect’s preferred habitat</th>
<th>Deforestation</th>
<th>Farming</th>
<th>Abandonment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trees</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grassland</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clean Water</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dung/Manure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Burnt land</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Open ground</td>
<td>Natural fire</td>
<td>Periode scrub burning</td>
<td>Severe erosion; farming; non-sustainable</td>
</tr>
</tbody>
</table>

fig. 5. A theoretical model of the impact on the composition of insect faunas occasioned by a ‘small temporary clearance’

Fig. 5. attempts to summarise some of the impacts upon elements of the insect fauna created by an episode of clearance and partial regeneration in a forested landscape, a small temporary clearance, perhaps prolonged by natural or domestic animal grazing. Open ground may have been extended by ring barking of large trees, rather than felling, and this could have lead to a peak in dead wood species before a decline in forest elements. Robinson has suggested that the presence of the large chafer Valgus hemipterus at the South Stanwick long barrow in Northamptonshire reflects suitable breeding habitats in the decaying tree stumps of recently cleared land.

Insects in immediate human landscapes

Not only are insects sensitive indicators of climate and environmental change, their food requirements may be such that they are confined to one species or a group of species not separable in the pollen diagram. The example in Table I summarises the plant hosts of the fauna identified by Robinson from the sealed old ground surface and structural turves beneath Silbury Hill, a large neolithic mound on Salisbury Plain in southern England. Radiocarbon dates on the turves indicate construction around 4500 BP. The beetle fauna shows no trace of woodland, and includes many species now characteristic of old established unimproved grassland, including the elaterids Agrypnus murina, Agriotes spp. Athous haemorrhoidalis, whose larvae encompass the familiar wireworms of pasture, Dascillus cervinus and the garden chafer Phyllopertha horticola. This picture of pasture is further reinforced by the suite of dung beetles of the genera Onthophagus and Aphodius, which would have lived in the droppings of domestic animals. The table also shows the level to which the pollen would have allowed identification. In this particular example, it is the character of the landscape which is better indicated by the Coleoptera, but there are many studies group seminar papers 5. Oxford 2000, 27–36.

situations, where the plants, particularly those utilised by man for either their leaves or stems, for example flax, *Linum*, and nettles, *Urtica*, are more likely to be recorded by the presence of their *phytophages* amongst the insects than by their pollen spectra. Nettles, for example, have a particularly broad suite of insect feeders, and may be harvested either as food, before flowering, or as a source of fibres. Similarly the leaves of docks and sorrel, *Rumex* spp, can form an important source of essential vitamin C, and like crop plants in the Chenopodiaceae, are harvested before coming into flower; both may be represented only by their phytophages. In the Silbury Hill list, the most likely species of *RhinoncUs* are those which live on terrestrial species of *Rumex* and *Polygonum*, *R. pericarpius* and *R. hruchoides* and *R. castor*.

<table>
<thead>
<tr>
<th>Taxon</th>
<th>Host</th>
<th>Pollen</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Chrysolina haemoptera</em> (L.)</td>
<td><em>Plantago</em> spp.</td>
<td><em>Plantago</em> (to species)</td>
</tr>
<tr>
<td><em>Hydroischassa glabra</em> (Hbst.)</td>
<td>Ranunculaceae</td>
<td>Ranunculaceae (some genera)</td>
</tr>
<tr>
<td><em>Galeruca tanacetii</em> (L.)</td>
<td>Asteraceae</td>
<td>Asteraceae (subfamily)</td>
</tr>
<tr>
<td><em>Neocrepidodera ferruginea</em> (Scop.)</td>
<td>Poaceae</td>
<td>Poaceae (some genera)</td>
</tr>
<tr>
<td><em>Manntura matthewsi</em> (Curt.)</td>
<td><em>Helianthemum nummularium</em></td>
<td><em>Helianthemum</em> sp.</td>
</tr>
<tr>
<td><em>Sphaeroderma rubidum</em> (Graells)</td>
<td><em>Cardaus</em> &amp; <em>Cirsium</em> spp.</td>
<td><em>Cardaus</em> &amp; <em>Cirsium</em> spp.</td>
</tr>
<tr>
<td><em>Bruchus</em>/<em>Bruchidius</em> sp.</td>
<td>Leguminosae</td>
<td>Leguminosae</td>
</tr>
<tr>
<td><em>Sitona sulcifrons</em> (Thun.)</td>
<td>Leguminosae, <em>esp. Trifolium pratense</em></td>
<td>Leguminosae</td>
</tr>
<tr>
<td><em>Cleon is pigra</em> (Scop.)</td>
<td><em>Cardaus</em> &amp; <em>Cirsium</em> spp.</td>
<td><em>Cardaus</em> &amp; <em>Cirsium</em> spp.</td>
</tr>
<tr>
<td><em>Liparus coronatus</em> (Goez.)</td>
<td>Umbelliferae</td>
<td>Umbelliferae</td>
</tr>
<tr>
<td><em>Hypera punctata</em> (F.)</td>
<td><em>Trifolium</em> spp.</td>
<td>Leguminosae</td>
</tr>
<tr>
<td><em>RhinoncUs</em> spp.</td>
<td>Polygonaceae</td>
<td>Polygonaceae (to some species)</td>
</tr>
<tr>
<td><em>Mecinus pyraster</em> (Hbst.)</td>
<td><em>Plantago</em> spp.</td>
<td><em>Plantago</em> (to species)</td>
</tr>
</tbody>
</table>

Table 1. The plant hosts of the fauna identified by Robinson 1997.

One of the characters of Western society is the apparent dominance of meat and cereal products in the diet, and this is often transferred onto cultures in the past, which may have found it wholly alien, having evolved a more balanced diet, away from the Big Mac. In part the plant macrofossil record inevitably reinforces this position, largely because the chances of preservation of cereals by charring, either during processing or by burning of residues in hearths, are so much the greater than most other crops. Pulses therefore tend to be under-represented, unless unusual circumstances lead to their preservation. The material figured (fig. 6) was charred by the Late Bronze Age eruption of Santorini in the Aegean, and shows evidence of infestation by the field pest *Bruchus rufipes*. Archaeologists put great effort into sieving large amounts of sediment to recover a few charred grains of wheat or barley, often of doubtful stratigraphic integrity; the degree to which rodents and invertebrates have bioturbated sediments is rarely assessed. Not only are seed crops more likely to appear in the archaeological record, but they also have the advantage over leaf crops for human consumption in that they can be stored from one season to another, providing subsistence at times when plant and animal productivity is low. Survival, however, also relies upon being able to overwinter sufficient livestock to maintain breeding populations and in most climates of Europe this requires collection of additional fodder, either in the form of grass


105 G. Hillman: *Reconstructing crop husbandry practices from charred remains of crops*, in: *R.

fig. 6. Charred pulses from Late Bronze Age Akrotiri, Santorini, Greece.
Note the frequent exit holes of the bean weevil, bruchid, *Bruchus rufipes*

hay or leaf fodder. The role of elm in this has been much discussed since Troels-Smith’s original paper, but other trees have been widely exploited as fodder sources, and there is direct evidence from Weier in Switzerland for neolithic winter stalling of animals and use of leaf fodder. The site also provides one of the few examples of study of an insect fauna from a neolithic settlement rather than landscape context. The assemblage is dominated by puparia of the flies *Musca domestica* and *Thoracochaeta zosterae*, both of which are associated with the warm of fermenting accumulations of herbivore dung. The former, the common house fly, is essentially a warm temperate species and it has been suggested that it probably first became closely associated with Man in Egypt. If this is the case, it represents one of his first fellow travellers, able to exploit the artificially cushioned habitats, which he created, and extending its distribution during the neolithic at least as far as central Sweden where similar evidence for stalled animals has been adduced. *T. zosterae* at the present day in Britain is restricted to coastal wrack beds, whilst as a fossil it can be very common in archaeological assemblages from cess pits and similar foul accumulations. Although it was possible that seaweed was being transported inland for industrial or other use, it seems more likely that its current habitat restriction reflects improved hygiene, a point later proved by biochemical analysis of puparia; in Germany, old records of this so-called seaweed fly occur from byre residues. The insect evidences from both Weier in Switzerland and Alvastra in Sweden provide convincing evidence of stalling at least of cattle during the neolithic. In the Netherlands, Schelvis has shown that another group, the mites can be similarly employed in the detection of dung, some appearing specific to the source animal. In this context, however, ectoparasites can be more useful and may provide evidence beyond the simple species present.

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110 Panagiotakopulu. *in press*
The cattle louse, *Damalinia bovis*, occurs at Weier in the byre, but Buckland and Perry have argued that the presence of large numbers of sheep lice, *D. ovis*, and the wingless parasitic fly, *Melophagus ovinus*, the ked, is more likely to indicate wool processing than simply the presence of their host. Insect remains may offer an original contribution to the debate concerning the timing of the secondary products revolution.

Ectoparasite remains can also be used to define other activities, of which delousing provides an example. Humans have three lice, one bug (*Hemiptera*) and one flea. The flea, *Pulex irritans*, is probably a primary parasite in the nests of an early South American domesticate, the Guinea pig, *Cavia* sp. It found human blood to its liking and by the Late Neolithic had travelled up the Americas and crossed Eurasia to reach remote Orkney off the northern tip of Scotland, probably utilising small steps in the gift exchange of furs as a transport mechanism. It appears in large numbers everywhere from New Kingdom Amarna in Egypt to Norse Greenland. The origins of the bed bug, *Cimex lectularius*, have been explored by Panagiotakopulu and Buckland; it is present at Bronze Age Amarna, but is unlikely to have found suitably warm habitats in Central and Northern Europe until the advent of heated stone housing in the Graeco-Roman period. Lice have probably been with, and co-evolved with, Man since his departure from Africa. The earliest records of the crab or pubic louse are from Roman Carlisle in northern England, but, closely related to a species on gorillas, it was perhaps more widespread on the human body when ancestors were more hairy. This point is also relevant to the head and body lice of the genus *Pediculus*, *P. humanus capitis* and *P. h. corporis*, which are sometimes accorded specific rank. As the body louse breeds in the clothing of its host, has it diverged from the head louse since humans began to wear clothes? The head louse is recorded from the Pre-Pottery Neolithic in Palestine and again is a common find in suitable desiccated, frozen or anaerobic deposits from Egypt to Greenland and Peru. On the post-medieval farm at Reykholt in western

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121 Panagiotakopulu 2001a; Panagiotakopulu 2001b.
123 H. K. Kenward: Pubic lice (Pthirus pubis) were present in Roman and medieval Britain. *Antiquity* 73 (1999) 911–915.
125 Panagiotakopulu 2001a.
Iceland, concentration of lice in one room sample has been interpreted as the result of de-lousing.\textsuperscript{126} on the fossil evidence a very necessary activity.

Stored hay, particularly grass and sedge hay, has a distinctive beetle fauna in storage, including species of the cryptophagid genera Cryptophagus and Atomaria, the lathridiid, Lathridius minutus (grp.), the endomycid Mycetaea hirta and the mycetophagid Typhaea stercorea. Their presence in large numbers in structures normally indicates fodder storage.\textsuperscript{127} However elements of this part of the synanthropic fauna would also be able to exploit other habitats in farms, including floors on which hay was spread to provide a working surface, and interpretation requires the careful evaluation of other lines of evidence as well as the coleopteran. This allows many of the problems raised by Kenward\textsuperscript{128} and often repeated, to be minimised, although what constitutes an indoor or outdoor assemblage may still be problematic.\textsuperscript{129} Fig. 8, based upon work in the Norse North Atlantic region\textsuperscript{130} summarises possible routes by which insect remains could come to be incorporated in rural archaeological sediments.

\textbf{The grain fauna}

Although the insect fauna associated with fodder may occur in other habitats, one particular assemblage that found in stored grain is unlikely to be found outside that habitat. Both the silvanid Oryzaephilus surinamensis – the name is perhaps unfortunate as the saw-toothed grain beetle is first recorded in charred grain from the late neolithic site at Mandalo in Macedonia\textsuperscript{131} – and cucujid Cryptolestes ferruginus are occasionally recorded from under bark.\textsuperscript{132} This is probably their natural habitat, but the grain weevil, Sitophilus granarius, is not known from the wild. This flightless weevil is probably a primary occupant of large grass seeds in the nests of wild rodents, and its usual pabulum with humans, in granaries and grain stores, is merely an extension of the same. The insect’s original distribution probably coincided with that of the wild progenitors of wheat and barley in the Near and Middle East, and the fossil record suggests that it probably travelled westwards with early agriculturists.\textsuperscript{133} Although able to maintain breeding populations in the Mediterranean zone, to the North it needs the artificial warmth of large stocks of grain to survive. It is therefore not surprising that the grain fauna first reaches northwest Europe in the baggage train of the Roman army, appearing in the Rhineland and England shortly after the conquest in the first century AD.\textsuperscript{134} There are, however, two earlier records, both from Linienbandkeramik (LBK) sites in Germany, one near Göttingen\textsuperscript{135} and the other at Erkelenz-
Kückhoven, in East Rhine province. The implications of these finds are considerable. They imply not only that this neolithic group practiced large scale storage and transport of grain, but extracting a tithe by destroying part of the crop in storage, they present a factor which requires building into any palaeoeconomic models of the remarkable episode of LBK expansion.

**Conclusion**

Insects offer considerable potential for refining the interpretation of archaeological contexts at both the regional and immediate level. The few neolithic sites, which have been examined, provide evidence of the nature of the pre-settlement landscape and of the manner in which the cleared landscape was exploited. They also provide palaeoeconomic evidence, which is not available from other palaeoecological sources.

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Wagner 1997
PREHISTORIC FISHING ALONG THE DANUBE

Considering the significant body of knowledge concerning the archaeozoology of the central Carpathian Basin (present-day Hungary) and the Iron Gates Gorge of the Danube (where the river forms the border between Romania and Serbia), largely publicized in the works of the late Sándor Bökönyi, relatively little is known about fish exploitation, an important source of animal protein in ancient times. This may be explained, to a great extent, with the lack of water-sieved or even dry screened find assemblages from archaeological sites from either of these two regions. In this situation, the remains of small animals, such as most fish in the Danube, are almost certainly lost. The first review of sporadically found fish remains recorded at archaeological sites in Hungary was presented fifteen years ago. Since then, new excavations as well as the occasional use of water-sieving have yielded new information. The aim of this work is to review the current state fish bone studies in the Carpathian Basin and the Iron Gates section of the Danube river.

Overexploitation, habitat loss and pollution have severely hit fish stocks worldwide. While the destruction of marine habitats has received great publicity (partly because of its international implications), dwindling stocks of fresh water fish attracted attention only in the case of major catastrophes induced by industrial activity, such as the mass poisoning of alluvial biotopes in the Rhine near Basel (Switzerland) in November 1986 or all along the Tisza river (Hungary) in 1999, when 650 t fish were poisoned by cyanide. From a zoological point of view, only a relatively few endangered or extinct species have been monitored. A remarkable exception is sturgeons, the largest fish in the Danube, which were relatively common until dams were built in the Iron Gates. The dams effectively cut off the migration route of endangered beluga sturgeon and other anadromous fish. Further upstream, sturgeon shoals thinned out as the river was regulated and walled off from the floodplain. Large-scale commercial navigation along the Danube also had a negative impact as it became necessary to keep the riverbed clean of sand and gravel deposits. By the mid-20th century, beluga sturgeon seldom swam upstream beyond the Iron Gates. The same human interference with river systems has also affected the entire aquatic ecosystem, including smaller bodied, less spectacular fish species. Diachronic changes in the composition of fish fauna are, therefore of interest in understanding the relationship between natural habitats and human subsistence activity. Prehistoric fishing represents the earliest point in such studies. Although fishing was presumably important during the Mesolithic and even earlier periods, to date only a few such settlement remains have been known from the Carpathian, with no convincing evidence of large-scale fish exploitation. Sporadically occurring fish bones may be observed more consistently from the early Neolithic onwards, as people apparently exploited the alluvial habitats in which they increasingly settled practicing agricultural production.

The reconstruction of prehistoric fishing is a multidisciplinary task. Chapters in this summary article, therefore were drafted with regard to the following aspects relevant to the subject:

1. Ichthyoarchaeological properties explain which species were exploited and how reliable is their representation (Chapter 3).

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3. www.transnationale.org
2. The palaeohydrological reconstruction of alluvial habitats helps in identifying locations where fishing may have taken place (Chapter 4).

3. Familiarity with fish behavior points to seasons when various fish could be most easily targeted (Chapter 5).

4. Ethnohistoric records of artisanal fisheries reveal basic attitudes towards fish exploitation (Chapter 6).

This outline is intended to provide an interpretive framework, showing the complex interactions between nature and society as reflected in the prehistory of fishing. The review of each of the four topics was based on the inclusion of additional data from natural and social sciences respectively, since the disciplinary boundaries between these areas of research often overlap.

Material and method

This summary is based on an analysis of data available in the literature, as well as unpublished data (especially from water-sieved assemblages) by the author. Most of the published fish bone materials originate from excavations where finds were collected only by hand and the naked eye due to both real limitations (especially time, labor and money) and the conservative attitude by some archaeologists. The advantage of hand-collected fish bone assemblages is that being inevitably selected by size, they are directly comparable to similar materials published in the literature. Thus a general framework may be outlined within which more detailed but less numerous analyses of water-sieved materials from recent excavations can be interpreted.

Due to the general character of this paper, its chronological scope ranges within the Mesolithic to the Bronze Age. Water-sieved assemblages, as well as radiocarbon dates are available only for a few settlements. These included Schela Cladovei5 (Iron Gates Gorge, Danube river) with Mesolithic and early Neolithic (Criş/Starčevo culture) occupations, Eszegfalva 236 (Tisza/Berettyó river) an early Neolithic (Körös culture) settlement, Győr–Szabadrét–domb7 (Danube/Rába river) a largely Copper Age (Boleráz group) site and Tiszauj–Kéménytető8 (Tisza river) a Middle Bronze Age (Nagyrév culture) tell.

The geographical distribution of sites included in this study is rather heterogeneous. In contrast with the title, some assemblages from the tributaries of the Danube, especially the Tisza river, have also been included, as alluvial habitats typical of the same overall landscape in most of the Carpathian Basin, especially the plains. These sites are characteristic of Neolithic subsistence,9 and as such deserve particular attention. The two major areas available for study, the sections of the Danube in Hungary and in the Iron Gates, are shown in fig. 1.

A few sites reviewed here represent the prehistory of a lower section of the Danube in the aforementioned Iron Gates region between Romania and Serbia. On the other hand, the upper reaches of the river, located in very different environmental and cultural settings in Austria and Germany, were beyond the focus of the present study.

A relatively small set of assemblages was recovered using water-sieving. These collections offer better sight of taxonomic richness, however, are not directly comparable to previous, hand-collected assemblages from Hungary without a significant risk of intersite interpretational bias. A target-oriented experiment has shown that, bone fragments measuring less than 19 mm, tend to be lost with great probability when finds are collected exclusively by hand.10 Unfortunately, as is clearly shown by water-sieved bone assemblages,

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5 Bonsall et al. 2001, 16.
7 Bartosiewicz et al. 1994.

the overwhelming majority of fish remains from prehistoric sites in Hungary would fall way below this size criterion.

Given the multitude of taphonomic factors that distort even the consumption refuse from archaeological sites, the reliable reconstruction of prehistoric aquatic habitats, ancient fishing and cultural attitudes to fish stocks is a near impossible task. In order to create a frame of reference within which these more complex phenomena may be interpreted, data on 32 present-day traditional fishing communities were integrated within this study. This set of data was hoped to provide an interpretative/contextual framework within which prehistoric relationships between humans and aquatic animals may be translated into sociocultural meanings.11 Ethnoarchaeology uses analogy as an interpretative tool and for developing appropriate research strategies in archaeology.12 It explores relationships between behavior and material culture often disregarded by ethnologists, and to attempts to establish how features of known behavior may be recognized in archaeological remains.13 Archaeologists often rely on analogical reasoning14 in testing hypotheses of non-observable ancient behavior by seeking modern parallels.15 Of the two different types of analogy used in archaeology, formal and relational, recently the first has been successfully used in the interpretation of archaeoichthyological assemblages from the north-western coast of Scotland.16 Formal analogy is based on the assumption that if two phenomena have two or more attributes in common, they probably share other attributes as well. Formal analogy is useful when no historical documents are available. A typical example is the reconstruction of prehistoric processes based on their material correlates in modern populations.17

16 Cerón-Carrasco 2002.
17 Wylie 1985.
Most of the fishing communities used in analogous reasoning in this study were documented in Oceania\textsuperscript{18} along the Pacific Coast of Asia.\textsuperscript{19} The next largest group of ethnohistoric observations represents Atlantic Europe\textsuperscript{20} and North America,\textsuperscript{21} (including two Pacific communities). Fewer ethnographic data are available from Latin America,\textsuperscript{22} while Africa\textsuperscript{23} was represented only by two studies. The geographical distribution of these ethnographic data, is shown in Table 1.


Table 1. The geographical distribution of artisanal fisheries used in the ethnographic analogy

<table>
<thead>
<tr>
<th>Continent</th>
<th>Number of fisheries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asia</td>
<td>8</td>
</tr>
<tr>
<td>Oceania</td>
<td>9</td>
</tr>
<tr>
<td>Europe</td>
<td>4</td>
</tr>
<tr>
<td>North America</td>
<td>5</td>
</tr>
<tr>
<td>Central/South America</td>
<td>4</td>
</tr>
<tr>
<td>Africa</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>32</strong></td>
</tr>
</tbody>
</table>

Data describing attitudes to present-day fish stocks data were synthesized using a factor analysis (Varimax rotation, latent roots ≥ 1). The purpose of this calculation was to establish basic relationships between various aspects of artisanal fish management. In the absence of written sources, such trends, hypothetically, would enhance our understanding of the prehistoric archaeoichthyological record.

**Archaeoichthyological finds**

The archaeozoological study of fish remains has several aspects. These include the representativity of samples, as well as the biological features of various fish species which have a bearing on both bone preservation and the culture-historical interpretation of ichthyoarchaeological finds.

**The frequency of fish remains in archaeozoological assemblages**

Most archaeozoological collections in Hungary contain an amazingly small portion of fish bones, largely attributable to the fact that, with a few recent exceptions, animal remains have always been collected exclusively by hand. The lack of dry screening of water-sieving may have a detrimental effect on the representation of entire classes of vertebrates, not to speak of even smaller animals such as land snails or arthropods.²⁴

In addition, depending on the scope and nature of excavations, the number of animal bones recovered from sites also tends to vary broadly. Given these great differences in assemblage sizes, the stochastic relationship between the decimal logarithms of the number of all identifiable specimens (lg Non-fish NISP = x, including mammalian and bird remains) and the number of fish bones represented in an assemblage (lg Fish NISP = y) is best expressed by

![Graph showing the relationship between lg Fish NISP and lg non-fish NISP](image)

**fig. 2. The occurrence of fish bones in hand-collected faunal assemblages**

fig. 3. Relationship between taxonomic richness and assemblage size

The linear regression between these two variables for the 16 prehistoric fish bone assemblages plotted in (fig. 2). Assemblages containing only a single, non-identifiable fish bone were not included in this calculation. Decimal logarithms improve the linearity of this equation by reducing the heteroscedasticity of data. The trend shown in fig. 2. may be described using the following equation:

\[ \text{lg Fish NISP} = 0.431(\text{lg Non-fish NISP}) - 0.007 \]

\[ (r = 0.641) \]

The significant but low correlation \((P \leq 0.010)\) as well as the low regression coefficient indicate that the recovery of additional bones from fish follows a clearly regressive trend for hand-collected fish bone assemblages. This means that (as would be the case with mammalian remains as well), increasing sample sizes yield ever more fish bones: the probability of encountering new specimens is not in a linear proportion with assemblage size. Statistical parameters of the overall picture, however, are somewhat distorted by the occurrence of single fish bones in numerous assemblages aligned at the bottom of the graph. This phenomenon points to the tremendous difference in the probability by which fish vs. larger mammalian bones are found when no form of fine recovery is practiced.

**TAXONOMIC RICHNESS**

Along similar principles, the so-called taxonomic richness (\(\text{lg Fish R} \), the number of taxa identified) of fish bone assemblages may be appraised as a function of fish bone sample size (\(\text{lg Fish NISP}; \text{fig. 3})\). Although, given the small number of fish bones to begin with, the representation of various species would be difficult to compare in numerical terms, the few major hand collected assemblages show at least trends in the presence of fish remains as a function of assemblage size.

\[ \text{lg Fish R} = 0.251(\text{lg Fish NISP}) - 0.035 \]

\[ (r = 0.512) \]

Archaeoichthyological remains originating from a greater variety of fish species originate from settlements represented by large assemblages. Increasing the size of archaeoichthyological assemblages, however, yields only a declining number of new taxa, and this trend is statistically significant \((P \leq 0.050)\). This is expressed by the low regression coefficient. To some extent, therefore, the inventory of fish remains, thus, would be more characteristic of sample size than the differential richness of the studied samples: in random samples the least frequent fish species would be the least likely to occur.\(^{25}\)

TAPHONOMY AND INTERSPECIFIC DIFFERENCES IN OSTEOLOGY

This review is built around the osteological evidence for fish, predominantly from the Danube and its tributaries in Hungary. These remains, recovered from archaeological sites, must also be discussed in terms of taphonomic bias and taxonomic identifiability.

The taphonomic process incorporates the entire sequence of post mortem changes that define the character and composition of zoological assemblages. Owing to its roots in aquatic ecology and palaeontology, taphonomic research has had an appeal to archaeozoologists, since in reality, the manifestation of ancient cultural phenomena in archaeoichthyological remains is distorted by these post mortem changes in the original fish skeleton. Taphonomic loss is related to ancient human activity, a host of natural effects and, last but not least, the archaeologists themselves. The simplified sequence of the taphonomic process is summarized in Table 2.

<table>
<thead>
<tr>
<th>Source of data</th>
<th>Selective process</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biocoenosis</td>
<td>not relevant</td>
<td>= living fish community, &quot;ichthyofauna&quot;</td>
</tr>
<tr>
<td></td>
<td>biostratonomy</td>
<td>= primary human action (fishing, processing, consumption, disposal) and pre-depositional natural effects (scavengers, weathering)</td>
</tr>
<tr>
<td>Thanatocoenosis</td>
<td>fossil diagenesis</td>
<td>= dead &quot;community&quot;</td>
</tr>
<tr>
<td></td>
<td>survey and excavation</td>
<td>= post-depositional natural effects</td>
</tr>
<tr>
<td>Archaeological assemblage</td>
<td>storage, curation</td>
<td>= secondary, modern human action</td>
</tr>
<tr>
<td></td>
<td>documentation, analysis</td>
<td></td>
</tr>
<tr>
<td>Publication</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2. Overview of the taphonomic process effecting fish remains

Ancient, "primary" human effects themselves, of the utmost interest to the archaeologist, form part of biostratonomy. They are a source of bias from the viewpoint of faunal history, but offer perspectives on important culture historical questions:

1. mode of procurement (selective fishing defined by human preference of technical limitations may distort the picture of the early exploitation of alluvial resources)
2. age and size criteria (these may have an influence on which fish were targeted within the populations available)
3. differential deposition (very large fish, such as sturgeon, were dismembered and parts transported, again selectively)
4. carcass processing (loss due to anatomically differential bone structure and degrees of butchering)
5. mode of deposition (well defined, protected features vs. scattered surface finds, scavengers' access to the remaining evidence: dogs, pigs and rodents may transport/ gnaw fish bones)

Post depositional natural effects on the thus deposited bone are described by the generic term fossil diagenesis. They include the effects of:

1. mechanical damage (changing surface conditions, soil pressure, mechanical erosion may all damage delicate fish bone)
2. soil pH and possibly autolysis by decaying fish fats (acidic soils and in some cases, fatty acids tend to dissolve bone, while basic soils preserve them)

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3. exposure to and transport by water (alternating exposures of fish bone, especially at coastal sites, may cause additional loss)

4. heat fluctuations - crioturbation (extreme heat and cold are most damaging near the surface)

5. activity by living organisms – bioturbation (burrowing animals, plant roots)

Excavator’s decisions act as the last set of filters on this body of information:

1. research policy (preferential funding, contract archaeology)

2. choice of excavated area (partial excavation, rescue work etc.)

3. spatial aspects of sampling (contiguous surfaces, trenches, test pits)

4. recovery techniques (hand-collection, screening, flotation/water-sieving)

5. data management and evaluation (documentation, storage and publication)

Depending on size and anatomical features, this multitude of taphonomic factors has a differential effect on various fish. Interspecific comparisons between different species are made difficult by the different skeletal characteristics fish. The remains of very small species fall victim not only to primary effects such as digestion by humans and animals, but are at a disadvantage during most of the taphonomic process. They are particularly sensitive to the precision of recovery. At the other extreme, it is chiefly large and compact dermal scutes of sturgeon which show up even in hand-collected assemblages, which otherwise contain few fish remains. They are arranged in dorsal, lateral and ventral rows along the body of the fish and differ both in size and shape by anatomical location. Similarly to the great number of vertebrae, dorsal fin rays and other serial features of the fish skeleton, these remains are extremely difficult to interpret in quantitative terms, not to speak of the insurmountable bias inherent to the reconstruction of the Minimum Number of Individuals (MNI).

ARCHAEOICHTHYOLICAL CHARACTERISTICS

When only hand-collected assemblages are available for study, mostly the remains of various sturgeons (Acipenser sp.), large carp (Cyprinus carpio L. 1758), catfish (Silurus glanis L. 1758), pike (Esox lucius L. 1758), and sometimes pikeperch (Stizostedion lucioperca L. 1758) may be identified. Small bone fragments are not only rare, but they may also originate from bones of these same species.

Fishing potentially yielded an abundant supply of animal protein in prehistoric subsistence economies in the Carpathian Basin, but the species available for consumption were defined by the composition of the local “ichthyofauna” of various alluvial habitats as discussed below. In spite of wet sieving, mostly the remains of these characteristically large fish species could be identified at the recently excavated Körös culture settlement of Ecsegfalva 23. A major difference was, however, that the presence of young individuals from large fish such as pike could also be established. The rest of that material (as was often the case with other, carefully excavated sites) was made up by small-size species and/or specimens of the carp family (Cyprinidae). These two groups of fish small-sized remains, however, clearly illustrate the importance of sieving in obtaining archaeoichthyological assemblages that offer a sound and reliable basis for interpretation even from a taphonomic point of view.

Familiarity with the range of fish ages/sizes represented by the archaeoichthyological remains at a site helps fine-tuning the reconstruction of roles various species played in the diet. The mass measurement of bones may be used in reconstructing the dietary role of fish. On the basis of standardized osteological measurements, sometimes the length of fish can be directly estimated (using coefficients or regression equations), as is the case with Beluga sturgeon.

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31 Bartosiewicz, unpublished data.


pike\textsuperscript{34} and catfish.\textsuperscript{35} Although similar comparative growth curves for wild carp have not been available, patterning in the size distributions of modern record specimens representing the feral form offer some insight in the sizes those animals reached during prehistory, especially in large, open waters, such as the Danube near Schela Cladovei,\textsuperscript{36} on the basis of other species whose skeletal remains could be studied in detail.\textsuperscript{37}

The more generalized, additional use of biometric size reconstruction in estimating the dietary roles of various fish is severely hampered by the difficulty of reliably counting the minimum number of individuals in fish bone assemblages. In this situation, familiarity with the size ranges of live fish could be of help in interpreting the list of species at least in an impressionistic/descriptive manner. The main dimensions of species relevant to this study are summarized in Table 3.

<table>
<thead>
<tr>
<th>Species</th>
<th>Total length, m</th>
<th>Live weight, kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beluga sturgeon</td>
<td>\textit{Huso huso} Linné 1758</td>
<td>2-3 (max. 10)</td>
</tr>
<tr>
<td>Russian sturgeon</td>
<td>\textit{Acipenser gueldenstaedti} Brandt 1833</td>
<td>2.00-2.50</td>
</tr>
<tr>
<td>Shirt sturgeon</td>
<td>\textit{Acipenser naias} Linné 1758</td>
<td>1.50-2.00</td>
</tr>
<tr>
<td>Sterlet</td>
<td>\textit{Acipenser ruthenus} Linné 1758</td>
<td>1.00-1.20</td>
</tr>
<tr>
<td>Carp</td>
<td>\textit{Cyprinus carpio} L. 1758</td>
<td>max. 1.00</td>
</tr>
<tr>
<td>Bream</td>
<td>\textit{Abramis brama} L. 1758</td>
<td>0.15-0.40</td>
</tr>
<tr>
<td>Barbel</td>
<td>\textit{Barbus barbus} L. 1758</td>
<td>0.70-0.80</td>
</tr>
<tr>
<td>White bream</td>
<td>\textit{Blicca bjoerkna} L. 1758</td>
<td>0.25-0.35</td>
</tr>
<tr>
<td>Crucian carp</td>
<td>\textit{Carassius carassius} L. 1758</td>
<td>0.20-0.50</td>
</tr>
<tr>
<td>Undermouth</td>
<td>\textit{Chondrostoma nasus} L. 1758</td>
<td>0.20-0.40</td>
</tr>
<tr>
<td>Orfe</td>
<td>\textit{Leuciscus idus} L. 1758</td>
<td>0.35-0.70</td>
</tr>
<tr>
<td>Knife</td>
<td>\textit{Pelophyllum fluviatile} L. 1758</td>
<td>0.25-0.50</td>
</tr>
<tr>
<td>Roach</td>
<td>\textit{Rutilus rutilus} L. 1758</td>
<td>0.10-0.35</td>
</tr>
<tr>
<td>Rudd</td>
<td>\textit{Scardinius erythrophthalmus} L. 1758</td>
<td>0.20-0.35</td>
</tr>
<tr>
<td>Tench</td>
<td>\textit{Tinca tinca} L. 1758</td>
<td>0.25-0.60</td>
</tr>
<tr>
<td>Virm</td>
<td>\textit{Vimba vimba} L. 1758</td>
<td>0.25-0.30</td>
</tr>
<tr>
<td>Catfish</td>
<td>\textit{Silurus glanisi} L. 1758</td>
<td>2.00-2.50</td>
</tr>
<tr>
<td>Pike</td>
<td>\textit{Esox lucius} L. 1758</td>
<td>0.50-1.50</td>
</tr>
<tr>
<td>Pikeperch</td>
<td>\textit{Stizostedion lucioperca} L. 1758</td>
<td>1.00-1.50</td>
</tr>
</tbody>
</table>

Table 3. Characteristic dimensions of fish species known from archaeological assemblages\textsuperscript{38}

Naturally, it is possible, that a massive and steady supply of small fish provided more animal protein than the odd, large specimen. Prolific small Cyprinids must have been much more easily available than formidable beasts, often heavier than humans. Large catfish or majestic Beluga sturgeon must have had a cognitive significance to the inhabitants of prehistoric settlements along the Danube. With all the fish species of large size under discussion here, the frequency and actual size of the largest specimens landed depends on the reproductive capacity and growth characteristics of the respective fish stocks.\textsuperscript{39} Since 1800, for example, the estimated 1.84 kg average annual decrease in record sturgeon body weights was found to be statistically significant.\textsuperscript{40} The large, 181 kg specimen caught at Paks (Hungary) in 1987

\textsuperscript{34} L. Bartosiewicz: Osteometrical studies on the skeleton of pike (\textit{Esox lucius} L. 1758), Aquacultura Hungarica 6, Szarvas 1990, 25–54.


\textsuperscript{38} Berinkey 1966.


\textsuperscript{40} Bartosiewicz – Takács 1997.
fig. 4. Sturgeon, weighing 181 kg, caught at Paks (Hungary) in 1987 (fig. 4), nearly two decades after the closure of the Iron Gates 1 dam, may have attained this respectable size after having been trapped upstream, behind the hydroelectric installation.

On the other hand, a size increase in carp is the natural consequence of large domestic carp going feral and cross-breeding with wild stock, leading to its genetic extinction. Wild carp is gone now in Europe (fig. 5), although the bones of extremely large prehistoric wild carp are known, for example, from prehistoric site of Schela Cladovei.

Habitat reconstruction

As opposed to terrestrial animals, fish are directly and inseparably bound to their respective aquatic habitats. It is the quality of water that directly regulates food supplies (depending on the place of each species within the complex aquatic food chain), and has a major impact on both the timing and success of reproduction for every kind of fish. The properties of water are influenced by climatic, topographic and hydrographic conditions, which act together in determining the suitability of habitats for the variety of fresh water species that live in various branches of rivers and their respective floodplains in the Carpathian Basin.

Water properties

Climate and topography influence aquatic life through the quantity of oxygen dissolved in water (y, mg/l). This is a function of current speed (x₁, m/s) and water temperature (x₂, °C).

fig. 5. Wild carp photographed by E. K. Balon in the Slovakian section of the Danube in 1955*


According to empirical data, this relationship may be expressed by the following regression equations:

\[ X_1 = \text{speed of current: } y = 1.953x + 1.984 \quad r = 0.943 \]

\[ X_2 = \text{temperature: } y = -0.221x + 13.669 \quad r = -0.979 \]

The regression coefficients of “x” values express the phenomenon that every additional 1 m/s in water velocity increases dissolved oxygen content by almost 2 mg/l in rivers, while a 1 °C rise in temperature would result in a 0.2 mg/l loss. Such habitat differences not only influence fish behavior; they may directly determine which species are available for fishing.

**TOPOGRAPHY AND CHANGES IN WATER QUALITY**

As the speed of the river is greater towards its source (and its temperature tends to decrease with increasing altitudes), the further upstream fish move, the better the circumstances for spawning. Aeration parameters in various sections of a river are summarized after Harka in Table 4.

<table>
<thead>
<tr>
<th>River section</th>
<th>Water velocity, m/s</th>
<th>Summer temperature, °C</th>
<th>Dissolved oxygen, mg/l</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spring (krenon)</td>
<td>&gt;1.5</td>
<td></td>
<td>&gt;5.5</td>
</tr>
<tr>
<td>Mountain (ritron)</td>
<td>1.5-2</td>
<td>13</td>
<td>4.5-5.5</td>
</tr>
<tr>
<td>Lower mountain (hiporitmo)</td>
<td>1-1.5</td>
<td>16</td>
<td>4.0-4.5</td>
</tr>
<tr>
<td>Foothill region</td>
<td>0.7-1</td>
<td>20</td>
<td>3.5-4.0</td>
</tr>
<tr>
<td>Lower foothill (epipotamon)</td>
<td>0.5-0.7</td>
<td>20</td>
<td>3.0-3.5</td>
</tr>
<tr>
<td>Plain (metapotamon)</td>
<td>&lt;0.5</td>
<td>25</td>
<td>2.5-3.0</td>
</tr>
<tr>
<td>River mouth (hipopotamon)</td>
<td>&gt;25</td>
<td></td>
<td>&lt;2.5</td>
</tr>
</tbody>
</table>

Table 4. General changes in water parameters along a river’s course

Alluvial habitats, defined by the parameters of water as listed above also differ in at least the percentual composition of various species in their fish fauna. To what extent this is reflected in an archaeoichthyological assemblage, is also a matter of differential fishing, preservation and recovery, the aforementioned three strongest selective processes in taphonomy. Short-range migrations of fish shoals also connect different sections of the same river, which reduces the environmental indicator value of these species.

Such finer details are unlikely to be directly manifested in the archaeoichthyological record, unless fine recovery techniques are applied. These sites represent different, lower foothill (epipotamon), plain (metapotamon) and, to some extent, river mouth (hipopotamon) habitats. As mentioned before, fish bone assemblages from the upper reaches of the Danube in Austria and Germany were not studied.

Owing to the immense difficulty of precisely quantifying fish remains (not least due to complex taphonomic situations such as the aforementioned natural deposition, selective preservation and partial recovery), emphasis in this was laid on the presence/absence evaluation of species and the environmental interpretation of those identified. The species composition of fish remains from 5 water-sieved assemblages can be compared to each other in Table 5.

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42 Pénzes – Tölö 1977, 327, Table 4; Harka 1993.
43 Harka 1993.
44 Harka 1993.
Table 5. The presence of various species identified in five water-sieved samples

Species identified in all five assemblages are marked by shading. Remarkably, these ubiquitous species include the fish (the “trinity” of pike, carp and catfish) whose large specimens are also known in almost all hand-picked fishbone collections. All three occupy a central position in this list. The diagonal pattern displayed by the various fish species begins with tench in the upper left corner and ends with sterlet in the lower right corner. The minimum requirements of dissolved oxygen by these characteristic freshwater fish species (as well as that of pikeperch) are as follows:

<table>
<thead>
<tr>
<th>Species</th>
<th>Minimum Dissolved Oxygen (mg/l)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tench (Tinca tinca Linne 1758)</td>
<td>0.7</td>
</tr>
<tr>
<td>Pikeperch (Stizostedion lucioperca Linne 1758)</td>
<td>2.0–3.0</td>
</tr>
<tr>
<td>Sterlet (Acipenser ruthenus Linne 1758)</td>
<td>3.0–3.5</td>
</tr>
</tbody>
</table>

The high value of (non-anadromous) sterlet indicates, why other oxygen-loving and anadromous species of sturgeons seek rapid rivers during the spring for spawning, and why water temperature is of decisive importance in the timing of their migration, as much as in the reproduction of even more sedentary fresh water fish species. Tench, on the other hand, located at the bottom of the list, is a small Cyprinid that well tolerates warm, stationary waters owing to its low requirement of dissolved oxygen.

Of the settlements examined in this table two sites, located in different parts of Hungary (Tiszaug-Kéménytető and Ecsegfalva 23), each represent a metapotamon type habitat. Tiszaug is located almost directly on the river, while the other Ecsegfalva 23 lay off the main stream of nearby tributaries. While Győr-Szabadrét-domb also falls in the metapotamon category, it is located near the largest inland delta in Europe, the Szigetköz region, that was a wetland area richly supplied by a web of various branches of the Danube. It may be looked upon therefore as a transitional habitat between the metapotamon and hipopotamon categories. It is important to note, however, that at this point, the Danube returns to itself.

\[Pénzes - Tőig 1977, 327.\]
rather than opening into the sea. An important feature, brackish waters, therefore is missing. It is the speed of the water that is most reminiscent of a "real" river delta. Owing to their special location downstream from the Iron Gates, the two chronologically distinct units originating from Schela Cladovei represent an entirely different habitat, most similar to a lower foothill (epipotamon) situation. Of all the identified fish species, the presence of undermouth would be most indicative of this habitat.

**RIVERBED GRADIENTS AND THE INTENSITY OF DISCHARGE**

As has been pointed out, aside from climate, the speed of water defines alluvial habitats through the quantity of oxygen dissolved. The velocity of water is directly related to topography. Even within the relatively even area of the Great Hungarian Plain, the evolution of a mosaic-like environment seems primarily related to local vertical variations in the landscape, i.e. the relative height of the water table. This important parameter defines aquatic habitats, soil formation, flora and fauna alike.

In the case of large rivers, such as the Danube, the effect of topography is even more dramatic. The \( \text{ca} \ 2300 \text{ m}^3/\text{s} \) average discharge of the Danube at Budapest more than doubles to over 5600 m\(^3\)/s in the Iron Gates gorges. Before the construction of the Iron Gates 1 dam, this latter, \( \text{ca} \ 130 \text{ km} \) long section of the Danube displayed extremely dynamic changes in water levels. Minimum discharge was 1400 m\(^3\)/s, while 16 000 m\(^3\)/s values were also measured.\(^46\) Prior to dam closure, the riverine environment of the Iron Gates gorges was characterized by strong currents, hard substrates, and was rich in nutrients, aquatic plants, insects and invertebrates that sustained rich and varied fish resources.

The Danube was confined to a width of only 170 m in the Khazan gorge. As shown in fig. 6, depths at this section varied between 0.5 and 50 m before the river exited to the plain. In the lower part of the Iron Gates gorges, near Turnu-Severin in Romania, the riverbed has a very steep gradient, falling 8 m in only 20 km. By contrast, over the 935 km between Schela Cladovei and the Black Sea, the riverbed declines overall by only 34 m.\(^47\) Thus the net gradient is three orders of magnitude different (40% vs 0.037%) not to mention the considerable differences in topography and relief between these two sections of the Danube Valley.

Prehistoric finds spots suggest that understanding habitat preferences of sturgeon may point to locations where certain types of fish could be caught most efficiently – information whose intimate knowledge must have been essential to prehistoric fisher folk. Lake sturgeon in Canada

\(^46\) Bancila et al. 1972, 9. 
\(^47\) C. C. Giurescu. Istoria pescuitului si a pisciculturii in Romania (The History of Fishing and Pisciculture in Romania). București 1964.
fig. 7. The relative frequency of sturgeon bones in hand-collected fish assemblages along the Iron Gates section of the Danube.

spawn in rivers at depths of ca 0.5–5 m, in areas of swift water or rapids at the foot of low falls that slow down further migration. Given the mass movement during the spawn run, such places must have been packed with sturgeons of all sorts in the Iron Gates gorges as well, making them increasingly vulnerable to human predation. This hypothesis seems to be supported by the differential proportion of from large fish in hand-collected archaeozoological assemblages at different locations within the Iron Gates. When appraising data in Table 6, it should be borne in mind that fish bone finds indicate catch (i.e. consumption), rather than entire fish populations.

<table>
<thead>
<tr>
<th>Sites (proceeding downstream)</th>
<th>Acipenserid</th>
<th>Catfish</th>
<th>Pike</th>
<th>Carp</th>
<th>Varia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Padina, Neolithic⁵⁹</td>
<td>64</td>
<td>1502</td>
<td>32</td>
<td>1053</td>
<td></td>
</tr>
<tr>
<td>Lepenski Vir I, Mesolithic⁵⁰</td>
<td>5</td>
<td>8</td>
<td>1</td>
<td>154</td>
<td></td>
</tr>
<tr>
<td>Lepenski Vir II, Mesolithic⁵¹</td>
<td>5</td>
<td>1</td>
<td>47</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lepenski Vir III, Neolithic⁵²</td>
<td>22</td>
<td>14</td>
<td>364</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vlasac, Mesolithic⁵³</td>
<td>2283</td>
<td>11</td>
<td>1552</td>
<td>5241</td>
<td></td>
</tr>
<tr>
<td>Schela Cladovei, Mesolithic⁵⁴</td>
<td>315</td>
<td>46</td>
<td>13</td>
<td>466</td>
<td>817</td>
</tr>
<tr>
<td>Schela Cladovei, Neolithic⁵⁵</td>
<td>131</td>
<td>30</td>
<td>19</td>
<td>303</td>
<td>251</td>
</tr>
<tr>
<td>Pontes-Kladovo, Early Medieval⁵⁶</td>
<td>34</td>
<td></td>
<td>22</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mora Vagei, Neolithic⁵⁷</td>
<td>8</td>
<td>6</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mora Vagei, Roman Period⁵⁸</td>
<td>11</td>
<td>9</td>
<td>5</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td>Mihajlovac Knjepiste, Neolithic⁵⁹</td>
<td>10</td>
<td>41</td>
<td>7</td>
<td>183</td>
<td></td>
</tr>
<tr>
<td>Iatrus – Krivina (Roman)⁶⁰</td>
<td>11</td>
<td>6</td>
<td>17</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 6. The number of bones representing large fish species in hand-collected assemblages from the Iron Gates.

⁵⁰ Bökönyi 1969.
⁵¹ Bökönyi 1969.
⁵² Bökönyi 1969.
⁵³ Bökönyi 1978.
⁵⁴ Bartosiewicz et al. 2001.
⁵⁵ Bartosiewicz et al. 2001.
⁵⁶ Bartosiewicz 1996.
⁵⁷ Bartosiewicz, unpublished.
⁵⁸ Bartosiewicz, unpublished.
The trend suggested by this table is even more clearly expressed in percentual terms, summarized in fig. 7. The historical landscape relevant to this situation may be appraised in an excellent early 18th century picture published by Marsigli, an Italian military engineer and polyhistor, who travelled along the Danube (fig. 8).

**Seasonality**

Seasonality in fish and, in fact, all animals may be most precisely appraised on the basis of stable incremental structures (e.g. otoliths, mussel shell). The open vs. closed state of growth rings in fish vertebrae makes distinction between summer/winter catch, to some extent, possible, but is a poor indicator of age itself, owing to the possibility of bone remodelling that may result in the resorption of growth rings. In the absence of the serial laboratory study of these features, inferences concerning seasonality were drawn from the presence and absence of certain fish in the find material.

Interspecific differences in spawning temperatures, as well as the presence of off-season stragglers meant that all fish species know from archaeological assemblages in the Danubian region, even anadromous sturgeons, were available year round. The use of their bones as seasonal indicators in archaeological assemblages, therefore, is limited to probabilistic interpretations. Evidently, all fish could be most successfully targeted during the spawning season, and their indicator value may be critically evaluated on the basis of this empirical observation. Most species seek shallow waters near riverbanks as well as residual waters for spawning, where they become more visible and easily fall victim to human predation. This may have been especially important in prehistoric times, when the success of fisher folk was

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63 The perpetual re-modeling through life makes bones ill-suited for this purpose.
65 Bartosiewicz et al. 1994, 110.
at least as dependent on the intimate knowledge of animal behavior as on the technology by which hunting and fishing equipment were produced.

In short, the sheer presence, rather than the age or size represented by the archaeological remains of various fish species, thus may be assigned with greater probability to their respective season of spawning. Regardless of the actual season, for example, groups of migrating sturgeon, tended to include individuals of different ages and sizes.66 The present-day spawning schedules of fish identified at prehistoric sites in Hungary are listed in Table 7.

<table>
<thead>
<tr>
<th>Species</th>
<th>Spawning time</th>
<th>Water temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beluga sturgeon</td>
<td>March–May</td>
<td>9 °C</td>
</tr>
<tr>
<td>Russian sturgeon</td>
<td>April–May</td>
<td>8–18 °C</td>
</tr>
<tr>
<td>Stellate sturgeon</td>
<td>April–May</td>
<td>10–17 °C</td>
</tr>
<tr>
<td>Ship sturgeon</td>
<td>April–June</td>
<td>10–17 °C</td>
</tr>
<tr>
<td>Starlet</td>
<td>April–June</td>
<td>12–17 °C</td>
</tr>
<tr>
<td>Carp</td>
<td>April–May</td>
<td>18–20 °C</td>
</tr>
<tr>
<td>Bream</td>
<td>April–June</td>
<td>12–13 °C</td>
</tr>
<tr>
<td>Barbell</td>
<td>May–June</td>
<td>17–19 °C</td>
</tr>
<tr>
<td>White bream</td>
<td>April–June</td>
<td>16–17 °C</td>
</tr>
<tr>
<td>Crucian carp</td>
<td>May–June</td>
<td>17–18 °C</td>
</tr>
<tr>
<td>Undermouth</td>
<td>April–May</td>
<td>–</td>
</tr>
<tr>
<td>Orfe</td>
<td>May–June</td>
<td>–</td>
</tr>
<tr>
<td>Knife</td>
<td>April–May</td>
<td>–</td>
</tr>
<tr>
<td>Roach</td>
<td>April–May</td>
<td>10–15 °C</td>
</tr>
<tr>
<td>Rudd</td>
<td>April–May</td>
<td>15–18 °C</td>
</tr>
<tr>
<td>Tench</td>
<td>May–June</td>
<td>22–25 °C</td>
</tr>
<tr>
<td>Vimba</td>
<td>May–June</td>
<td>–</td>
</tr>
<tr>
<td>Catfish</td>
<td>May–June</td>
<td>18–19 °C</td>
</tr>
<tr>
<td>Pike</td>
<td>February–March</td>
<td>7–10 °C</td>
</tr>
<tr>
<td>Pikeperch</td>
<td>April–May</td>
<td>12–14 °C</td>
</tr>
<tr>
<td>Tench</td>
<td>May–June</td>
<td>22–25 °C</td>
</tr>
</tbody>
</table>

Table 7. Spawning parameters of various large fish species identified at archaeological sites67

Beluga, Russian and Stellate sturgeon swim upstream to the Iron Gates between January to June as well as October to December. These two periods also coincide with seasons of high discharge in this region (fig. 9),68 when low water temperatures and high water velocity favour spawning. Sturgeon fishing between June and September only took place opportunistically in the Iron Gates when water temperatures were high and discharge low. Mátyás Bél, an 18th century Hungarian naturalist, documented the same two seasons in Hungary: spring fishing began in March and continued uninterrupted until June. The fall season for sturgeon lasted from August until December.69 Temperatures within the same month may very between different aquatic habitats. Regional variations between aquatic environments across Europe introduce additional noise into this system.70

Historical and ethnographic aspects of fish exploitation

While large Acipenserid bones commonly occur in some Mesolithic and Neolithic archaeological assemblages, they seem to become rare by the late Middle Ages. In part, this may be explained by a shift in the focus of archaeological research: catch sites were more likely to coincide with the sites of consumption during prehistory.

68 Bancila et al. 1972, 19.
69 Bél 1764.
Catching large fish, such as sturgeon or catfish, in the mainstream of the Danube evidently required specialized techniques in comparison to simple forms of fish “gathering” (e.g. potting) that could be practiced anywhere in its floodplains of the Great Plain. The landing of such large individuals must have also required cooperative fishing techniques. Aside from the cultural difference to the apparently more opportunistic form of fishing practiced in the Great Plain, the presence of sturgeon in classical Starčevo assemblages from within the Iron Gates is also explained by the statistical fact that anadromous sturgeons are caught with greater probability in the lower sections of rivers. It must be mentioned within this context that, historically, sturgeons were known to have migrated upstream way beyond the Carpathian Basin into sections of the Danube located in present-day Austria and Bavaria.\(^{71}\)

The extensive floodplains of the slowly meandering rivers and wetlands in the Great Plain offered completely different opportunities for fishing. After early summer floods receded, millions of fish of all sizes were trapped in pools where they could be simply gathered. Mátyás Bél, a 18th scholar, mentioned the unbearable smell of dead fish, left behind after major flood of the Tisza river.\(^{72}\) While it remains a question what the culturally determined reaction of prehistoric people would have been to this development in the environment,\(^{73}\) it is quite conceivable that fish was a lot more common in the diet of most prehistoric sites would be is suggested by the insignificant numbers of fish bones recovered from hand-collected settlement assemblages.

Sporadic occurrences of prehistoric fishing gear (e.g. fish hooks,\(^{74}\) net remains\(^{75}\)) from prehistoric sites in Hungary also indicate that, while opportunistic forms of fishing must have been important, some fishermen also possessed special skills and they possibly worked in an organized, cooperative manner.

According to a kind personal communication by Eszter Bánffy, a Mesolithic find from the Lake Balaton region may possibly be interpreted as the remains of a coracle.\(^{76}\) Other boats

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\(^{71}\) A. Khin: A magyar vízák története (The history of Hungarian sturgeons). Budapest, Mezőgazdasági Múzeum Füzetei 2, 1957.

\(^{72}\) Bél 1764.


are also known both from the Mesolithic and the Starčevo culture in the Pannonian region. In addition to general transport, such boats may have been used in fishing.

In the absence of written sources, however, social and cognitive aspects of prehistoric fishing can be studied at best using ethnographic analogies. It is at this point, that the prestigious body of literary data concerning ethnohistoric records on artisanal fishing, compiled by Acheson and Wilson, was worth analyzing. The 11 dichotomic variables (presence/absence) recorded in these traditional fishing communities, represent attitudes to the aquatic resources and their exploitation by indigenous communities around the world. Factor loadings of the two major factors (latent roots > 1) obtained by their analysis are indicative of two fundamental dimensions that characterize artisanal fishing (Table 8).

<table>
<thead>
<tr>
<th>Management attitudes</th>
<th>Factor 1</th>
<th>Factor 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&quot;traditional&quot;</td>
<td>&quot;commercial&quot;</td>
</tr>
<tr>
<td>protection of breeding stock</td>
<td>0.791</td>
<td>-0.154</td>
</tr>
<tr>
<td>protection of young</td>
<td>0.614</td>
<td>0.357</td>
</tr>
<tr>
<td>conservation ethic</td>
<td>0.593</td>
<td>-0.334</td>
</tr>
<tr>
<td>size limits</td>
<td>0.560</td>
<td>0.500</td>
</tr>
<tr>
<td>seasonal limits</td>
<td>0.288</td>
<td>0.306</td>
</tr>
<tr>
<td>areas of fishing territory</td>
<td>0.123</td>
<td>0.302</td>
</tr>
<tr>
<td>fishing quotas</td>
<td>0.019</td>
<td>0.762</td>
</tr>
<tr>
<td>industrial fishing</td>
<td>-0.071</td>
<td>0.781</td>
</tr>
<tr>
<td>technology</td>
<td>-0.153</td>
<td>0.244</td>
</tr>
<tr>
<td>limited access</td>
<td>-0.294</td>
<td>0.402</td>
</tr>
<tr>
<td>protect from overcrowding</td>
<td>-0.457</td>
<td>-0.202</td>
</tr>
<tr>
<td>Latent root</td>
<td>2.092</td>
<td>2.151</td>
</tr>
<tr>
<td>% of total variance</td>
<td>19.0</td>
<td>19.6</td>
</tr>
</tbody>
</table>

Table 8. Latent roots expressing the relationship between attitudes to aquatic resources

As is shown by the greatest values on the first, bipolar factor (encompassing 19.0% of the total variance), protection of the breeding stock and of young fish, conservation ethic and size limits form a closely related group. These are values shared by many indigenous groups in the developing world. By regulating how people fish, these communities have developed strategies best adapted to the chaotic population patterns that fish stocks tend to exhibit. Spawning, growth and mortality figures may have varied unpredictably even in prehistoric times (e.g. according to drought/flooding), which probably effected early subsistence economies more directly. This factor thus, represents "traditional" attitudes to fish management.

Factor loadings exceeding 0.5 on Factor 2 (19.6% of the total variance) also include size limits, associated with historical examples of industrial fishing (especially in the United States and Atlantic Europe) in which the protection of breeding stock was a low priority in the absence of a traditional conservation ethic. Size limits and fishing quotas characteristic of this attitude regulate stocks by the output, rather than the entire system of fish exploitation. This may be characterized as a "commercial" attitude.

In archaeoiichthyological studies, our ability to transfer the abundant ethnographic information from its original framework to archaeology is of critical concern. Archaeoiichthyological assemblages, especially from prehistoric, are probably a product of traditional values that determined fish exploitation in ancient times. Paradoxically, however, fish remains from archaeological sites by definition represent output, i.e. fish that were

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"not protected". This is what makes the reconstruction of prehistoric attitudes to fisheries management difficult. Most interestingly, however, two variables, seasonal limitations and the areal definition of fishing territories played no direct role in determining these two basic types of attitudes. These seem to be equally independent from the two basic forms of fisheries management.

Conclusions

While it cannot be demonstrated that fishing played a key role in the lives of all prehistoric peoples living along the Danube, the potential significance of exploiting aquatic resources should not be neglected at sites where fish bones have been recovered.

Owing to their generally small size and concomitant poor resistance to a host of taphonomic factors, fish remains tend to be dramatically underrepresented at sites where the material is collected without screening or water-sieving. Therefore, due to the hand-collection of finds that still dominates in Hungarian archaeology, the majority of bones available to specialists overwhelmingly represent large-size fish, which leads to the selective representation for mature individuals of carp (Cyprinus carpio L. 1758), pike (Esox lucius L. 1758) and catfish (Silurus glanis L. 1758). It is noteworthy, however, that the remains of these important species also occur most systematically in water-sieved assemblages from a number of sites. They may thus be considered ubiquitous in appropriately large surfaces of water on the basis of their consistent presence in archaeoichthyological assemblages from Hungary.

In this sense, their dominance in almost all major hand-collected samples has been reconfirmed by refined methods of recovery. Water sieved samples often yield bones from the younger and therefore smaller individuals of these large species. This is a very clear trend in the case of pike, while (with the exception of a few diagnostic skeletal elements, such as pharyngeal teeth) the thus recovered bones of younger carp are extremely difficult to distinguish from those of small Cyprinid species, which provide the bulk of finds from the sieved residue of prehistoric settlement deposits.

As a result of the natural geography of the Carpathian Basin, a region covered by marshland throughout its past, new assemblages obtained using more refined methods turn out to contain a great variety of bones from small species belonging to the carp family (Cyprinidae). Sturgeons (Acipenseridae) in the Danube form another better known group, whose prehistoric remains occurred most typically at settlements in the Iron Gates gorge, characterized by a radically different, dynamic aquatic habitat.

Although species-level identification in many fish families (Acipenseridae, Cyprinidae) is limited to special elements, small fish from the Danube must have played comparable roles in most cultures. Their known differing habitat preferences, however, may be used in illustrating variability in their respective aquatic habitats.

Ethnographic examples were used in an attempt to distinguish between traditional and commercial attitudes to fishing. While the two factors represent only 40% of total variance, they indicate that, cognitive aspects of traditional fishing may be distinguished from the modern, market-oriented exploitation of aquatic fauna. The idea of "managing" environmental resources is unlikely to have existed in its contemporary sense during prehistory. Traditional fishing cultures show, however, that both ideological and technical limitations were placed on the input i.e. reproductive aspect of fish stocks, as opposed to commercial fishing more determined by criteria defined the output. Prehistoric fishing in Hungary must have been closer to the first type.\(^{81}\)

\(^{81}\) I am grateful to Eszter Bánffy for having provided guidance in the archaeological literature pertinent to the subject of navigation. Figures from Marsigli's original work were kindly provided by Andrea Kreutzer of the Military Museum in Budapest. Thanks are due to Alice M. Choyke for useful comments on the text as well as Erika Gál and László Daroczi-Szabó who translated articles written in Romanian.
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Harka 1993

Járó – Költő 1988

McCay – Acheson 1987

Pénzes – Tölö 1977

Rudder – Akinichi 1984

Rudder – Johannes 1985

Thomas 1996

Williams 1982

Wylie 1985
THE NEOLITHIC AVIFAUNA OF HUNGARY WITHIN THE CONTEXT OF THE CARPATHIAN BASIN

Archaeo-ornithology is a special field within archaeo-zoology. It offers information both on the composition of the avian assemblages and fauna of the settlements. Various aspects of archaeo-ornithology also contribute to the environmental reconstruction and seasonality of the inhabited sites. An interesting subject within this special field is the study of worked bird bones that provides information concerning the use of bird bones as raw materials for different instruments (e.g. flutes and pipes) and objects (tools, amulets, etc.).

In the past, some archaeologists did not pay much attention to small bones in the excavated materials, thus contributing to the loss of fish-, bird and herpetological remains. This attitude fortunately has changed and recently in many excavations the bones are collected not only using hand-collected methods but using flotation, and wet as well as dry sieving. The identification of avian remains requires at least a basic comparative bird bone collection, specialization in bird osteology, taphonomy and taxonomy, and a certain skill in biology. Therefore many bird bone materials still lay in deposits of different museums and institutions being labelled only as “Aves indeterminated”.

Data concerning the Neolithic bird remains found in archaeological contexts in Hungary and former Yugoslavia were summarized by Sándor Bökönyi, Dénes Jánossy and Anneke T. Clason. Other publications also listed bird bone materials and species beside the mammalian assemblages. A few Neolithic bird remains were noted by István Vörös as well. The subfossil avifaunas in Romania were studied and published by Tiberiu Jurcsák, Eugen Kessler and Erika Gál. Some recently found remains have been identified, while others needed revision. The aim of this paper is to give a general overview about the Neolithic avifauna of the Carpathian Basin including the latest and yet unpublished results.

Results

Twenty four Neolithic deposits of 21 localities furnished bird bones in Hungary (fig. 1). The assemblages richest in bird remains and in recognized species were found at Körös culture settlements (Table I). Although the greatest number of bird bones (607) was found at site Endrőd 119, only 10% of the material was identifiable. The recently excavated site Ecségfalva 23 yielded an outstandingly well preserved bird bone material by 276 remains

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7 Bökönyi 1992, 198.
related to 65 individuals and 43 identifiable species. The Alföldi Linear Pottery Culture (ALPC) Endrőd 6 furnished the best represented assemblage among the 15 Middle- and Late Neolithic sites (Table 4).

Fewer Neolithic settlements with bird bone assemblages are known in Serbia and in Romania (fig. 1). The Starčevo – Criș site Starčevo9 and the Körös culture Ludas-Budzsák10 yielded considerable avian materials in Serbia. Among the Transylvanian localities, Vinča culture Parta11 and the Petrești – Linear Band Culture Ungureasca Cave12 provided significant assemblages (Table 2).

The richest Neolithic avifaunas are known from the 23 Hungarian settlements by 76 bird taxa, 61 of which were recognized to species level. The total number of bird bone remains is 1109. The Körös culture settlements yielded 1053 bones of which 74 taxa were identified, while the Middle- and Late Neolithic sites furnished only 56 bird remains and 25 taxa. The four Serbian sites yielded 113 remains in all, and 28 bird taxa with 22 species were recognized. In Romania, 9 settlements yielded 81 bird bone remains and 31 taxa, 27 of them being identified to species level (Table 2).

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8 Gál in prep. b.
9 Classon 1980.
10 Bökönyi 1974, 436.
All the species mentioned in this article are included in a separate table that also summarizes their ecological characteristics and seasonality\(^{13}\) (Table 3).

**Discussion**

Archaeornithological studies have accelerated in the last four decades. While in 1965 only 17 species were known in the Neolithic of Hungary,\(^{14}\) 20 years later this number grew to 38.\(^{15}\) Recently the number of bird identified taxa is 76.

The distribution of bird bone assemblages is different both within the Carpathian Basin and within the periods of the Neolithic. Some settlements yielded a remarkable number of avian remains and taxa while others furnished only a few bones and species. From a chronological point view Early Neolithic sites provided the most abundant bird bone accumulations and the richest fauna.

In Neolithic avian assemblages mainly the remains of middle to large sized birds dominate. This phenomenon may have at least three basic reasons: taphonomic explanations, excavation methods and economic interest of the ancient peoples. Smaller bones rather fall prey to taphonomic loss caused by predators and other pre-depositional factors. Larger bones are usually more easily noted during the excavations with hand collecting methods. Finally, time and energy invested in (bird) hunting would target bigger prey animals. Other reasons, such as the frequency of and access to certain species in nesting or feeding place, seasonal fowling, etc. would also determine taxonomic composition.

From a taxonomical point of view, large and middle sized wading birds (Ciconiiformes and Charadriiformes), waterfowls (Anseriformes), terrestrial birds (Galliformes and Gruiformes) and perching birds (Passeriformes) are numerous in Neolithic avifaunas. Many more diurnal birds of prey (Accipitriformes and Falconiformes) than owls (Strigiformes) were reported among the predators. Pigeon, e.g. Woodpigeon (*Columba palumbus*), Roller (*Coracias garrulus*) or woodpeckers, e.g. Great Spotted Woodpecker (*Dendrocopus major*) have rarely been found.

Water fowl (swans, geese and ducks) are outstandingly well presented within the fauna. Different dabbling ducks (*Anas*) and diving ducks (*Aythyा*) were hunted. Swans (*Cygnus*) and geese (*Anser*) were also present at many localities. Remains of Greylag Goose (*Anser anser*) were found at 13 sites. Coot (*Fulica atra*) and Mallard (*Anas platyrhynchos*) were the most hunted aquatic birds; they have been reported from 10 and 9 settlements, respectively. This latter species yielded the most abundant accumulation (33 remains of 6 individuals) at Ecsegfalva 23. Among wading birds large herons such as Grey Heron (*Ardea cinerea*) and Spoonbill (*Platalea leucorodia*) were often hunted at 7 and 6 sites, respectively. Within the large group of terrestrial birds White-tailed Eagle (*Haliaeetus albicilla*) was found at 7 sites. Vultures were reported only from Serbia and Romania.\(^{16}\) Black Grouse (*Tetrao tetrax*) was found in 9 sites. This species – as already pointed out by Jánossy\(^ {17}\) – was living in plains from the Neolithic to Bronze Age.\(^ {18}\) Black Grouse seems to be especially frequent at Endröd 119 and Ludas-Budzsák. A marshland species Crane (*Grus grus*) was reported from the greatest number of settlements (14), and warm steppe species Great Bustard (*Otis tarda*) also was hunted in 10 sites (Tables 1–2, 4).

Among passerines, especially corvids and larger songbirds such as Golden Oriole (*Oriolus oriolus*), different thrushes (*Turdus*) and Starling (*Sturnus vulgaris*) were found. The remains of small birds were abundant in the deposits of Ecsegfalva 23 and Ungureasca Cave (Romania) (Table 1–2). In the case of the recently excavated site Ecsegfalva 23 we know that beside of the hand collecting methods flotation, and dry and wet sieving of the material were also performed. This kind of separation of the remains from the sediment and other finds

\(^{13}\) Peterson et al. 1977; Cramp (ed.) 1998.

\(^{14}\) Bökönyi – Jánossy 1965, 92.

\(^{15}\) Jánossy 1985, 96–97.


\(^ {17}\) Jánossy 1965, 96.

\(^{18}\) E. Gál – E. Kessler: Eneolithic bird remains from the tell site of Bordușani Popina (in press); E. Gál: Bronze Age bird remains from the Carpathian Basin (in prep.).
always results in a higher proportion of small bones. The Petrești culture level of Ungureasca Cave yielded large bird species (e.g. Greylag Goose, Crane and Great Bustard) suggesting human interest in the economic value of the prey, but also some birds of prey and passerines. Concerning the settlement type, the faunal composition and the habitat of the recognized birds we may assume that different predators also may have contributed to the subfossil accumulation of this cave.19

The great number of wild fowl, aquatic- and wading birds must be in relation with the habitats around the Neolithic settlements. Majority of the sites are close to large rivers (e.g. Danube and Tisza) and their branches. The ecological significance of bird species indicate at least periodically flooded areas surrounded by swamps, reed beds and humid meadows. Many of the recognized species live in or close to waters, and make their nests on floating vegetal remains or in the reed bed.20 Wooded wetlands such as gallery forests, where large wading birds and other arboreal species nest, also had to be around many localities. Although the number of identified species and thus the share of the different ecotypes are not always proportional in the studied settlements, one can notice the bigger ratio of aquatic species at site Maroslele-Pana, and the abundance of the arboreal species in wetland at Röszke-Lúdvár (fig. 2). Open field birds attached either to humid meadows or steppe and crops are generally well presented, in some localities (e.g. Röszke-Lúdvár and Ecsegfalva 23), however, are recognized in smaller numbers by 20–30%. Forest species living in or at the edge of woodlands were found at Parta (Romania) and Ecsegfalva 23 in greater number (fig. 2).

Studying the seasonality of the best represented Neolithic sites on the basis of bird species, one may notice that the seasonal presence of birds varies in different sites. Resident species that are common all year round and summer visitors that come in the breeding season usually predominate. The only exception is site Maroslele-Pana where facultative over wintering species were in the biggest proportion. This group of birds includes migratory species that may stay during the cold season if the winter is mild and food is available.

Certain passage species also may remain during the winters. Black-throated Diver (Gavia arctica) identified from Kötelek-Huszársarok was observed in Hungary between October and April.22 Bean Goose (Anser fabalis) known from Endröd 119, Szolnok-Szanda and

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21 Jánossy 1985, 71.  
22 Peterson et al. 1977, 30.  
23 Bátki 1993, 198.  
24 Jánossy 1985, 73.
THE NEOLITHIC AVIFAUNA OF HUNGARY

Par(a (n= 15)
Ludas-Budzsák (n=15)
Röszke-Lúdvár ( n= 14)
Maroslele-Pana (n=20)
Endrőd 119 (n=20)
Ecsegfalva 23 (n=43)

■  Resident □  Summer visitor ■  Passage Wintering Facultative overwintering ■  Vagrant

fig. 3. Seasonal presence of different bird species at the most represented settlements (n=number of species recognized)

Padina (Serbia),25 and White-fronted Goose (A. albifrons) from Endrőd 119, Maroslele-Pana, Ószentiván26 and Foeni (Romania) pass through Hungary in large numbers but often over winter between October-November and March-April.27 Tufted Duck (Aythya fuligula) recognized from Ecsegfalva 23,28 Röszke-Lúdvár29 and Ludas-Budzsák30 also may over winter in November–April.31 Vagrant species Shelduck (Tadorna tadorna) identified from Padina and Parta,32 and Herring Gull (Larus argentatus) known from Maroslele-Pana may occur in late autumn-early winter.33 Common spring- and autumn passage species (mainly ducks) and vagrants generally were found in small numbers in the Neolithic avifaunas (fig. 3). Winter visitors were identified in small number from Neolithic settlements. Ecsegfalva 23 yielded Goosander (Mergus merganser), Parta furnished Branta sp. indet. and Goosander, while Endröd 119 provided Slavonian Grebe (Podiceps auritus).

We have to mention that the study of birds' seasonality is based both on palaeontological data and recent ornithological evidence. In the case of this latter, one has to take into consideration the changes in bird migrations due to the recently alternating ecological and climatic conditions, and birds' adaptation to human environments.34 Although swans lately are seen only during the winter in Hungary, according to ornithological evidence they used to breed in this region until the 20th century. Crane recently is considered a passage species but it also used to breed in Hungary.35

Conclusions

Körös culture and generally Neolithic settlements are rich in avian remains and taxa both in Hungary and in the Carpathian Basin. The representation of sites with bird bones and taxa in the earlier and later periods is significantly weaker (fig. 4). Although a generally decreasing tendency in hunting can be observed after the Neolithic, we cannot attribute the gap in fowling to a sudden disinterest of people in bird hunting. It is very likely that different excavation

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25 Classon 1980
26 Jánossy 1985, 71.
28 Gild (in prep.)
29 Jánossy 1985, 72.
30 Bökönyi 1974, 436.
31 Peterson et al. 1977, 67.
33 Peterson et al. 1977, 60; 145.
methods, bird bone separation and selective identification of the remains gave rise to such an uneven distribution of results.

The numerous aquatic and wetland birds recognized from the settlements reflect the characteristic environment around Neolithic sites. The inhabitants lived near wetlands but also close to grazing grounds and scarce forests where exploitation of water- and woodland resources, as well as animal keeping was possible. The mosaic-like environment that must have had a specific role in the adaptation of Neolithic people in the Carpathian Basin\textsuperscript{36} can be evidenced on the basis of bird faunas as well.

Birds were usually hunted in the breeding season when the diversity of avifauna is the greatest and both the adult birds and eggs were easily exploited. Some winter visitor species and the large number of resident- and possible over wintering birds do not exclude all year habitation at certain sites. On the other hand, the diverse avifaunas poor in remains and individuals do not indicate long-lasting settlements.

The bird bone assemblages usually do not indicate any system in fowling, this probably being an opportunistic and mainly seasonal occupation like fishing and shellfish-collecting. Although certain species (e.g. Mallard, White-tailed Eagle, Crane or Great Bustard) were often hunted in the Neolithic, we may state that bird hunting had an opportunistic character, and people did not focus to any species in particular. On the other hand, the abundance of wing bones in the particularly rich assemblage from Ecsegfalva 23 suggests a kind of interest in some species.\textsuperscript{37} Thus we may assume that the captured or hunted birds must have had a well defined – usually economic or trophy – value.\textsuperscript{38}

\textsuperscript{36} P. Sümegi this volume
\textsuperscript{37} E. Gál (in prep.)
\textsuperscript{38} I am grateful to the next colleagues who invited me to work on the bird bone remains from the excavations having lead: Ms. Diana Bindea (Ungureasca Cave and Zăuan), Dr. Georgeta El Susi (Foieni and Parta), Dr. Viktória Kiss (Balatonszemes – Bagodomb), Dr. Zoia Maxim (Sincrai, Tureni – Sândulescu) and Prof. A. Whittle (Ecsegfalva 23). Dr. László Bartosiewicz provided the avian remains from site Endrőd 6 being excavated by Dr. Dénes Jankovich. I thank Mr. M. Gasparik for the access to the recent bird bone collection of the Hungarian Natural History Museum. Erika Gál currently is being employed by the Hungarian project NRDG 248/2002.
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Kessler – Gál 1997  

Kessler – Gál 1998  

Peterson et al.  
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THE NEOLITHIC AVIFAUNA OF HUNGARY
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<td>III-X</td>
<td>Carnivorous</td>
</tr>
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<td>II-X</td>
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</tr>
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<td>Diurnal bird of prey</td>
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<td>Summer visitor</td>
<td>IV-IX</td>
<td>Diurnal bird of prey</td>
</tr>
<tr>
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<td>Woodland</td>
<td>Resident</td>
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<td>Wet meadow</td>
<td>Resident</td>
<td>III-X</td>
<td>Carnivorous/Insectivorous</td>
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<td>III-X</td>
<td>Carnivorous</td>
</tr>
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</tr>
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<td>III-X</td>
<td>Carnivorous</td>
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<tr>
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<td>Carnivorous</td>
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<tr>
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<td>Sz+E</td>
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<td>III-X</td>
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<td>III-X</td>
<td>Carnivorous</td>
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<td>Carnivorous</td>
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<td>Omnivorous</td>
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<td>Carrion Crow</td>
<td>Ny+E</td>
<td>Resident</td>
<td>III-X</td>
<td>Omnivorous</td>
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<tr>
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<td>Ny+E</td>
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<td>Omnivorous</td>
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<td>Passer domesticus</td>
<td>House Sparrow</td>
<td>E=Ny</td>
<td>Resident</td>
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Table 3. General table including the ecological and seasonal characteristics of bird species.
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<tr>
<th>Species</th>
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<th>ALPC</th>
<th>Szilmeg</th>
<th>Music note-Zseliz</th>
<th>Tisza</th>
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Table 4. List of identified bird taxa from the Middle- and Late Neolithic sites in Hungary
AGRICULTURE, STOCK FARMING AND ENVIRONMENT: ADAPTATION AND CHANGE DURING THE NEOLITHIC LAKESHORE PERIOD (4300–2400 BC CAL) IN SWITZERLAND

Lakeshore settlements are especially interesting to researchers dealing with questions of environmental change and human-environment interactions due to their very good preservation of organic material such as plant remains (wood, seeds and fruit remains, leaves, twigs), animal bones, antler, textiles, etc. Owing to the good preservation of wood, it is possible to date the life spans of these villages precisely with the help of dendrochronology.

In Switzerland, lakeshore settlements can be found from the Neolithic Period (between 4300 and 2400 BC cal) and again during the Bronze Age (between 1900 to 1500 and 1050–850 BC cal). The Neolithic Period is divided into three phases:

- upper (younger) Neolithic (4300 to 3500 BC cal, Pfyn and Cortaillod cultures),
- later Neolithic (3300 to 2750 BC cal, Horgen culture) and
- final Neolithic (2750 to 2400 BC cal, Corded Ware culture and Bell Beaker culture).

There is a high correlation between the fluctuations of atmospheric 14C as a proxy-indicator for climatic changes and the presence or absence of lakeshore settlements in the studied region.

![Geographical distribution of the Neolithic lake shore sites in the northern Alpine foreland which supplied archaeozoological assemblages (after Schibler et al. 1997, 554, fig. 1)](image)
fig. 2. Frequencies of wild (black) and domestic (white) animal bones in lake shore settlements of central and eastern Switzerland between the 43rd and the 25th century cal BC

The database discussed in this paper includes archaeozoological results from 138 settlement layers and archaeobotanical results of 38 settlement layers. The sites are distributed evenly over the Swiss midlands and 112 of the settlements are dated precisely with the help of dendrochronology (fig. 1).

The relationship between the bones of wild and domestic animals shows the overall tendency of decreasing importance for hunting during the Neolithic (fig. 2). However, during the upper Neolithic there are great fluctuations in the importance of wild animals, their bones varying between less than 20% and more than 80% of all identifiable bone specimens. These fluctuations are caused by an apparent increase in hunting, while the importance of domestic animal bones remains stable through time (fig. 3–4). This means that more meat was available in the daily diet. A period with a very great importance of hunting is the 37th century BC (fig. 5). The importance of wild animals is very high in all the villages of that time, regardless of archaeological culture or geographical location. Indicators of various origins (atmospheric 14C, glaciation, timberline etc.) show a short-term climatic deterioration for the time around 3650 BC cal labelled “Piora 2" or “Rotmoos 2“ cold phase. It is very likely that neolithic farmers tried to compensate losses in cereal yields with an intensification of hunting and gathering.

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fig. 3. Importance of wild animal bones in lake shore settlements of central and eastern Switzerland between the 43rd century and the 25th century cal BC. The values represent numbers of animal bone fragments per square meter and cultural layer / settlement phase.

Low densities of cereal grains and threshing remains as well as high areal densities of collected wild plant remains make this interpretation even more probable.

During the later and final Neolithic Period, the fluctuations between wild and domestic animal bones have much smaller amplitude, despite the fact that short-term climatic deteriorations still took place. Either food shortages did not appear in such a way as during the upper Neolithic or people were able to compensate for them in another way. Both possibilities might be true: on the one hand, climatic fluctuations seem to have been less extreme than before. On the other hand, the landscape had changed a lot compared to the upper Neolithic and the people had adopted their agricultural strategies and stock farming. Archaeozoological and archaeobotanical results are indicative of the following changes between the upper Neolithic Period (4300–3500 cal BC) and the later/final Neolithic Periods (3300–2400 cal BC):
fig. 4. Importance of domestic animal bones in lake shore settlements of central and eastern Switzerland between the 43rd century and the 25th century cal BC. The values represent numbers of animal bone fragments per square meter and cultural layer/settlement phase.

Gradual opening of the landscape (lower percentages of forest species among seed and weed remains and fewer woodland bird species; higher densities of mammals typical for open landscapes, such as hare and roe deer)

First indications of grazing the open land since the late Horgen and especially Corded Ware cultures (seeds and fruit remains from tread-resistant vegetation)

Higher densities of domestic animal species (Horgen culture: intensification of pig husbandry; Corded Ware culture: more cattle and more sheep/goat herding)

Diversification of stock keeping (first oxen in the Corded Ware culture, perhaps even in the Horgen culture; woolly sheep since the Corded Ware culture)

Use of traction power evidenced by finds of wheels and possible ploughs since the Corded Ware culture, perhaps even since the Horgen culture, i.e. 34th century BC

Better techniques of animal keeping, probably better strategies for overwintering (sudden increase in stature and frame of cattle and sheep/goat during the Corded Ware culture)

Intensification of summer crops such as poppy and flax since the Horgen culture allows a better distribution of labour over the year

Intensified cultivation of less demanding crops, such as barley and spelt wheat, cultivation on less favourable soils than before

Larger villages with longer duration of occupation

Eutrophic lakeshores with the first spread of reed belts

The typical field system of the late and final periods of the Neolithic may have been an alternating system of crop cultivation and grazed short fallows.

Human and animal activity, such as cultivation and grazing, led to a gradual opening of the landscape and mineralization of the lakes. Different types of open land developed, which led to an increasing diversity of ecosystems. The transformation of the natural environment
into a cultural landscape started during the Neolithic Period. Neolithic farmers adapted to the new, transformed environment by developing new agricultural techniques and herding strategies (cf. more open land > higher densities of cattle). New techniques and perhaps even new forms of domestic animals and plants have been introduced at the beginning of a new archaeological culture (cf. Corded Ware culture: woolly sheep), but they have also developed within one cultural sequence, as is shown by the example of the Horgen culture. Whilst the pottery style of the Horgen culture may not look very sophisticated, its agriculture and stock keeping strategies were all the more innovative and adaptable.
Early Holocene archaeological sites in the Iron Gates region (fig. 1), related to the Lepenski Vir culture, due to their early and long occupation as well as their socio-economic complexity, are of crucial importance for understanding the Mesolithic/Neolithic transition in Southeast Europe and beyond. Changes in subsistence strategies, domestication of plants and animals, as well as an overall change in man-animal relationships are among those characteristic aspects of this transition that are considered to pave the path to the sedentary way of life. Yet, all these changes played out in a very specific way in the Iron Gates. The practices of hunting were largely important in all prehistoric societies, yet in the Iron Gates hunting and fishing most likely dominated the economy even once sedentary habits might have been accepted, such as building houses and developing monumental art.

Detailed reviews of archaeological sites, research history, stratigraphy and chronology of the region are presented by Radovanović and Boric. One should only mention that several sites in the Iron Gates provided sequences dated to the early phases of the Holocene, around or before 9000 cal BC. Recent radiometric dates associated with trapezoidal buildings at the key-site, Lepenski Vir, indicate that the occupation of these structures covers a time span from c. 6200 to 5500 cal BC. However, the unquestionable evidence of Mesolithic occupation at Lepenski Vir is enabled by new AMS dates that indicate deposits dated to around 8200–7600 cal BC.

Environmental changes at the beginning of Holocene did not have the same rhythm in every region. The environment of the Iron Gates is peculiar in this respect, and it is known as an environmental refugium that preserved many Tertiary plant and animal relics. It is also possible, and even expectable, that changes in the faunal composition, including large mammals related to the end of the Pleistocene and the beginning of the Holocene were restrained in the Iron Gates, and that Pleistocene faunal elements survived in the Iron Gates while they were already extinct in the surrounding regions. If one could find the evidence for this assumption, it would be also possible to suggest that this environmental “delay” in the Pleistocene/Holocene faunal changes could have influenced the Mesolithic/Neolithic transition in the Iron Gates with regard to many archaeological differences between this and the surrounding areas.

The expression “Mesolithic/Neolithic” from the title relates to the fact that the paper deals with both periods, but, at the same time, it is a deliberate reminder concerning dilemmas of associating the Lepenski Vir culture to one or the other realm, and to the general fact that classification of human societies does not stand our rigid categories.

On the basis of the archaeozoological material that has been examined so far, primarily from the sites of Padina and Lepenski Vir, I would like to emphasize that domestication did not play an important role in the Iron Gates Mesolithic/Neolithic transition. Hunting and fishing were the basis of subsistence in both periods, while catching anadromous fish was the main reason for the selection of settlement locations, and the most important socio-economic

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1 Radovanović 1996.
activity that directed the life rhythm of these groups. This way of life might have been chosen due to the environment of the Gorges, and here one finds an example where the transition from the Mesolithic into the Neolithic is not accomplished by accepting the influence of presumably more advanced societies, but through the adherence to logical choices in the given environment.

Archaeozoological research presented in the first reports soon after the rescue excavations in the Iron Gates in the 1960s, more recently have seen a new impetus through the analyses of material from renewed excavations, analyses of previously unpublished material from old excavations, and reanalyses of the previously published material. This new work facilitated reinterpretations of the faunal data, and has also played an important role in the reinterpretations of the archaeological data in general.

The following discussion about a fragmented lion tooth in the reanalysed material from Padina is thus one element of the zooarchaeological potential that this renewed work made possible.

A lion tooth fragment from Padina

A lion tooth fragment discovered at the site of Padina has fragmented parts of crown and root (fig. 2, a, c). The preserved part of the crown is its central portion, with the incision between the main cusps and part of a carnassial’s blade. The protoconid is broken below its tip, and its blade, stretching from the incision toward the tip, with the preserved length of approximately 8 mm, is worn in such a way that a narrow dentin band is exposed. The paraconid is broken immediately in front of the incision. On the buccal side of the crown an islet of enamel is exposing the line of the base of the crown, although the enamel is missing at the swelling that marks the transition between the crown and the root. Lingually, the base of the crown is

8 Dimitrijević – Borić (forthcoming).
damaged. Only the anterior process of the root is preserved, and in its full length, while its anterior portion below the base of the crown is damaged.

The tooth was broken along its narrowest, and thus the weakest part, along the line dividing the anterior and posterior fang of the root and corresponding parts of the crown. In addition to this major break, the tooth is further damaged orally and lingually at the level of the crown base, and this damage is not from a simple mechanical break, but looks like it was made by several strokes. It is most probably of biogenic origin, i.e. made by a human or an animal. All these damages are old, most probably made prior to deposition. Missing flake of the enamel on the buccal side of the crown, and the one at the anterior portion of the root are recent, as the result of excavation or post-excavation damages.

The carnassial blade shows that it is a carnivorous carnassial tooth. The position of the incision dividing the protoconid and paraconid in relation to the root branching point shows that it is a lower carnassial, and its size indicated that it comes from a large cat of the genus *Panthera*, the species that in size corresponds to present-day lions.

The tooth is compared with the first molar of the lower jaw of a cave lion identified in the Upper Pleistocene fauna of the Risovača Cave in central Serbia (fig. 2). The wear of the Risovača specimen is somewhat more advanced, as the exposed enamel band on the protoconid blade is broader. The details of the morphology, which can be observed on the preserved part of the crown of the Padina specimen, are similar to those of the comparative specimen from Risovača: the buccal side of the crown is convex, the base of the crown is

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9 Dimitrijević 1997.
swollen, and the crown is deeply excavated lingually at the level of incision. The position of the divergence point between the processes of the root is the same. The size comparison is made difficult by the fragmentary nature of the specimen from Padina and the Risovača specimen’s imbeddedness in the jawbone. On the Padina specimen, it is only possible to take the measurement of the buccal height of the incision (Table 1), which is slightly smaller than on the Risovača specimen. The visual comparison of the two specimens’ sizes indicates a smaller size for the specimen from Padina.

<table>
<thead>
<tr>
<th>Measurement</th>
<th>PAD</th>
<th>RIS</th>
<th>Slatina (Ninov 1999)</th>
</tr>
</thead>
<tbody>
<tr>
<td>length (1)</td>
<td>29.4</td>
<td>26.3</td>
<td></td>
</tr>
<tr>
<td>protoconid length (2)</td>
<td>16.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>paraconid length (4)</td>
<td>14.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>breadth (7)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>lingual incision height (16)</td>
<td>12.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>buccal incision height</td>
<td>9.9</td>
<td>10.2</td>
<td></td>
</tr>
</tbody>
</table>

Table 1. Panthera M1 inf. (mm)

However, this comparison with the Pleistocene cave lion is not intended to identify the Padina specimen to this species but rather demonstrate that both specimens belong to the same genus. Moreover, there are no clear morphological differences in the lower carnassial between the species of this genus. The size difference is important, although again not very conclusive. Generally, cave lions are larger than present-day species, but specimens of different sizes are known from the European Pleistocene, some of them overlapping with those of modern comparative specimens of the species belonging to this genus. Differences in size can also be due to sexual dimorphism within the same species. If we assume that the Pleistocene lion survived into the Postglacial, one should expect a reduction in size, according to Bergman’s rule and adaptation to presumably less suitable environments.

The tooth was found in the layer of intensive black soil above the rocky base of Sector II (Trench 2, Block 3a) at Padina. The tooth’s colour and structure are similar to many fragments of animal bones that are found in the same layer.

It is reasonable to assume that the remains of lions will rarely comprise a palaeontological or archaeozoological assemblage. These animals are on the top of the nutrition chain; normally they are rarely hunted, and, only occasionally are found in the bone accumulations of predators. Although lions are hunters, they do not accumulate bones as hyaenids and some other felid species. Although some examples from south-east European prehistory concerning the presence of lions are quoted below, their rarity in faunal assemblages come from the fact that humans rarely opposed but rather avoided this beast.

**Upper Pleistocene cave lions and Holocene European lions**

The lion, variously assigned to the same species as the recent animal, Panthera leo (Linnaeus), or separate subspecies, Panthera leo spelaea (Goldfuss), or separate species, Panthera spelaea (Goldfuss), inhabited a vast region from Western Europe to eastern Asia in the Pleistocene. The taxonomic is at least partly due to the fact that morphological distinctions between the Pleistocene cave lion, on one hand, and the Holocene and the recent species, on the other, are present but not very accentuated, while the chronological separation is often taken for granted.

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10 The numbers in brackets are the numbers of measurements from Schmidt 1940, Plate 1.
11 Schmidt 1940; Argant 1991.
Remains of the Upper Pleistocene cave lion are found in many caves in the Balkans and in the surrounding regions. In Serbia, they are found in the following caves: Risovača, Prekonoska, Pećina u crvenim stenama, Lazareva and Jerinina. The size of these specimens is larger when compared to recent animals belonging to this species.

In the European Holocene lion remains are rare. The westernmost Holocene find is a single canine from the Late Neolithic cemetery of Zengővárkony in the Carpathian Basin. Other finds in this area come from three sites of Eneolithic age. Together, these finds cover the time span of approximately one thousand years (3500–2500 BC). A pelvis fragment was found at Tiszaföldvár-Téglagyár, an upper jaw fragment with incisors and premolars at Gygöngyöshalász-Encspuszta, and, both teeth and skeletal remains (two canines, fragments of scapulae, radius, two ulnae, two metatarsals and one phalanx), at Tiszaluc-Sarkad. Cut marks and damages on some of the bones led Vörös to conclude that “lion was hunted, its flesh eaten, teeth and bones used as bone implements”.

“How did the lion get into the Carpathian Basin?” as Vörös named one of subtitles in his paper, was explained by migration from Asia via Eastern Europe at the “Late Neolithic-Copper age faunal wave”. Vörös presumed that the warming and aridity at the end of the Atlantic opened new migration routes for the animals, e.g. across the dried out marshes of the Lower Danube.

This scenario cannot be accepted for the find from Padina, since its age predates the climatic optimum. Moreover, its presence in the Danube valley, which connects the Pannonian and Dacian Basins, offers another explanation for the occurrence of these finds both at Hungarian sites in the Pannonian Plains and at Bulgarian sites in the Dacian Basin. This latter region might have been the area from where the spread of lions was possible in the course of the Atlantic and Subboreal, even if its distribution was possibly restricted to the Danube Gorges in the Early Holocene, Preboreal and Boreal.

With regard to the Padina find in particular, it is more probable that the lion survived in this area as a Pleistocene relict than that it migrated into the region through already populated areas of Eastern Europe and the Danube Gorges during the Mesolithic and Early Neolithic periods.

One could hope that future finds will fill the gaps in the record, since in addition to the first find at Goljamo Delcevo, only in the last two decades several new reports of lion remains come from Bulgaria. Together they cover the time span from the Neolithic (Karanovo) to the Late Bronze Age (Durankulak). A tooth fragment is found in the Neolithic levels of Karanovo, while there are many more finds in the Eneolithic: a single atlas in Goljamo Delcevo, a proximal part of ulna at Slatino, a juvenile tibia and a first phalanx at Sozopol, a humerus fragment at Devetaška Cave, and the most numerous remains come from Durankulak: two mandibles, one scapula, three humeri, four radii, one tibia and one rib from the Eneolithic and one mandible from the Late Bronze Age strata.

Ninov provided some important observations with regard to the broad ecological tolerance of the Holocene lion from Bulgaria, as its remains are found at sites located both in lowland and mountainous regions, and both by major rivers and in karstic regions. Consequently, lions could inhabit wooded, wooded-steppe, or open-steppe environments. Probably the most important limiting factor was the availability of prey, and, according to Ninov, this condition is met in the richness of ungulates at Eneolithic sites in Bulgaria. I would add that concerning the survival of several important Pleistocene ungulate species, such as Bos primigenius Bojanus and E. hydruntinus Regalia, even the composition of herding ungulates did not drastically change since the Pleistocene, although this large predator could possibly shift from one species of prey to another, as long as a sufficiently large prey mass was available.

17 Vörös 1983.
18 Vörös 1983.
19 Vörös 1983.
21 Ninov 1999.
22 Ninov 1999.
23 Ninov 1999.
The southern Balkans lion finds in Greece, and those from the Ukraine are more important for filling another gap in the record, between the archaeozoological finds and written historical sources. In the Ukraine, lion bones have been found at seven sites: Chalcolithic Mayaki, Bolgrad and Molukhov Bugor, and Early Iron Age Ol’biya, Berezan’, Chernomorka II and Chernovaty. The latest finds indicate the presence of lion at the Black Sea coast even in the last centuries of the first millennium BC.\(^{24}\)

The most southern find is from Tiryns at Peloponnesus, while the most numerous remains come from Kastanas, a Bronze and Iron Age settlement from Macedonia in Greece, where twelve skeletal parts were found. They originate from different layers covering the span of several hundred years at the beginning of Iron Age (1200–800 BC).\(^{25}\)

The finds of actual bones, combined with ancient written sources and the artistic representations of lions, reaffirm that lions were present in Greece well into the historic period.\(^{26}\) Besides notions on Greek lion mythology and iconography, Babic\(^{27}\) presented a review of the most interesting descriptions of lion in ancient written sources. The important remark is found in the citation of Aristotle, who mentioned “two species of lions, the plump, curly-maned, and the long bodied, straight maned”.\(^{28}\) This observation is interestingly commented by Babic as a possibility of an existence of both surviving cave lion and Asiatic migratory specimens.

**Other Pleistocene “survivors”**

Generally, Holocene and Pleistocene faunal compositions differ considerably, and most remarkable differences occur in the composition of the large mammalian fauna. There are a number of shared species, such as red deer, roe deer and wild swine, although the relative frequency of particular species differs. While some large mammalian species disappeared, the extinction of others was postponed. This process is best documented for aurochs *Bos primigenius* and *Equus hydruntinus*. Aurochs is present in the Iron Gates archaeofaunas, as it is in archaeofaunas of the surrounding areas—the Carpathians, the Pannonian Plains, and the central Balkans. It is characterized by a decreased size in comparison to the Pleistocene species, which makes it difficult to distinguish it from domestic forms. Contrary to the conclusions of earlier researchers,\(^{29}\) we\(^{30}\) do not find domestic specimens of cattle at Padina and Lepenski Vir during the occupation of these settlements.

Life conditions in the Upper Gorge in this region were not so favorable for *Equus hydruntinus* Regalia, a zebroid horse species, sometimes wrongly referred to as “European ass” (but different from the true asses and hemiones in tooth morphology).\(^{31}\) Its presence is reported for Lepenski Vir.\(^{32}\) A single find of a horse from Padina is not identified to the species level.\(^{33}\) At the same time, this animal is frequent, and even abundant at some sites of the Early Neolithic Starčevo–Körös culture groups,\(^{34}\) and became finally extinct in the Late Neolithic/Eneolithic. The Holocene appearance of this small equid in the Carpathian Basin, Vörös\(^{35}\) explains as the consequence of their migration from the East, within the same “faunal wave” that brought lion and other species,\(^{36}\) although admitting that oddly enough there are no *E. hydruntinus* remains in Eastern Europe and Southern Eurasian steppes during the Mesolithic and Neolithic periods, and that their expansion toward the west during the warming and rising humidity of the climate contradicts the supposed ecological demand of the species, i.e. arid steppes.

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\(^{26}\) Babic 2001.

\(^{27}\) Babic 2001.


\(^{29}\) Bökényi 1969; Clason 1980.

\(^{30}\) Dimitrijević (in press); Dimitrijević – Boric (forthcoming).


\(^{32}\) Bökényi 1969.

\(^{33}\) Clason 1980.

\(^{34}\) Vörös 1981.

\(^{35}\) Vörös 1981.

\(^{36}\) Vörös 1983.
Wild horse, *Equus ferus* Boddaert, and interestingly enough, elk, *Alces alces* Linnaeus were recorded at two cave sites on the left banks of the Danube in the Iron Gates region—Cuina Turcului and Climente.\(^3\) Wild horse remains are known from the wider region, but Postglacial elk remains are very rare, although also known from Hungary.\(^4\)

A fragmented scapula found under the floor of one building at Lepenski Vir gives an indication about the presence of a large stature deer, comparable to elk or giant deer.\(^5\)

All of the above mentioned species might have been possible preys for large predators, such as lion. Another carnivorous predator not previously recorded in the Iron Gates, although of much smaller size, was found at Padina. A felid distal humerus of a medio-lateral breadth of 26.6 mm was found, and can be compared to lynx, *Felis (Lynx) lynx* Linnaeus (fig. 3). It is of similar morphology but distinctly smaller stature. At the same time, this specimen is larger than the same bone of wild cat, *Felis silvestris* Schreber. On the basis of its size, it could fit pardine lynx, *Felis (Lynx) pardina* Temminck.

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\(^5\) Dimitrijević 2000.
The bio/geo/chronological distribution of pardine lynx is somewhat dubious. Its recent distribution is restricted to the Iberian Peninsula, according to Hemmer, while the idea of its presence in northern Greece, southern Albania and southern parts of former Yugoslavia has been rejected. It has also been shown that recent and sub-recent lynx populations in the Balkans belong to a subspecies of northern lynx, *Lynx lynx martinoi* Miric, characterized by a smaller size in comparison with the Carpathian and Scandinavian lynxes, but still within the range of the species variability, and different from pardine lynx.

In the Upper Pleistocene of south-western Europe, there are finds ascribed to pardine lynx that show its previous, wider distribution. It is especially significant that this species is also found in the Postglacial and Upper Pleistocene of southern Europe and the Balkans. In Veternica Cave in Croatia, remains of at least four animals identified as pardine lynx were found, originating from three different layers, Layer “d” of Postglacial age and Layers “i” and “h” of the Last glacial age. In Layer “i”, a distal humerus is found with the medio-lateral breadth of the distal end measuring 27.0 mm. A single find, a complete tibia, originates from Upper Pleistocene deposits of Vrelksa Cave, Serbia.

The peculiarity of the Padina find is not only the occurrence of pardine lynx, but even more its co-presence with undoubtedly confirmed northern lynx, *Felis (Lynx) lynx*. Werdelin suggests the coexistence of these two species, assuming that the competition with larger species, more precisely northern lynx, in the course of the Upper Pleistocene influenced the size reduction of pardine lynx.

**Conclusions: Immigrants from Asia or Pleistocene survivors?**

Climatic changes at the end of the Last Glacial are marked by drastic changes in the distribution and composition of fauna in Europe. Apart from large-scale migrations, many large mammalian species became extinct. Whether this process was sudden and catastrophic or more gradual is the question that has occupied the attention of palaeontologist for decades. Although these extinctions can be seen as sudden in the sense of geological time, and catastrophic with regard to changes in the faunal composition, continuing palaeozoological research, particularly with the help of absolute dates, has indicated that the process might have lasted for several thousand years.

Several large mammalian species were spared from extinction during climatic changes only to be “finished off” in the course of the Holocene. Some of these species, such as aurochs, and *Equus hydruntinus*, were still abundant at the beginning of the Holocene, and their presence in this period is well established. Others are much rarer and their existence in the Holocene is hardly recognizable. These are largely species that became mostly extinct in their previous habitats, but survived for a long time as isolated populations in certain areas. An illustrative example is the survival of dwarf mammoths on Wrangel Island well into 3700 BP, the species discovered only in the last decade of the last century. Giant deer, *Megaloceros giganteus* (Blumenbach), survived into the Early Holocene in the Middle Urals, as well as wooly rhinoceros, *Coelodonta antiquitatis* (Blumenbach).
Although it is possible that migrations took place and that some animal species came in this way from Asia, or any other given region, into Europe, I suggest that it is unlikely that a lion, a predator that needs large undisturbed hunting territory, would have migrated into the already populated land of south Europe, i.e. into environments that were already in the course of the Neolithic altered due to human impact. It is more likely that this species survived the end of the Last Glacial in restricted areas of Southern Europe, from where it might have spread in several episodes during the Holocene. The lack of more abundant finds of this species in the Pleistocene/Holocene archaeofaunas could be the consequence of human reluctance to hunt it. The presence of another carnivorous species mentioned above, pardine lynx, is even more difficult to explain by an assumed Postglacial migration, since the distribution of this species shrinks towards the Iberian Peninsula in the Holocene. At the same time, importantly, large herds of herbivores survived the end of the Last Glacial, providing large carnivores with adequate prey as one of the main conditions for the survival of these large predators.51

51 I thank Borislav Jovanović for his kind permission to reanalyse archaeozoological material from Padina, Dušan Borić for sharing effort and pleasure while working on it, as well as for the valuable comments on this paper, and Staša Babić for an interesting discussion on Greek and “Serbian” lions.
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DENDROCHRONOLOGY AND NEOLITHIC RESEARCH IN HUNGARY

Dendrochronology, i.e. archaeological dating based on the annual-rings of trees has become an integral part of archaeological research. In Hungary, systematic investigations started relatively late at the end of the 1980s. Nevertheless, the main questions could be clarified by now and the construction of a dendrochronological sequence has begun.1

The current status of research does not yet permit the absolute dating of neolithic sites, but relative dating, i.e. internal chronologies of archaeological features and sites can be established. However, several features were observed on more recent material, which raise serious questions that need to be answered by prehistorians as well.

The most important question formulated during the analysis of annual-rings is whether and to what extent the current dendrochronological status of the Carpathian Basin directly available for research, can be projected onto the past?

Unfortunately, experts in none of the scientific fields concerned (dendrochronology, biology, forestry) have paid attention to this question. The problem is even more relevant since dendrochronological research considers the "dendrochronological zones" as stable all over Europe. However, dendrochronological investigations in Hungary during the last 15 years revealed some phenomena that do not correspond to this topos and that have to be evaluated in future research.

The analysis of modern materials has shown that samples originating from the Northern Hill region and its geological continuation, the Pilis–Buda Hills are comparable. Similarity could also be established with samples from the Great Hungarian Plain. Thus, these series present the "central Hungarian basic oak chronology". Data from other regions did not consistently correlate either with this data set or with each other.

The reason for this data fragmentation is probably the fact that the Carpathian Basin and present-day Hungary within it, lay at a crossing point of different climatic, meteorological and therefore diverse vegetation zones. Thus, only the central part of the country and the basin display homogeneous features, while in other regions the different influences interfere to different and rapidly changing extents, giving a strong local character to the growth of the trees. Unfortunately, the climate and vegetation historical background of the phenomenon is not well understood. In addition more work needs to be carried out on a comparison of subsoil water levels and changes in water level in dendrochronological zones.

According to the analysis of the archaeological material it seems that this kind of "mosaic" is not only a recent characteristic, but also existed in historical times, too. It seems likely that similar features characterised prehistoric times as well although this remains to be demonstrated through future research.

None of the chronologies of the Carpathian Basin could be compared to those of the neighbouring regions. The Pannonian oak chronology based on numerous samples originating from Roman period sites (it now covers two periods: 454–207 BC, 170 BC – 99 AD, respectively) produced positive results in comparison to the South German oak chronology. This means that contrary to the recent, modern and medieval data series, the oak chronology of Roman Pannonia seems to be comparable (!) to the south German data. If this observation is correct, it means that in this period at least the edge of the region covered by the "German"...
chronology lay much more to the east than today, extending even into Roman Pannonia. However, this leads us to the supposition that the dendrochronological zones of Hungary and the Carpathian Basin must have changed at least once in the last 2500 years! Up to now, the reason for this change remains obscure. It certain occurred, however, which should alert scientists to the fact that similar, basic transformations must have taken place in other, earlier epochs, too.

For year-exact dating, counting the number of the annual-rings in the sapwood of the different tree species is a prerequisite for the dendrochronologist. The image based on research into recent material (17 + 2/-s annual-rings) corresponds to the statements of European research, according to which the number of annual-rings in the sapwood decreases step by step eastwards (The investigation into the reasons for this feature remains the task of future work). At the same time, scholars commonly suggest that this number was constant through the centuries, too, i.e. the same factors characterised the given region centuries earlier, as well. The analysis of the Hungarian archaeological material led once again to considerations that may inspire new investigations. During the construction works of the M3 motorway, an 18th century well was found at the site of Szíhalom-Pamlényi field. Altogether 38 dendrochronological oak samples could be collected. Most of the samples contained the sapwood as well, in 23 cases even completely, i.e. till the bark. This allowed us to make statistics concerning the average annual-rings in this group of samples. It has turned out that the obtained number differs considerably (by a facto of 2.3) from the number observed on recent material. Since the data series of annual-ring thickness of the Szíhalom well largely correspond to each other, the number of sapwood annual-rings has to be considered as representative for the given material. It will be the task of future research to se whether the discrepancy in the number of sapwood annual-ring is characteristic only for the trees used for the construction of the well, or whether it can be observed over a larger region, too, and thus we have found a phenomenon that changes through time.

Unfortunately there is no reference material from other sites, which would contain such a large number of samples with complete sapwood and bark. Nevertheless, we could frequently observe an extremely low number of sapwood annual-rings on samples from the Roman period. This fact too, indicates that the number of sapwood annual-rings has to be investigated systematically and we cannot accept as an axiom the stability of this factor through the centuries. A great help in finding the answer would be if the biologists and the foresters could tell us what influences the number of sapwood annual-rings in a given tree species.

Besides the classical dendrochronological problems, research on archaeological sites also allows observations concerning the forest exploitation of the population. One of these observations is that the data series of the samples of a given site is often comparable to each other, but the number of covered annual-rings is not very high. This allows the conclusion that the trees exploited did not grow in each other’s proximity, i.e. the material of a given object (e.g. a well’s lining) was collected and brought to the site from a very large region. Two different reasons can be given for this phenomenon: it either refers to a selection system that means that suitable trees were chosen and timbered within the forest, or there was appropriate wood was left in the settlement’s environment, therefore the suitable material had to be bought on the market. This latter possibility seems to be probable, especially in those cases when the structure was not built from choice, “nice” wood. In both cases, however, one may acquire new, thought-provoking information.

While analysing the samples we could sub-divide them into two groups by the manner of dressing: some of them are “segments”, sawn tangentially from the sapwood which do

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2 Recently e.g. K. Christenson: Sapwood in oak trees from Schleswig to Trondheim. Lecture on the conference “Advances in European Dendrochronology” (Travemünde, 14–18th September 1994).

3 Rescue work of A. Várady whom I’m grateful for her help and cooperation.

not contain the pith, others are “planks” sawn approximately radially or cut longitudinally. This difference indicates different times and different practices of dressing, too. If the trees representing the two types of dressing are contemporaneous, we must find another explanation, e.g. different function.

Future tasks of dendrochronological research in Hungary lead in two different directions, which are nevertheless interrelated. On the one hand, “floating” chronologies can be lengthened and sooner or later these series of relative chronologies will be anchored to one or several absolute dates. As part of this work a long relative chronological sequence can be produced probably first for the Avar Period which will remain disconnected for a while, but will allow us to make an internal periodisation of the given time period, as well as the comparison of these data to archaeological dating, answering a number of questions (as well as raising some new ones). A part of this work research started in Transylvania in 2003. These works are led by the Hungarian Dendrochronological Laboratory.

The other field of research goes beyond simple dendrochronological dating, and needs the adoption of methods from dendroclimatology, climatic-history, geology, and landscape-history. In other words comprehensive, interdisciplinary research would be needed. The first step in this direction was the foundation of the Budapest Tree-Ring Laboratory in the Department of Paleontology of the Eötvös Loránd University in Budapest, together with Miklós Kázmér, assistant professor at that department. The results of this research will provide a basis for the scientific analysis of climatic, meteorological and vegetation-historical questions in historical periods. The results of this comprehensive research will benefit not only researchers of historical periods, but also “fans” of the Neolithic.
FINDINGS OF GEOARCHAEOLOGICAL AND ENVIRONMENTAL HISTORICAL INVESTIGATIONS AT THE KŐRÖS SITE OF TISZAPÜSPÖKI – KARANCSPART HÁROMÁG

There has been an intensification of research related to the distribution of the Körös culture and its northern boundary during the past few years and numerous interpretations have been advocated explaining the possible reasons for the emergence of this borderline. All these processes have been univocally triggered by archaeological excavations implemented at the Mesolithic sites of the Jászság, which had been discovered by an amateur archaeologist Gyula Kerékgyártó of Jászberény, under the supervision of Róbert Kertész.1 Two highly distinct conceptions have been put forward for the area of the Middle Tisza region.

Makkay applied an approach of language history while formulating his concept of the “Jászság boundary”, saying that it was historical-cultural factors that have finally led to the emergence of this borderline, plus the fact that the Mesolithic groups frequently encountered the Neolithic groups of the Körös culture.2 According to his views, the line running along the meeting points of communities bearing different technical and cultural traditions and belonging to distinct language families should mark the trajectory of this boundary. Discussing the critics of this concept is not the subject of this paper however, it must be mentioned that the emergence of a cultural interface stretching for several hundred kilometers seems to be quite unlikely within the Carpathian Basin3 with data on population densities of hunting – fishing – gathering communities at hand,4 due to the low population numbers of the foraging Mesolithic groups inhabiting the area.

The second concept of a geoarchaeological model draws upon the fact that the Carpathian Basin has been characterized by a large-scale versatility during the past 10 000 years. As a result, a large-scale mosaic-like segmentation or complexity emerged, observable both at the macro-, meso- and micro-scale within the basin from as early as the Ice Age.5 The emergence of a macro-scale mosaic or complexity is due to the overlap of four major climatic zones in the region.6 Thanks to the cumulative interaction of these climatic zones, a mosaic-like vegetation developed in the Carpathian Basin as early as the end of the Pleistocene, and this mosaic-like complexity is observable in the composition and distribution of the modern vegetation of the basin as well.7

The effects of the extensive overlapping climatic zones are further intensified and influenced by the regional and local morphological and hydrological conditions.8 The strongest climate-modifying influences emerged within the river valleys, as well as on the northern and southern slopes of the hills and mountains.9 Thus the interface of the different climatic zones does not form a clearcut uniform boundary at the macro level, but appears as rather segmented minor puzzle pieces, restricted to adjacent smaller areas, creating a mosaic-like pattern. Furthermore, all these climatic influences followed a cyclically fluctuating trend,

1 Kertész et al. 1994a,b, 1997.
2 J. Makkay: Theories about the origin, the distribution and the end of the Körös Culture, in: L. Talas (ed.): At the Fringer of three worlds. Szolnok 1996, 35–49.
appearing with given frequencies throughout the course of history,\textsuperscript{10} rendering some sort of plasticity to the boundary of the likewise periodically expanding – contracting climatic and environmental puzzle pieces.\textsuperscript{11} The mosaic-like segmentation reached such a large-degree, that the actual borderline or interface of the individual climatic and environmental units is practically resolved.\textsuperscript{12}

This complexity or mosaicity of the climatic, faunal, floral and soil endowments developing during the Quaternary and cyclically fluctuating in space and time had a major deterministic role on the immigrating and settling human communities. Simply because it practically prevented the expansion or spreading of the gathered, hunted or even produced plants and animals giving the economic foundations of these societies to the whole of the Carpathian Basin at a given moment of time.\textsuperscript{13} Therefore, the immigrant groups of people from various climatic-environmental areas could occupy only certain parts of the basin at a time. Those parts, which corresponded to their economic experience acquired up to that time, and which provided for their hunted, bred, foraged or cultivated animals and plants.\textsuperscript{14}

This new geoarchaeological model, conceptualized earlier, was developed for the whole of the Carpathian Basin by taking into account all the environmental and social factors, which were influencing and could have determined the spreading of the Neolithic communities bearing Balkan-Mediterranean cultural roots and production experiences.\textsuperscript{15} Based on the model, the authors hypothesized the emergence of a Central European-Balkan Agroecological Barrier (CEB AEB) within the central parts of the Carpathian Basin, which in essence determined the possibilities of spreading of the productive societies within the whole basin during the Early Neolithic.

The ecological needs of the cultivated plants and the farmed animals of the Körös–Starčevo culture, as the earliest group engaged in agricultural production, the preservation of a dual subsistence made up of productive and non-productive phases, the emergence of a sedentary lifestyle, as well as the level of technical development and production experiences gave the basis of this new agroecological model.\textsuperscript{16} While formulating the new hypothesis of the CEB AEB, the authors on the one hand systematically disproved the theories advancing the presence of the "Proto-Tisza" boundary. On the other hand they have also emphasized the important role of the river valleys acting as rendezvous points and infiltration zones for the Mesolithic and Neolithic groups in the whole process of neolithization within the Carpathian Basin.\textsuperscript{17}

A part of the archaeologists working on the Neolithic accepted this new model right away without showing any doubts,\textsuperscript{18} while others simply rejected it without bringing up any acceptable counter-arguments.\textsuperscript{19} However, it must be borne in mind that above-mentioned, new agroecological model works at a scale of several 1000 km\textsuperscript{2} (macro level) for the explanation of the process of neolithization within the Carpathian Basin.\textsuperscript{20} Although some initial steps have been taken for the conceptualization of a model working at a regional scale\textsuperscript{21} by taking into account the regional differences observable within the basin,\textsuperscript{22} no final version has come to light so far. Conversely, when we have a look at the settling process of the Körös communities at the macro level, it becomes quite obvious that the sites of settlement were purely restricted to the floodplains

\textsuperscript{10} Sümegi et al. 2000; Sümegi – Krolopp 2002.
\textsuperscript{11} Sümegi 2003a.
\textsuperscript{12} Sümegi 2003a.
\textsuperscript{13} Sümegi 2003a.
\textsuperscript{14} Sümegi – Kertész 1998.
\textsuperscript{15} Sümegi – Kertész 1998; Sümegi 2003a, b, c, 2004.
\textsuperscript{16} Sümegi – Kertész 1998.
\textsuperscript{17} Kertész – Sümegi 1998.
\textsuperscript{20} Sümegi – Kertész 1998, 2001; Sümegi – Hertelendi 1998; Sümegi et al. 2002, 2003a, b, c, d.
\textsuperscript{21} Sümegi 2000, 2003; Sümegi et al. 2003a, b, c, 2004.
fig. 1. The analysed Körös sites in the Carpathian Basin

and alluvial areas of the rivers. Based on this outcome derived from an observation made at the macro level, several authors have arrived at the conclusion that the hydromorphic soils of the floodplain must have had a significant role in the subsistence of the Körös culture groups.

It is essential to consider the importance of the presently lacking local and regional investigations corresponding to analyses implemented at the micro and macro levels, and the fact that the first local investigations yielded contradictory results to those of previous archaeological researches. The following parts of the present paper are discussing the findings of a complex geoarchaeological investigation implemented at the micro level at an Early Neolithic site, located at the northern boundary of the Körös culture belonging to the zone of the CEB AEB, in the vicinity of Tiszapüspöki.

Archaeologists of the János Damjanich Museum of Szolnok implemented detailed archaeological excavations at the site, enjoying public funding, preceding the construction of the No. 4 highway, under the supervision of Dr. Marietta Csányi, who was the head of the Department of Archaeology, Board of Trustees of the Museums of Szolnok County at the time. It was the Board that asked us to carry out our investigations at the site and we are all grateful for their kind support.

Materials and methods

Based on finds collected by field walking, a Körös site belonging to the village of Tiszapüspöki and registered to the prefecture of Törökszentmiklós was excavated during the summer of 1999 (fig. 1). From the site Karancspart–Háromág, several objects are dated to the Körös culture,
burial places and refuse pits have come to light besides the settling points of various other cultures.27 Parallel with traditional archaeological investigations, detailed geoarchaeological studies have been carried out as well at the site.28 These included the analysis of the following aspects, in accordance with the required steps of a palaeoecological study implemented with an archaeological perspective:29

1. Detailed morphological studies of the area (with the help of aerial photos, historical and modern maps of the area, personal field mapping and the construction of a digital elevation model).30

In other to capture the regional geomorphological conditions of the site the following maps have been utilized: the historical maps of the First Military Survey, the so-called “Josephian” maps (1782), the map series of Sándor Lietzner (1787-1790) and Sáumel Lányi (1845) depicting conditions preceding the 19th century river regulations, the map of the Third Military Survey prepared after the river regulations (1863), the soil map of Kreybig (1937), the geological map of Sümeghy (1941) (figs 2–3), and the modern digital maps prepared by Gábor Timár (figs 4–5).31

After the evaluation of the map data, the gained results were complemented with our personal morphological (fig. 6) and field work observations in 3D (fig. 7). The use of the historical maps in our work was highly important, as the river regulations of the 19th century significantly altered the original hydrological system of the Great Hungarian Plain. Thus the original environmental conditions of the site could be captured only via the combined use of these historical maps and data retrieved from various palaeoenvironmental sites. Aerial photographs were taken personally from an elevation of 60–100 meters above the site.32

27 Marietta Csányi’s personal communication.
28 Sümegi 2001b.
29 Birks – Birks 1980.
fig. 3. Kőrös site (Tiszapüspökí, Karancspart) and active, inactive river channels on the historical (1790) map (Sümegi 2000)
1. Pollen-site, 2. Kőrös-site (Karancspart)

2. In order to determine the spatial distribution of soils and reveal the underlying geology of the area high-resolution coring was carried out at 5, 10, and 20 m intervals with the help of an auger retrieving samples at 5 cm intervals in three sections (figs 8–10).

3. Open geological profiles were dug at the site for detailed lithostratigraphical, palaeopedological, fine stratigraphical and sedimentological studies (fig. 11). Grain-size distribution of the samples taken at 10 cm intervals were determined via traditional hydrometry,33 while the carbonate and organic content was determined by the method of Dean-type34 loss on ignition. The palaeopedological investigations embedded the analysis of micromorphology,35 grain-size distribution, carbonate and organic content of the soils,36 as well as the measurement of the pH, and potentiometric pH measurements on water-based solutions in order to determine the former bioactivity and the genetic type of the soils, embedding the Early Neolithic artifacts.

4. Undisturbed samples for pollen studies were taken not from the adjacent Tinóka creek and the area of the Háromág, due to the presence of about 3 m-deep drainage channels, but at a more distant site of the Kartsú creek located at the edge of the village of Tiszapüspökí which must have been an active channel of the river Tisza during the Holocene, but now completely

33 Molnár 1980.
34 Dean 1974.
35 G. Szendrei: Talaj-mikromorfológia (Soil micromorphology). Budapest 2000;
36 Dean 1974.
silted up.\textsuperscript{37} Pollen extraction was carried out after the generally used method of Zólyomi – Erdtman with ZnCl\textsubscript{2}.\textsuperscript{38} During the evaluation, the quantitative and qualitative changes of the vegetation induced by the climate,\textsuperscript{39} the climate indicator species,\textsuperscript{40} as well as the ecological needs of the various plant species were considered\textsuperscript{41} along with the anthropogenic influences on the environment.\textsuperscript{42} The sudden drops in case of the arboreous pollens were taken to correspond to human influences, while the gradual changes were interpreted to represent climatic events. The most important and frequent taxa were depicted in temporal and appearance order on pollen diagrams prepared by the software Psimpoll. The number of AP (arboreal pollens) and NAP (non-arboreal pollens) were evaluated together. The corroded, changes in Hungary in the last ten-thousand years]. Hungarian Meteorological Survey 92 (1988) 96–100.
\textsuperscript{41} Behre 1988; Horváth et al. 1995; Simon 1994.
\textsuperscript{42} Behre 1988; Diegerfeldt 1972; Sümegi 1998.
5. Middle Tisza region within Karancspart Körös site on the digital 3D field map

redeposited as well as the folded pollen grains unsuitable for determination were also counted for AP and NAP. The aquatic vegetation was evaluated separately.

5. In order to determine the horizon corresponding to the time of the Körös culture within the pollen profiles, and to reconstruct the temporal changes of the vegetation during the Holocene, some samples were radiocarbon dated in the Light Isotope Laboratory of the Nuclear Research Center of the Hungarian Academy of Sciences in Debrecen (Table 1).

6. The soil horizon embedding the Körös artifacts as well as the deposits of pits of the Körös objects, and those located further away from the Körös objects were wet sieved (several hundred kg) using a mesh of 0.5 mm, in order to retrieve the mollusc shells for malacological analysis. The rates of abundance, dominance as well as the Haarlow index were calculated (height x width x dominance) in order to eliminate the taphonomic and preservation bias during the evaluation of the mollusc fauna as well as the determination of the dominant form. The mollusc material has been used for the reconstruction of the once-prevailing local environmental conditions of the site at the time of the Körös culture.

All these detailed natural scientific studies were aimed at preparing a complex environmental reconstruction of the site on the one hand, and to establish a system of intercontrolled palaeoenvironmental analyses on the other hand. The final results of the palaeoecological and geoarchaeological investigations implemented at the site and its surroundings, and conceptualized in the next parts will reveal the interrelations of the Early Neolithic human communities and their surrounding environment at a local level. The principles and concepts put forth are valid only at a local scale and can not be extended regionally to other Körös site or sites due to the presence of the three-level mosaic-like complexity present in the Carpathian Basin as mentioned previously.
Results

The findings of geomorphological and historical studies

The evaluation of the historical maps unambiguously revealed that although the representatives of the Körös culture chose an alluvial plain as the site of their settlement, this plain is by no means homogenous, neither with regards to the morphology nor landscape evolution, in contrast to the former environmental archaeological assumptions. In other words, the alluvial plain, when examined at a macro level, seems to be a homogenous landscape with ideal hydrological and hydromorphological conditions and soils. However, it turns into a heterogenous system in reality composed of individual island-like Pleistocene lag surfaces.

These Pleistocene lag surfaces tend to represent traces of an earlier fluvial system of channels and floodplains which got into an elevated position due to the neotectonic movements commencing at the end of the Pleistocene, beginning of the Holocene and the displacement of the active channels and the horizon of fluvial erosion, creating a system of elevated island-like surfaces above the Holocene floodplains. Hydrogeologically speaking, these floodplain islands and elevated abandoned levees comprise a system free of annual floods and suitable for long-term settlement and agricultural production.

The Körös site of the Karancspart, Háromág at Tiszapüspöki and its surroundings is given by an extensive, elevated, island-like lag surface of Pleistocene age (figs 1–7). In other words, as justified by the findings of detailed evaluations of historical maps and digital elevation models of the area, the communities of the Körös culture chose the floodplain as the site of their settlement, however not the direct bank areas of the former channel of the Tisza river, but the more distant elevated Pleistocene lag surfaces and the bank areas of the silting-up abandoned channels acting as secondary or tertiary drainage channels in the area at the time. Naturally, these alluvial lag surfaces were by no means totally flat, uniform and homogenous areas, but were comprised of a complex, versatile system of abandoned, channels, riverbacks and backwater areas. These fluvio-morphological units of the Pleistocene alluvia are clearly observable in the studied region as well, the Tinóka creek located south of the site (figs 1–7).

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41 Sümegi 2000, 2003a,b; Sümegi et al. 2002.
being a remnant abandoned channel of Upper Pleistocene age located on a lag surface elevated above the present-day alluvial plain of Holocene age. Furthermore, the area of the Karancspart is composed of an elevated backswamp with infusional loess deposits and a loess-covered, sandy abandoned natural levee (figs 3–4). This highly variegated lag surface is made up of smaller units of different elevations. The deepest, lowermost parts are occupied by silted-up abandoned channels (83–84 m), while the highest areas are composed of loess-covered abandoned natural levees or riverbacks (88–89 m).

With these topographical data at hand we can state the following: the formerly active but presently abandoned channels could have become flooded during the floods of the river Tisza in times preceding the river regulations, when the extension of the flooded areas and floodplains exceeded 30 000 km² but the water levels were not as high as recorded today, turning these abandoned riverbeds into secondary and tertiary drainage channels. However, the highest elevated areas managed to remain free of floodwaters.

Consequently, the communities of the Körös culture occupying the elevated areas of the Karancspart site were in fact dwelling in an aquatic habitat close to the river, but not on the banks of the active riverbed, but on the flood-free banks of the Pleistocene abandoned channels acting as drainage channels during the times of floods. This typical type of settling method is linked to well-definable morphological units thanks to the special landscape development of the Great Hungarian Plain, namely the Pleistocene lag surfaces.49 What does it exactly mean? These channels had been active riverbeds during the Würmian and at the end of the Pleistocene, which got into an elevated position as a result of the end-Pleistocene tectonic movements and turned into inactive canal-like channels via minor subsidence. The canal-like, longitudinal abandoned channels are one of the most characteristic geomorphological features of the Great Hungarian Plain observable almost in every part.50 These canals must have been fully flooded during floods harbouring huge amounts of floodwater and becoming secondary and tertiary drainage channels during the Holocene.

49 Sümegi 2000.

50 Sümegi et al. 1999, 2000, 2002a, 2003a,b,c.
Several such drainage channels could have been identified at the site of Karancspart, Háromág of Tiszapüspöki, which could have carried floodwaters into the vicinity of the settlement during the Holocene. These are for example the channels of the Tinóka creek, the abandoned riverbeds under the name Háromág (Three branches), and finally the Kartsú creek (after the map of Leitzner 1790) at the edge of the village of Tiszapüspöki, which was an active channel of the Tisza River during the beginning of the Holocene. Floodwaters managed to reach the lowermost parts of the area during the flooding of the Tisza, turning the backswamp areas of the Pleistocene lag surfaces into a pond during the Holocene (fig. 2: Fejér Pond, named after the map of Leitzner and the First Military Survey). According to the morphological data available for the studied area, the channels and depressions surrounding the elevated, loess-covered, abandoned levee of the Karancspart were covered with water during and after the floods, turning the settlement site of the Körös culture into an approximately 5 ha peninsula, which was a part of an extensive alluvial island stretching from Töröszentmiklós, to Tiszapüspöki and Szajol, covering an area of about 8–10 km² (figs 2–5). Several such Neolithic sites, occupying similar alluvial islands could have been identified from other areas of the Great Hungarian Plain so far.\footnote{Sümegi 2000, 2003b,c, 2004; Sümegi et al. 2002a,b, 2003b,c.}

**Results of sedimentological and faciesanalytical investigations of the cores**

Geological maps (fig. 9) and cross-sections (fig. 10) were prepared for the area via the analysis of boreholes deepened at 5, 10 and 20 m intervals. According to the findings of these analyses, different morphogenetical units reflecting the morphology, Pleistocene water coverage, and fluvial sedimentation characteristic of a former floodplain could have been identified. Aolian loess was deposited on the elevated heights of the levees, while its aquatic counterpart, infusional loess accumulated on the floodplains behind the levees and the backswamp areas along with other floodplain loess-like sediments.\footnote{Pócsi 1993; Földvári 1957.} These differences in the lithology, and the
fig. 9. Geological map of Karancspart, Háromág Körös site at Tiszapüspöki (Sümegi 1999)
1. Holocene flood plain sediments, 2. Loess, 3. Infusion loess, 4. Wind-blown sand,
5. Canalised Pleistocene river channel

two major loess types were clearly identifiable on the borehole profiles with the help of grain-size, carbonate and organic content data (figs 11–12).

Three major horizons or layers could have been identified within the boreholes deepened at the highest points of the Karancspart between 87 and 88 m at the settling points of the Körös culture. The bedrock is made up of sandy deposits, more precisely grayish-yellow, well-sorted, very fine-fine sands, which are either carbonate-free or contain minimal carbonate. This layer is overlain by a yellowish-brown layer of fine silty-coarse silt with significant carbonate content, a typical aeolian loess deposited among dry conditions (fig. 11). On this loess layer an organic-rich, blackish brown soil developed with calcareous coating in its B and B/C horizons, embedding the artifacts of the Körös culture. No signs of fluctuations in the groundwater table (iron spots or precipitates) could have been identified in the elevated areas.

Sedimentary structures like iron precipitates and reddish-brown spots indicating groundwater fluctuations are observable in the layers below 86 m ASL, accompanied by an alteration of the sedimentary facies as well. Here we could have identified coarse-silty fine silts of brownish-green hue with iron and carbonate precipitates and significant clay content, or infusional loess genetically speaking (fig. 12). The bedrock here is also very fine-fine sand, and a black soil horizon developed on top of the infusional loess deposits with higher clay content than that on the aeolian loess layer (figs 10–12). According to the facies distribution analysis of the boreholes, the infusional loess layers are inter-fingered with the type aeolian loess layers comprising most likely a heterotypical facies, which emerged at the same time during the end of the Pleistocene in different environments and topographic position. According to the findings of sedimentological and malacological investigations,53 the most important differences between these two loessy facies were those of the height of the ground water table, and the humidity as well as the vegetation cover of the area serving as the site for dust accumulation. In case of the infusional loess deposits, the accumulation of the dust particles took place in an environment, which was under water cover at least in a part of the year, while the type aeolian dust particles, lacking any signs of groundwater influences, must have accumulated among dry steppe-forest steppe conditions. All these data seem to imply that in the area of the Great Hungarian Plain the evolution of a loessy hydroseries from

the lowermost part of the floodplain to the topmost part of the levees was highly dependent on the geomorphological endowments, the elevation and the actual level of the groundwater. As a result, a dust accumulation surface with frequently fluctuating water coverage emerged on these areas, determining the process of dust accumulation on the one hand, and the structure and composition of the yielding loessy deposits via the diagenesis on the other hand.

When the findings of the former geological and geomorphological surveys of the Great Hungarian Plain are considered, which were implemented at a higher resolution, it might seem surprising that in areas with relatively small differences in their relief significant variation can be observed in the sedimentary facies even within a relatively small distance. However, after the complex, palaeoecological analysis of the site of Szeged-Öthalom it became rather apparent that the area of the Great Hungarian Plain is made up of relatively smaller, well-traceable, topomorphological sedimentary units which extend over a couple hundred metres, characterized by distinct sedimentological parameters influencing both the vegetation and soil conditions, as well as the possibilities of human settlement, as it has been shown by the most recent geoarchaeological studies. These sedimentary units managed to preserve signs of their original morphological, topographical and sedimentary conditions as well as the groundwater levels prevailing during the time of their formation.

Results of the palaeopedological studies

The extensive archaeological excavations and the geoarchaeological coring involving an area of several ha enabled the detailed study of the prevailing soils at the site, as well as the extrapolation of the horizontal alterations of the bedrock and the overlying soil horizons to larger areas (fig. 13). Thus the horizontal tracing of the settlement horizons of the individual cultures was also feasible (fig. 14). According to the findings of soil analyses, the evolution of soils in the area was determined by the composition of the bedrock, and the topographical and morphological conditions of the site. The topmost horizon is covered by chernozem, the surrounding areas of these by meadow black earth soils, while hydromorphic meadow soils developed in the lowermost areas.

Pedological and archaeostratigraphical correlation of the individual horizons was also feasible with the help of a geoarchaeological profile dug at the site (fig. 14). The tools and artifacts of the Körös culture are univocally linked to the lowermost part of horizon A of the

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54 Rónai 1985.
55 Krolopp et al. 1995.
56 Sümegi 2000.
fig. 11. Sedimentological results of a bore-hole sequence on the topmost part of Karancspart, Körös site at Tiszapüspöki (Sümegi 2000)

blackish-brown organic-rich soil, well-below the plow-zone in undisturbed conditions and the borderzone of the A, B horizons.

Chernozem soils, with clearly distinguishable horizons developed in the topmost part of the studied area (fig. 15). Below the 30 cm deep plow zone, a highly disturbed, slightly calcareous, neutral, friable A horizon with 4–5% organic content and a blackish-brown hue could have been identified with a thickness of 50–60 cm. The pits of the Körös culture were filled in with soils of the same parameters in great thickness, sometimes reaching 100 cm as well. Below this A horizon, a calcareous, friable B horizon developed with sporadic carbonate veins and coatings, numerous crotovines and a dark brown hue with a thickness of approximately 30–50 cm. Significant amounts of calcareous coatings, concretions and crotovines are observable at the border of the B and C horizons. According to these parameters, calcareous chernozem soils developed on the aeolian loess covering the topmost parts of the site. However, it is still ambiguous whether the formation of chernozem soils observable in the modern soil horizon was present during the Early Neolithic as well, when the representatives of the Körös culture settled in the area.

According to the findings of sedimentological and micromorphological investigations, aeolian loess sediments accumulated on top of the sandy deposits of the Pleistocene abandoned levee. The soils, which developed on this loess layer, are characteristic of open vegetation areas and are observable both in the pits assigned to the Körös culture and embed the artifacts of the same cultural group.

However, no signs of root holes or biogalleries, characteristic of arboreal vegetation, have been observable neither in the profile nor the thin-sections of the micromorphological studies. Conversely, significant amounts of crotovines, though unknown age, have been encountered in the soils embedding the Körös artifacts.57 A part of these crotovines made by gophers and

57 Marietta Csányi's personal communication.
hamsters starts out from the settlement horizon of the Neolithic. Thus they can be regarded to be coeval with the Early Neolithic artifacts.

No signs of clay movement or groundwater influences could have been observed in the thin-sections. Conversely, significant amounts of smaller-size biogalleries and filling in carbonates were identified.

The carbonate-rich horizon primarily appeared in the soil horizons rich in organic matter, but significant amounts of carbonates could have been observed in the underlying horizons as well.

On the basis of these observations, we can say that the representatives of the Körös culture settled onto a Holocene steppe-forest steppe area with chernozem-like soils, which had developed on aolian loess bedrock. In our view, the concept of chernozem soil is not a historical but a genetical term. Thus in order to be utilizable in palaeoenvironmental studies for the identification of fossil soils of this type, the main observable parameters of this fossil soil should be clearly set first.

Another source of uncertainty comes from the fact that pedogenesis was prevalent during the Neolithic in the area as well, and this might have led to an alteration of the former Early Neolithic soils, bringing about the formation of polygenetic soils in the end.

There is a significant change in the character of soils in the levels below 86 m at Karancspart with a sudden change in the carbonate content (fig. 16), a significant increase in the clay content of the A horizon giving it a darker hue, and the appearance of iron and limonite spots in the B horizon. The A horizon is brownish-black, alkalescent with a minimal carbonate content, reduced friability, and a greasy lustre. The B horizon is characterized by a suddenly rising carbonate content, alkalescent pH and a significant decrease in the organic
Iron spots and limonite spots, implying the influences of a fluctuating water table are observable in the borderzone of B and C horizons. The bedrock of the soil is primarily infusional loess.

Another change in the genetics of soils is observable in the areas with an elevation around 84 m ASL. Although the hue is still blackish-brown, the organic content is a lot lower, yielding a polihedric, carbonate-free, slightly acidic A horizon with reddish-brown iron and limonite spots. There is no sharp boundary between the A and B horizons, the B horizon is being of significant clay content and a grayish-brown hue located below the A horizon. Iron and manganese spots as well as pea structures could have been identified here with an increasing trend towards the bedrock. Several, cm-thick standing biogalleries could have been observed in this horizon, filled in with secondary iron or carbonate, which can be linked to the presence of a former arboreal vegetation. The appearance of arboreal vegetation is presumable in the lower lying areas of the Karancspart, enjoying better hydrological conditions and water supply. The bedrock or the hydromorphic meadow soil here is given by clayey, silty floodplain deposits.

The alterations of the soils in accordance with the local morphological endowments and the emergence of a soil series at the site (calcareous chernozem, meadow chernozem, meadow soils) all seem to imply that the fossil groundwater table, morphology, elevation and the relief conditions must have been important not only during the formation of the Pleistocene hydroseries, but in the Early Holocene pedogeny as well.

Results of the sedimentological and palaeobotanical analysis of cores, the reconstruction of the former vegetation in the area

In the channel of the Karancspart, located at the edge of the village of Tiszapüspöki at the end of the football field, a minor drainage channel was dug suitable for retrieving samples for sedimentary, palynological and radiocarbon analyses, to capture the initial phase of channel development and the evolution of the Holocene vegetation in the surroundings of our Körös site, the closest as possible to the area of the Karancspart.

Deposits on the surface of the Karancspart bed were only slightly disturbed, thus we could retrieve undisturbed core samples to a depth about 7 m, starting off from the surface. The collapse of the borehole in the deepest sandy horizons prevented detailed sampling from...
fig. 14. Soil horizons within Neolithic finds on the Karancspart at Tiszapüspöki

and below this level. However, knowing the morphological parameters of the riverbed we may assume that the actual floor of the channel is situated well below this depth.

The bottom of the borehole (bw. 7.0–6.4 m) yielded very fine sandy fine sands with a significant fraction of medium-grained sands implying a deposition from high-energy fluvial waters. These sediments correspond to the active channel deposits of a former river. No pollen grains suitable for evaluation has come to light from this horizon, but some shell fragments of the mussel *Unio cf. crassus*, preferring moving water habitats corroborated our first conception of the prevailing palaeoenvironmental conditions. According to the radiocarbon analysis of charcoal remains retrieved from a depth of 7 m, the active channel phase was present in the area even at the opening of the Holocene as well dated between 9000 – 9100 BP (Table 1, fig. 17).

The deposition of very fine-fine sands continued in the section between the depths of 6.4–5.6 m with the intercalation of minor silty seams and layers providing some pollen grains suitable for evaluation. The differential deposition of the sedimentary layers containing alternatively more sand or silt in the active riverbed must have been linked to the fluctuations of the water level in the channel. This systematically alternating composition of the sediments retrieved from the borehole clearly implies that we have managed to core not the central but the marginal sedimentary sequences of the former riverbed. Sampling via coring from the center of the former riverbed along the main channel line was hampered by the presence of a 1.5–2 m deep drainage channel, which had been created during the 19th century river regulations.

<table>
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<th>Metre</th>
<th>δ¹³C(PDB) [%o]</th>
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<th>Radiocarbon age cal BC 16</th>
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<td>-27.12 ±0.06</td>
<td>3210 ±60</td>
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<td>deb-7948</td>
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<td>-27.57 ±0.03</td>
<td>9050 ±110</td>
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</tr>
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</table>

Table 1. Radiocarbon data from Kartsú-creek core profile

There is a significant change in the composition and character of the sediments between the depths of 5.6–5.4 m, yielding organic-rich deposits of dark brown hue and a significant silt fraction. This has been interpreted as remnants of a pack of drift-wood deposited in the channel around 7000–7100 BP as shown by radiocarbon dates. If the material of this horizon is not the outcome of the secondary redeposition of earlier deposited fossil wood remains of Holocene
fig. 15. The results of the soil analysis on the black earth soil profile on the topmost part of Karancspart, Körös site at Tiszapüspöki (Sümegi 2000)

age, referred to as the “black oak” phenomenon by Starkel68 taphonomically speaking, then this sedimentary layer must have accumulated at the beginning of the Atlantic Phase based on the chronological classification applied for the Holocene.69

There is a gradual decrease in the sand fraction within the deposits upward from this layer with cyclic reappearance of sand grains coarser than very fine sand. The fraction of very fine sands was reduced to 50% of its original amount (fig. 17). Coarse silty fine silts with a significant clay, organic and carbonate content were deposited between 5.4-4.0 m. During this period, corresponding to the second half of the Holocene, the channel of the Kartsú creek located on the floodplain received waters during certain periods of the year only, becoming part of the active channel system of the river at times of flooding.

There is a sudden increase in the sand fraction between 4.0-3.8 m, implying that the studied channel turned into an active river branch again during this period. According to the sedimentological and facies analyses of the sedimentary sequence of the channel, this period was the last of an active channel in its evolution followed by a slow, gradual silting-up in what was turned into a cut-off channel. According to the calculated rate of sedimentation based on radiocarbon dates, this change in the hydrological conditions must have happened around 4400 BP, marking the final cut off of the channel from the active riverbed and the emergence of an oxbow lake (fig. 18).

There is a sudden increase in the silt and organic content of the deposits lying upward from the depth of 3.8 m, accompanied by a significant drop in the coarse fraction (fig. 17). All these changes seem to imply that the water in the cut-off channel must have experienced a rapid eutrophization consummating at a depth of 3 m with the deposition of blackish-brown, clayey silts corresponding to eutrophic lacustrine deposits. Samples taken above 3 m were unsuitable for evaluation due to disturbance by human activities (creation of drainages).

According to the sedimentary data, sandy deposits deriving from larger distances of the wider watershed area of the ancient river Tisza must have been deposited in the studied channel between the depths of 7 and 4 m. However, this grain-size composition poses the problem of the origin of the retrieved pollen grains and whether or not they are suitable for the reconstruction of the local vegetation.60 Palaeoecological studies generally do not consider oxbow lakes as ideal sites of sampling for pollen analysis,61 because the recurring temporal overflows may result in the transportation and accumulation of pollen grains deriving from larger distances into the basin of the lake on the one hand. Furthermore, the currents may stir up the deposits on surface of the lake's bottom resulting in a mixing of both sediments and pollen grains preserved in them as well, hampering the adequate sedimentological, geochemical and palaeontological interpretations and evaluations. Several taphonomic investigations have been implemented on silting-up oxbow lakes of the North American content in the past few years.62 Due to problems surrounding the evaluations, the final outcome of these studies is highly ambiguous and subject to frequent

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60 Sümegi et al. 1999; Sümegi – Bodor 2000.
61 Birks – Birks 1980.
62 Fall 1987.
debates.\textsuperscript{63} Conversely, according to the findings of similar recent studies on Hungarian oxbow lakes,\textsuperscript{64} two major lake types can be distinguished regarding pollen accumulation and preservation. The first one is the group of the classical horseshoe-shaped oxbow lakes, where the majority of the accumulated pollens are of local and extralocal origin, meaning that similarly to other small sedimentary basins pollen grains deriving primarily from the littoral aquatic and terrestrial vegetation tend to accumulate and be preserved in their basins. On the other hand, we cannot say this about the longitudinal channel-like oxbow lakes, giving the second group, which are cyclically flooded and connected to the main channel system of the rivers during floods. An enrichment in the floating pollen grains carried into the channel by floodwaters in the silt fraction, and the ash particles and heavier pollen grains in the sand fraction can be observed and even in this lake system the final pollen composition may be a factor of the composition of the deposited sediments.\textsuperscript{65} Thus in other words the pollen composition tends to reflect not the local vegetation but that of a larger region.

Besides the problems of pollen taphonomy, another significant hardship in the analysis of pollen grains deriving from the Kartsú creek arises from the fact that the coring site is located some 10 kms away from the actual Körös site of the Karancspart in a totally different geomorphological position, the floodplain of the Holocene Tisza river. This way we could capture the vegetation of not the actual settlement site, but only its wider background area, the floodplain of the active river Tisza in our palynological analysis.

\textsuperscript{64} Sümegi et al. 1999, 2004; Sümegi – Bodor 2000; Magyari 2002.
\textsuperscript{65} Fall 1987.
Unfortunately, human disturbances related to the 19th century river regulations in the area via the construction of a network of extensive drainage channels and other regulatory objects hampered the possibility of sampling in the direct vicinity of the site.

Samples suitable for evaluation turn up from a depth of 6.7 m and upwards in the borehole, the first pollen zone located between 6.7 and 5.7 m characterized by an extremely low number of pollen grains.

The dominating APs belong to the taxa of common oak (Quercus robur), and Norway pine capable of getting to larger distances because of its airbag supported floating grains (Pinus sivestris). An indicator taxon of slightly acidic soils is firmly present in this horizon though in small percentages, birch (Betula pendula). At the end of this zone, representatives of the marginal terrestrial taxon Alnus viridis, avoiding calcareous soils and those of hazelnut (Corylus) appear in small numbers. The small quantity of Corylus pollen grains, and the exuberance of Quercus put this horizon into the Atlantic Phase. The large quantity of redeposited marine Lower Miocene pollen grains in the whole zone, and folded pollen grains towards the end of the period are highly characteristic of this horizon. All these findings seem to point to the significance of extralocal pollen grains originating from larger distances and washed into the basin at the beginning of the Holocene.

According to the pollen composition, the presence of a gallery forest, with the dominance of oak and enjoying ideal hydrological conditions could have been inferred for the floodplain of the river Tisza at the beginning of the Holocene around 8000 and 5000 cal BC (Table 1). The undergrowth must have been rather scant made up of the representatives of the Artemisia-Chenopodium association primarily. According to Berglund, this stage in the development of the undergrowth is characteristic even during the Atlantic Phase as well on the European continent. The taxa of Artemisa are not the same as those on a cold continental steppe however, but their firm presence in the pollen material may imply the temporary emergence of minor clearances within the reconstructed oak dominated gallery forest covering the floodplain. The presence of the taxon gentian (Gentiana) as an indicator of fresh, drying-out marshland meadows is highly significant here, though must be regarded as local in origin and distribution. Some representatives of shield-fern, Dryopteris and Polygonum must have been present in the wet areas as well. The taxa Xanthium and Hypericum appear at the end of the first phase. The presence of Xanthium as a floodplain weed member tends to indicate human influences in the area (fig. 19). The first plants indicating human disturbance and influences appear in the horizon dated between 5800–5900 cal BC in the form of cultured Gramineae pollen grains, followed by those of cereals at 5700–5800 cal BC, according to the radiocarbon dates and the calculated sedimentation rates in the basin (fig. 19).

In the second pollen zone (5.7–4.7 m) an advent of beech (Fagus) could have been observed, besides the remaining prevalence of Quercus robur; reaching its maximal distribution towards the end of the phase. This large-scale occurrence of the taxa Fagus in the area of the

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67 Berglund 1985; Iversen 1973
68 Berglund 1985.
69 Járai-Komlódi 1966.
70 Tamboer et al. 1976.
fig. 19. The results of the pollen analyses (selected pollen taxa)

Great Hungarian Plain is rather unusual and calls for an explanation. The rapid increase in the dominance of *Quercus*, *Fagus* and *Carpinus* brings about an irreversible change in the woodland vegetation.\(^{71}\) When climatic conditions are beneficial, *Fagus* can easily spread in the lower-lying areas as well, partially because of the decline of *Tilia*. The presence of *Quercus* and *Tilia* in the vegetation hampers the free spreading of *Fagus*.\(^{72}\) The contrasting trends in the amount of *Quercus* and *Fagus* are clearly observable on our diagram as well (fig. 19). The taxa *Fagus* and *Tilia* have similar edaphic needs. Thus the decline in *Tilia* may lead to the expanse of *Fagus* in the deserted areas, as humans tended to show a preference for more fertile, drier soils for settling.

Human influences might have had a role in the expansion of the latter taxon as well.\(^{73}\) Logging was mainly restricted to the wood of *Quercus* and *Tilia* ideal for construction at this time, bringing about a decline of these woodland members and opening up new spaces for the spreading of *Fagus*.\(^{74}\) The massive spreading of *Fagus* in low-lying areas and some valleys of the Massif Central was attributed to human influences as well.\(^{75}\) On the other hand climatic influences and the decline in the fertility of soils might have played a significant role,\(^{76}\) as *Fagus* does not generally tolerate cold winters,\(^{77}\) but displays high tolerance to soil differences.

\(^{71}\) Böhr 1988
\(^{72}\) Iversen 1973; G. H. Godwin: The History of the British Flora. Cambridge 1975\(^{2}\).
According to Berglund, all these factors must have been important in the spreading of beech acting commonly.

Several different views have arisen in connection with the phenomenon of the spreading of Fagus. In Norway for example due to the climatic conditions and its low presence (0.7–2.6%), its pollen grains are regarded to be of extralocal origin transported from larger distances into the area.79

According to Tauber, as the pollen grain of Fagus is relatively heavy, it is more likely to reach the ground on site without being filtered by the leaves of the trees, which commonly happens to lighter pollen grains. Rainfall largely enhances accumulation and deposition on site and as such, the pollen grains of Fagus are regarded to be locally deposited by that. Transportation from larger distances is more likely in the vicinity of mountains, being heavy grains as has been postulated by Hafsten as well. This effect must be less influential in a lowland area.

However, we cannot fully exclude the possibility of these grains having been transported into the area of the Great Hungarian Plain and deposited in the basin of the Kartsú channel from the more distant mid-mountains. The expansion of the more lush Fagus vegetation in the area of the Great Hungarian Plain must be attributed to edaphic factors and climatic effects, a milder winter and more balanced precipitation rates at the end of the Atlantic Phase.

According to Birks, the mean July palaeotemperatures were 5 °C higher in Central Europe than today during the Atlantic. A similar climate has been inferred for this period by Járai-Komlódi earlier as well. No signs of such a large-scale warming could have been identified neither in the alluvial nor the non-alluvial Hungarian palaeoenvironmental sites.84 When the precipitation rates inferred from the pollen composition are projected to our pollen composition at the studied site, then the large-scale expansion of Fagus would clearly justify an annual rainfall of 700–1000 mm for the end of the Atlantic, which is 200–500 mm (!) higher than the average present-day value (500–550 mm) recorded for one of the driest areas in the country, the Middle Tisza region.

When the formerly reconstructed mean July palaeotemperatures of 25–26 °C are also considered, then we must reconstruct almost subtropical conditions prevailing in the Tisza-valley around 5000 BP, which is a nuisance. All this seems to point to an important aspect of palaeoenvironmental reconstructions, namely that the climatic parameters inferred from the pollen data must be taken with caution on the one hand. Secondly, the unique pollen accumulation and taphonomical conditions, which could have developed on the floodplain or alluvium of the river Tisza and in the long, channel-like oxbow lakes (reworking and redeposition, regional pollen traps, accumulation after significant transportation) must have yielded a lighter correlation between the former local vegetation and the pollen composition of the oxbow lake’s deposits.

A rapid decline is observable in the proportions of Ulmus, Tilia, Betula pollen grains in the third pollen zone (between 4.7–4.0 m). These changes may refer to either an intensified deforestation or the use of foliage as fodder, as the ratio of cereal pollen grains becomes significant only from the middle part of the zone. The sudden drop in the ratio of Fagus is coeval with the appearance of cereals in this pollen phase. After a significant increase in the frequency of cereal pollen grains, sudden drops can be observed even in case of the wood and

78 Berglund 1985.
82 H. J. B. Birks: Changes in vegetation and climate during the Holocene of Europe – Landscape-

83 Járai-Komlódi 1966.
84 Sümegi 1996.
86 Járai-Komódi 1966.
bush taxa utilized for fodder, construction or heating (e.g. Corylus) as well. There is a large peak in the number of Pteridinium, the spreading of which is generally linked to deforestation, even though it does not directly indicate land cultivation. The proliferation of Pteridinium may refer to the human-induced nature of the sudden drops in the ratio of the previously mentioned tree and bush taxa. It may also indicate that larger areas were deforested than what was actually needed for instant cultivation.

A significant fluctuation in Pinus, Picea, Quercus, Fagus and Corylus is observable among the APs. The runoff of the Pitus–Picea–Fagus ratios in the first group is quite similar to one another just like that of Quercus–Corylus in the second group. The two groups display a strong negative correlation. The former group must have been characteristic for the more humid and milder periods, while the latter must have prevailed during the drier and warmer periods. There is an outstanding drop in the number of folded pollen grains and those, having been reworked from the Miocene within this pollen phase. A drastic fall in the sand fraction of the deposits was coeval with these changes marking the final isolation of the cut-off channel from the main channel system and the initiating eutrophization of the pond.

There are some representatives of the taxa Dryopteris and Xanthium in this zone, with the latter heliophyl, stenohaline species appearing on soils rich in N. The decrease in the number of Dryopteris is clearly accompanied by an increase in the number of Fagus as shown on our diagram. The regional value of Dryopteris is a lot lower than that of Fagus, because fern stands usually densely cover the near-surface areas of the ground. Thus their spores are a lot less likely to become airborne. The common appearance of the taxa Secalae and Triticum is observable in the middle of the zone. Representatives of the taxa Scabiosa, Centaurea also appear from here along with those of Chenopodium botrys, which strictly avoids haline habitats and also Geranium, an accessory plant of oak woodlands. Polygonum and Centaurea cyanus tend to be the accessory weeds of “intensified prehistoric agricultural activities” indicating extensive land cultivation and crop production. After an increase Secalae pollen grains become coherent in the profile from the end of the zone most likely marking the peak of land cultivation here. The pollen grains of Triticum are not as significant and numerous as those of Secalae in this zone. However, this can be attributed to the better spreading capacities of the former with large pollen production. While, the latter tends to remain on site right next to the cultivated lands. The appearance of the taxon Plantago major towards the end of the zone refers to treading, construction of roads and trails as well as pastoralism. A common undergrowth plant of clearances, appearing after deforestations Rubus turns up towards the end of the phase. Nitrophilous weeds like Polygonum bistorta, and the heliophyl, stenohaline Bidens, which prefers soils rich in N also appear towards the end of the zone.

From the aquatic phytoplanktons the representatives of Botryococcus braunii were dominant. The occurrence of Mongeotia, Zygnemataceae indicates the presence of an open-water system in the oxbow lake in a mesotrophic state. The firm presence of Sphagnum and Spirogyra refers to either slightly acidic or alkalescent (pH 5–7) waters. The pH optimal for the proliferation of the planktonic forms present in this horizon (Mongeotia, Zygnemataceae, Spirogyra) is also between 5–6.

Open-water pondweeds (Myriophyllum verticillatum) are continuously present with an increase in Potamogeton natans from the middle part of the profile. All this refers to a deepening of the water in the lake, corresponding to the previously mentioned increase of Geranium and Alnus reaching their peak values by the end of the phase. The proliferation of Potamogeton natans indicates rapidly warming mesotrophic waters. There is another rise

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87 Van Geel 1978.
88 Brogens 1972.
89 Horváth et al. 1995.
91 Tümbler et al. 1976.
92 Danielsen 1969.
93 Behre 1981.
94 Behre 1981.
95 Van Geel 1978.
97 Cruise 1990.
Sediment description
Troels-Smith's categories
Riskshbrown
As2Sb2
Dark brown
As3Sh1
Light brown
As3Gx1
Light brown
As3Sh1
Dark brown
As3Sh1
Greenish grey
Ga3As1
Palaeohidrological stages
Oxbow lake phase with eutroph water
Eutrophization phase with mesotrophic water
Oxbow lake phase with oligotroph water
Oxbow lake and active river channel stages fluctuated
Soil erosion ?
Active river channel
Palaeoecological stages
No pollen remains
Fagus forest with strong human impact
Fagus forest with small human impact
Quercetum forest with human impact
Quercetum forest without strong human impact
No pollen remains
fig. 20. Lithological, pollen analytical and palaeoecological stages on the core sequence of Karstú-ér at Tiszaptispóki
in the ratio of Riccia pollen grains at the end of this phase. This is inferred as a sign of rise in the water level by several researchers. The firm presence of Trapa natans refers to water temperatures above 20 °C throughout most of the growth season. The low ratio of the littoral Phragmites, Typha and Glyceria, indicating increased trophicity, seem to corroborate the reconstructed mesotrophic state of the oxbow lake.

There are cyclic fluctuations in the amount of Quercus robur and Fagus pollen grains, occupying near-water areas from the depth of 4 m up to 2.8 m. The quantity of Ulmus remains low. Parallel with this, a drastic clearance is observable in the undergrowth (Geranium) of the hornbeam-oak woodlands as depicted in the NAP diagram. NAPs inhabiting the other wet habitats also experience a decrease like Artemisia, Polygonum sp., Chenopodium rubrum. From the genus Polygonum the taxon Polygonum aviculariae is the most important. The representatives of Centaurea cyanus also disappear here. Dry-resistant forms become more characteristic in the section with the prominence of Amaranthus appearing in the drier habitats along the roads and arable lands. The taxon Festuca sp. also turns up along with Plantago major, a characteristic form of treaded weed associations and mesophytic, fresh habitats. There is a sudden increase in the ratio of the heliophyl, stenohaline and stenocalc thyme (Thymus) preferring drier habitats with nitrogen poor soils in the middle of this zone. According to Digerfeldt, there is an increase in the frequency of NAP, especially that of the taxa of Gramineae during the second half of the Holocene represented by the taxon Festuca in our case with its very first appearance throughout the whole profile. Berhe also considered the late part of the Holocene to be the peak time of Gramineae. Thanks to the lower fertility of the soils, crop cultivation must have been subordinary with a dominance of animal husbandry during this period. The lack of cereal pollen grains in our

100 Simon 1994.
102 Horváth et al. 1995.
pollen diagram might also be linked to the prevalence of animal husbandry, corroborated by a clear proliferation of plants tolerating drier climates and treading.

There is a rise in the number of the aquatic Botryococcus at the beginning of this zone, followed by the appearance of Oenanthe, Sparganium sp. and the increase of Nymphaeaceae towards the end of the zone signifying a marked change and the emergence of shallow, still water conditions in the basin of the lake. The dominant forms of open-water pondweeds are Myriophyllum verticillatum, and M. spicatum the taxa Potamogeton natans becoming subordinate. As implied by the pollen composition there must have been a drop in the lake level, accompanied by an increase in the trophic rate of trophicity. However the mesotrophic stage could have been preserved at the beginning of the period followed by a gradually increasing eutrophization. Minor patches of Phragmites, Rorippa, Polygonum amphibium, and Circuta virosa could have occupied the littoral zone and floodplain areas. Conversely at the end of the zone the taxon Chenopodium rubrum returns, occupying fresh habitats of stenohaline weed associations with soils rich in nitrogen and carbonates. The marked sudden increase of Sanguisorba officinalis in the central part of the local pollen zone is a clear sign of temperature drop just like that of firm presence of Thalictrum flavum with similar ecological needs.

There could have been a minor expansion of Sparganium erectum and Rorippa in the littoral zone in the second part of this pollen zone with Phragmites occurring only sporadically. All these alterations seem to indicate a probable increase in the trophic state of the water, and a reduction in water depth. The appearances of marshland plants tolerant to and characteristic of waters of higher trophic stage (Stratiotes aloides, Lemna, Sparganium erectum), and the complete disappearance of Botrychium further corroborate this assumption. However, the firm presence of Mougeotia and Potamogeton natans points to the succesful preservation of the mesotrophic state. A decrease in the water level might have induced the succesful expansion of marshland plants. The poor preservation of the pollen grains up from 2.8 m within the profile hampered the successful evaluation of the retrieved samples.

As it has been shown by the gained sedimentological and pollen data, the oxbow lake of the Kartsú creek located in the vicinity of the village of Tiszapüspöki must have been an open-water system since its very birth (fig. 20). The lake itself must have been in a mesotrophic stage regarding water quality. Minor changes like eutrophization were traceable in the upper part of the profile only. The constant presence of acidophilous algae (Mougeotia, Zygnemataceae, Sphagnum), and the taxon Spirogyra refers to slightly acidiferous conditions with pH around 6. Open-water pondweeds, rooted in deeper waters (Myriophyllum spicatum, Potamogeton natans) appeared even in the earliest stage of the lake’s evolution. Water temperatures must have been around or slightly above 20 °C during the hottest months of the growth season. There was no extensive reed vegetation surrounding the lake in the littoral zone, rather it was substituted by taxa like Sparganium and Rorippa. The coast must have been occupied by a narrow line of gallery forest of Salix, Alnus and Betula. Extensive, lush, deciduous woodland could have emerged a little farther away from the beach. The elevated parts of the alluvium were covered by typical Atlantic Quercus woodlands from about 8000 BP with the appearance and gradual expansion of Fagus from the closure of the period, though due to the special regional nature of the pollen trap sampled the site of origin (local or distant) of the Fagus pollen grains can not be univocally determined.

A large-scale variance was observable in the undergrowth of the gallery forest represented by plant associations preferring, fresh, humid woodland habitats or swamp meadows. The prevalent taxon was Chenopodium occupying more humid substrates. The taxa tolerating drier conditions like Thymus, Amaranthus and Gramineae appear only towards the end of the Atlantic in smaller proportions. The sudden and drastic drop in the AP from about 5700-5500 cal BC must be attributed to human influences, namely intensive deforestation. The presence of the pollen grains of cereals and a wide-scale of weeds seems to justify this assumption. In the light of this information derived from the pollen data, humans must have followed a

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sedentary lifestyle for a longer time and was engaged in intensive land cultivation at some distance away from the woodland areas. Changes in the pollen composition indicating the use of foliage as fodder in animal husbandry are dated around 5500–6000 cal BC while those indicating land cultivation and constructions turn up from about 5500 cal BC. From about 4400 cal BC, vegetation indicating an intensifying extensive animal husbandry could have been inferred. Weeds and cereals indicating the reappearance of crop cultivation are traceable only at a later stage, between 1500–1800 cal BC.

The studied channel must have emerged as early as the final phase of the Würmian at the end of the Pleistocene or during the Late Glacial around 10–20 000 BP years. However, the collapse of the fluvial sandy bedrock material in the foot of the borehole enabled the capturing of the final phase of this early evolutionary stage of the active channel only, which extends into the Holocene. This development stage yielded no pollens suitable for evaluation.

According to the radiocarbon dates measured on the inwashed charcoal material, the riverbed was an active channel at the beginning of the Holocene and was completely cut off around only 7000 BP leading to the emergence of a dynamic oxbow lake. According to the pollen data, the lake was surrounded by hardwood woodland with a dominance of oak (Quercetum) showing no signs of human disturbances or activities.

As the sedimentological data implies, the terrigenous material initiated to inwash into the lacustrine basin around 7000–6000 BP. These changes though are coeval with the transformation of the active channel into an oxbow lake, might have come emerged as a result of human activities as well, because plants indicating animal husbandry and crop cultivation tend to show up here in the pollen material besides the remaining dominance of the hardwood oak woodlands (cereals, weeds inhabiting treaded habitats or those subjected to grazing).

According to the calibrated radiocarbon dates (cc. 5600–5700 cal BC), this transformation was coeval with the settlement of the first human groups, the representatives of the Early Neolithic Körös culture in the area. Several objects of this culture have been discovered in the studied area of the Karancspart of Tiszapüspöki (graves, pits, houses). However, this settlement site is located about 10 km away from the channel of the Kartsú creek, subjected to pollen sampling. Thus the identified human influences dated to the Early Neolithic in that profile must be attributed a different, separate group of the same culture, which must have settled closer to the actual channel.

Unfortunately, detailed archaeotopographical surveys are lacking in the studied region leaving us with the question of whether or not there were other Körös settlement sites or settlement points on the investigated floodplain area of the Tisza. However, several previous archaeological investigations proved to be successful in identifying several settlement points of this Early Neolithic culture in the studied region.

Initially, the newborn oxbow lake, which had developed between 7000–4000 BP, enjoyed temporal water supply during floods leading to the emergence of clear, well-lit waters in an oligo-mesotrophic state turning into eutrophic from the closure of the Bronze Age as a result of gradual silting-up and increasing human influences (deforestation, grazing, increasing soil erosion). A woodland with beech as the dominant form must have surrounded the lake at this time. The accumulation of beech pollen grains, or the transportation of these onto the studied area must have started around 5000–5100 BP, becoming a dominant element in the vegetation only from 4500 BP. Human influences reached the peak of their intensities during the Late Bronze Age, as was indicated by the pollen composition of the profile suitable for evaluation. From this time onwards the retrieved pollen material was unsuitable for evaluation due to secondary dehydration (river regulations) and decay. The increase in the clay content within the deposits of the channel implies intensified soil erosion and the acceleration of the silting-up...
of the lake leading to eutrophization. The further evolutionary history of the channel cannot be elucidated (medieval, modern etc.) because of the significant soil erosion, and disturbance and mixing of the individual layers attributed to human activities.

The results of malacological analysis

Approximately 50 kg of sediments retrieved from the excavation site of the 1999 fall and deriving from the chernozem horizon stratigraphically corresponding to the one embedding the Körös artifacts, but sampled at a distance from the actual Körös objects, was subjected to wet sieving to retrieve and determine the mollusc remains (Table 2). This site of sampling located farther away from the actual settlement point was chosen deliberately, in order to gain data on the background environmental conditions of the actual human settlement, because treading, gardening and the construction of houses at the settlement points might have easily led to the transformation of the original natural endowments calling for an adaptation of the vegetation and the mollusc fauna as well.107

<table>
<thead>
<tr>
<th>Species</th>
<th>Abundance</th>
<th>Dominance</th>
<th>Haarlow-index (height x weight x dominance)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gramaria fraceatum (Draparnaud 1801)</td>
<td>17</td>
<td>3.51</td>
<td>69.8</td>
</tr>
<tr>
<td>Vallonia costata (Müller 1774)</td>
<td>201</td>
<td>41.53</td>
<td>246.7</td>
</tr>
<tr>
<td>Chondrula tridens (Müller 1774)</td>
<td>97</td>
<td>20.04</td>
<td>947.9</td>
</tr>
<tr>
<td>Helicopsis striata (Müller 1774)</td>
<td>152</td>
<td>31.41</td>
<td>1099.4</td>
</tr>
<tr>
<td>Cepaea vindobonensis (Férussac 1821)</td>
<td>17</td>
<td>3.51</td>
<td>1533.9</td>
</tr>
<tr>
<td>TOTAL</td>
<td>484</td>
<td>100.00</td>
<td></td>
</tr>
</tbody>
</table>

Table 2. The Mollusc fauna from the Neolithic soil horizon of the archaeological excavation, Karancspart at Tiszapüspöki.

Only mesophytic and xerophytic species could have been identified in the mollusc fauna poor in species.108 These elements tend to dwell in open-vegetation areas like steppes-forest-steppe today,109 thus there is every reason to believe that they must have occupied similar habitats during the Early Holocene as well. As shown by these malacological data, the communities of the Körös culture chose and open-vegetation area of steppe-forest steppe experiencing dry conditions in a part of the growth season as the site of their settlement. According to the composition of the malacofauna and the calculated values of the malacothermometer method110 the mean July temperatures must have exceeded 20 °C with values fluctuating between 20–22 °C. In other words, the conditions of the growth season were much like what we have today in the region. This picture drawn on the basis of the composition of the malacofauna regarding the palaeoenvironmental conditions is utmost different from the former one reconstructed via the pure utilization of geomorphological data.111

of the mollusc fauna, reflecting the local environment is in good agreement with the other major environment indicator, the chernozem-like soil reflecting the presence of a steppe-forest steppe vegetation at the site of the Karancspart during the Early Neolithic. According to the values of the calculated Haarlow index, a dominant form of this environment was a taxon, which is still a character species of the modern forest steppes of the Great Hungarian Plain, *Cepaea vindobonensis*.\(^{112}\)

<table>
<thead>
<tr>
<th>Species name</th>
<th>Abundance (i)</th>
<th>Dominance (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Viviparus acerosus</em> (Bourguignat, 1862)</td>
<td>7</td>
<td>1.32</td>
</tr>
<tr>
<td><em>Lithoglyphus naticeoides</em> (Pfeiffer, 1828)</td>
<td>1</td>
<td>0.19</td>
</tr>
<tr>
<td><em>Lymnaea stagnalis</em> (Linnaeus, 1758)</td>
<td>1</td>
<td>0.19</td>
</tr>
<tr>
<td><em>Planorbus planorbis</em> (Linnaeus, 1758)</td>
<td>1</td>
<td>0.19</td>
</tr>
<tr>
<td><em>Chondrula tridens</em> (Müller, 1774)</td>
<td>1</td>
<td>0.19</td>
</tr>
<tr>
<td><em>Cepaea vindobonensis</em> (Fürussak, 1820)</td>
<td>3</td>
<td>0.56</td>
</tr>
<tr>
<td><em>Unio pictorum</em> (Linnaeus, 1758)</td>
<td>487</td>
<td>91.71</td>
</tr>
<tr>
<td><em>Unio tumidus</em> (Rezias, 1788)</td>
<td>16</td>
<td>3.01</td>
</tr>
<tr>
<td><em>Unio crassus</em> (Rezias, 1788)</td>
<td>11</td>
<td>2.07</td>
</tr>
<tr>
<td>Anisidonta sp.</td>
<td>3</td>
<td>0.56</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>531</strong></td>
<td><strong>99.99</strong></td>
</tr>
</tbody>
</table>

Table 3. The mollusc fauna of the Körös pits at Tiszapüspöki-Karancspart, archaeological excavation.

The 1999 excavations at the site have led to the discovery and excavation of several minor pits yielding Körös pottery remains, burnt daub fragments, charcoal, bones and a remarkable shellfish as well as fish material.\(^{113}\) Thus to fulfill the requests of archaeologists approximately 268 kg of dirt was wet sieved using a mesh of 0.8 mm to retrieve the embedded mollusc remains (Table 3). All shellfish shells were measured individually, yielding a total of 6.17 kg shellfish material belonging to the taxa *Unionidae*. However, only a minor portion of the fauna was suitable for determination (Table 3). The composition of the mollusc fauna was almost the same at every single site, characterized by a dominance of *Unio pictorum* and a couple of accessory elements making the fauna more colourful, which were also of the same taxa in each and every pit. So the whole mollusc fauna of the pits could have been treated as one during the evaluation.

531 specimens of 10 different species (4 aquatic, 2 terrestrial gastropods, 4 bivalves) have come to light (Table 3). The proportion of aquatic faunal elements exceeded 99%, with about 92% given by the representatives of the taxon wide-spread in mesotrophic lakes and cut-off channels, *Unio pictorum*. Conversely, several specimens of species preferring moving water habitats have been retrieved from the pits as well like the gastropods *Viviparus acerosus*, *Lithoglyphus naticeoides* or the mussel *Unio crassus*. None of these elements have come to light from the terrestrial deposits of the site, and they could not have come from the floodwaters either, as the area of the Karancspart was an elevated levee located high above the areas affected by floodwaters preceding the river regulations, as shown by sedimentological findings of the profile established there.

The significant proportions of an aquatic mollusc fauna and the rheophylic species present in the culture layers require some sort of an explanation. They must have ended up in the culture layers as a result of some sort of a human activity. The numerous shell medals and necklaces retrieved from several Hungarian Neolithic sites along the river Tisza\(^ {114}\)

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\(^{112}\) Fűrész, A. 1821.

\(^{113}\) Marietta Csányi’s personal communication.

clearly indicate that the shells of the gastropod *Lithoglyphus naticoides* and mussels *Unio* was frequently utilized for making jewellery.\textsuperscript{115} Signs of such activities could have been identified on a single specimen from our studied site (Photo 1).

There are several explanations for the presence of shell material at these sites and the possible role of shellfishing. In our view the meat of these mussels must have primarily served as a food resource during the Early Neolithic, and the shells of other minor molluscs, the meat of which had not been consumed must have gotten into the refused shell material accidentally, as part of the shellfishing or fishing activities.

Several interesting questions arose in connection with the surrounding environment of the Karancspart and the retrieved mollusc fauna. These questions were posed by the fact that the channels and ditches surrounding the Karancspart, and experiencing silting-up during the Holocene (Tinóka creek, Háromág, Fehér Pond) had been subjected to such large-scale transformations as a result of the river regulations (dredging, drainage, plowing) hampering their use in palaeoenvironmental reconstructions. Thus we can not univocally determine whether the shellfish material came from the Kartsú creek being an active channel at the time located about 10 km away from the Körös site on the floodplain of the river Tisza, or the nearby Tinóka creek.

According to the findings of the archaeozoological studies of the shellfish material retrieved from other archaeological sites (Ecsegfalva, Gorzsa, Nagykőrű, Polgár, Tiszaszőlős), shell mounds in the vicinity of active riverbeds were dominated by moving-water species like *Unio crassus* and we have come across some specimens of the gastropod *Valvata piscinalis* as well in each and every case. These forms are however, completely missing here. Conversely, several specimens of the rheophylic *Lithoglyphus naticoides*, *Viviparus acerosus* have been retrieved from the Körös site of the Karancspart indicating that the gathered material or at least a part of it must have come from moving waters. In order to interpret the dominance of *Unio pictorum* in the harvested shellfish material, one needs to get a clear view of the importance of the elevated cut-off channels, which had been active during the Pleistocene (Tinóka creek, Háromág), in the life of the Körös settlement.

According to the prevailing modern geomorphology in the study area, the objects belonging to the Körös site of the Karancspart must have occupied a position between 86 and 88 m ASL, with the silted-up channel of the Tinóka creek located lower at around 83 m ASL during the Neolithic. The channel of the Kartsú creek, being an active branch of the Tisza at the time was located 82 m ASL. The highest modern floods in the studied area exceed 10 metres. However, the floodwaters restricted to a relatively small floodplain of about 3000 km\(^2\) today must have affected a much larger area of about 30 000 km\(^2\) preceding

\textsuperscript{115} Sümegi 1999a,b.
river regulations. All this seems to imply that the waters producing extremely high floods today could have been dispersed on a floodplain of a size about 10 times of its modern counterpart during the Neolithic, meaning that floods could have been only a couple metres high at that time. These waters, though could not have flooded the Körös site of the Karancspart, they could have easily invaded the areas of the Tinóka, Háromág creeks and the backwater areas of the Fehér Pond flowing through the Kártás creek. In other words the Tinóka creek located some hundred metres away from the actual Körös site must have functioned as a drainage channel for floodwaters during the Neolithic, enjoying water coverage of 2–3 m during floods.

The interaction between the unregulated river and the surrounding floodplain must have been completely different in the Neolithic from that of their modern counterparts. The movement of floodwaters onto the floodplain and back into the active channel must have been less rapid enabling the emergence of habitats with slowly moving-water conditions within the channels connecting the active riverbed with the floodplain, at least in a part of the growth season. In other words, this resulted in the cyclic fluctuations of slowly moving and still water conditions in the channel of the Tinóka creek. This temporary supply of fresh moving water during the floods must have been beneficial for the proliferation of the still-water habitat preferring *Unio pictorum*, and the rheophylic species.

Archaeological excavations implemented at the Körös site of the Karancspart yielded an outstanding mollusc fauna retrieved from the soil layers embedding the cultural artifacts. The majority of these forms (bivalves, aquatic elements) is not natural to the terrestrial facies, and must have ended up in the culture layers as a result of human activities, partly via intentional shellfishing for food and as accessories of the shellfishing or fishing activities.

**Summary**

The following palaeoenvironmental picture could have been drawn in connection with the settlement site of the Körös culture at Karancspart based on the findings of detailed geomorphological, sedimentological, palaeobotanical, malacological and radiocarbon analyses: The Körös group of the site of Karancspart must have chosen a peninsula-like extension of a loess-covered Pleistocene lag surface, covering about 10 km² as the site of their settlement.

This lag surface formed an island-like structure on the Holocene floodplain of the Tisza due to the presence of numerous drainage channels, which had emerged even during the Pleistocene. The highest parts of the lag surface and the direct neighbourhood of the Körös settlement site were covered by calcareous chernozem soils harboring a dry steppe-forest steppe and characterized by mean July temperatures of 20–22 °C.

A hydromorphic counterpart of this chernozem must have encircled these highest areas. Hydromorphic meadow soils with typical floodplain vegetation, including arboreal species occupied the lower-lying areas and the banks reflecting the evolution of a loessy hydroseries from the lowermost part of the floodplain to the topmost part of the levees highly dependent on the geomorphological endowments, the elevation and the actual level of the groundwater. This must have been especially true for the floodplain areas located west of the lag surface of Karancspart, having been covered by an extensive gallery forest of large-scale species diversity and the dominance of oak (*Quercus*) during the opening of the Neolithic.

This complex environment composed of gallery forest-covered floodplains, Pleistocene riverbeds and backswamps, contributing to a mosaic-like diversity regarding habitats, soils, bedrock conditions at the micro level must have offered ideal conditions for leading both a productive and nonproductive lifestyle during the Early Neolithic. In our view the direct neighbourhood of the site of Karancspart was suitable for crop cultivation and animal husbandry at the Neolithic state of development. While the surrounding floodwater influenced drainage channels, and floodplain areas could have been havens of an nonproductive lifeway of hunting–fishing–gathering. Thus

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116 T. Belton: *A Tisza néprajza* [Ethnography of the Tisza], Budapest 2003.
the Körös community of the Karancspart had the possibility of being in parallel engaged in a dual lifestyle ensuring ideal and stable food resources throughout their lives.

In our view these island-like Pleistocene lag surfaces situated on Holocene alluvia in the northern borderzone of the expansion of Neolithic cultural groups bearing Balkanic and Aegean cultural roots, offering special conditions for settlement, must have been of crucial importance in the migration and settlement of the Körös cultural groups within the Carpathian Basin and the whole process of neolithization. The observed temporary summer settlements of Mesolithic groups on the alluvia covered by gallery forests surrounding lag surfaces suitable for agricultural production in Hungary as well as the temporary boosts of the population reconstructed at these sites further corroborates this presumption. Thus these floodplain areas or alluvial areas, primarily around the river Tisza must have been the sites of first contact and interaction between the Neolithic groups dwelling on the nearby lag surfaces and the Mesolithic groups inhabiting temporarily the floodplains. Consequently, these were of crucial importance in the spreading of Neolithic culture within the Carpathian Basin and the emergence of the Linear Pottery Complex.

On the other hand the settling of the Körös cultural groups to the site of Karancspart corroborates the findings of previous studies, according to which the settlement of these groups onto the loessy areas with chernozem soils could have commenced even during the Early Neolithic and this adaptation process is by no means connected to the groups of the Middle Neolithic Linear Pottery Complex as it had been advocated earlier. This adaptation process observable at the northern margin of the Körös culture bearing Balkanic and Aegean cultural roots seems to point to an important factor. Namely that this group had a much more flexible and wide-scale adaptation activity and capacity regarding environmental conditions than what had previously been assumed. Thus the sporadic sites identified north of the formerly drawn borderline of this culture may actually be satellite sites of the same group. It is also probable, that the Körös communities adapted to the conditions of these loess covered areas had a much more important role in the shaping of the spiritual and economic life of the Linear Pottery Complex than it had been previously assumed. The most important question is how far this adaptation process of the Körös culture could get in the Tisza valley on the one hand? And what was the role of this environmental adaptation process in the neolithization of the Alluvial Fan Complex of the Northern Great Hungarian Plain?

The northern boundary of distribution of the Körös culture seems to form a continuous line only at a regional scale of several hundred kilometres, and displays large-scale discontinuities deriving from the mosaic-like distribution of these groups inhabiting the island-like lag surfaces along the river Tisza and its tributaries when examined at a local scale of a resolution of some kilometres and beyond. The same can be said about the environmental conditions, which developed in the central parts of the Carpathian Basin, the Pannonicum during the last 30 000 years. Thus the mosaic- or puzzle-like local environmental segments are acting as fractals unifying into larger units at a regional-scale only. Once one manages to acknowledge this mosaic-like patterning of the Carpathian Basin observable at the micro-, meso- and macro levels, along with the whole underlying dynamic mechanism acting during the Holocene, the adaptation and settling strategies exercised by the Körös groups will become more apparent as well. Furthermore, we can also understand the latest version of the Central European Balkanic Agroecological Barrier, which is based on the fact that this scattered, island-like settlement pattern observable at the local level turns into a boundary surface when examined at a regional scale. And the role of surfaces enhancing settlement in the river valleys can not be interpreted at a regional level, but only at the local level. In the light of these latest findings, the previous opponents of the CEB AEB may be able to reconsider their former doubts and counter-arguments considering the preceding conceptions of this model as well.

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120 Kalicz – Makkay 1977.
122 Kösse 1979.
123 Kertész – Sümegi 1999a,b.
125 Sümegi 2003a,b,c, 2004.
126 Sümegi 2003a,b,c, 2004.
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P. Sümegi: Környezetrégészeti problémái Magyarországon [The problems of the environmental archaeology in Hungary], Múmosz (2001) 17–49.
| Sümegi 2004 | P. Sümegi: Preneolithization – egy kárpát-medencei, késő-mezolitikum során bekövetkezett életmódbeli változás környezettörténeti rekonstrukciója (Preneolithization – the environmental historical reconstruction of a change in lifestyle occurring during the Late Mesolithicum in the Carpathian Basin). Múmosz II. konferencia anyaga, Debrecen 2004 21–32. |
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Timár – Rácz 2001

Timár – Rácz 2002

Van Geel 1978
RÖMISCHE BODENSTÄNDIGE KERAMIK

Folgender theoritischer Überblick ist eine Zusammenfassung der Beobachtungen der spät-keltischen – früh-römischen handgeformten Keramik1 aus der Umgebung von Esztergom, dem Ausgrabungsmaterial des Vicus von Albertfalva2 und Almásfüzitő,3 bzw. einer Grube der einheimischen Siedlung von Szakály-Réti földék,4 weiters vom Fundplatz Budapest-Meggyfa Str.-Kerék Str.5

Einführung

Die römischen handgeformten Gefässe besitzen im Gegensatz zum auf der Töpferscheibe hergestellten provinzialen Material, welches einen uniformen überregionalen Charakter hat, eigenständige lokale Charakteristika und bilden verschiedenen keramischen Kreisen zusprechbare Gruppen. Um die ethnoarchäologische Definition zu gebrauchen, stehen wir regional abweichenden technologischen Dialekten,6 sog. Keramikprovinzen7 gegenüber, worunter jene technologische Tradition zu verstehen ist, die durch ein abweichendes Formenspektrum und Formgebung, und in der Tendenz der angewendeten Verzierungsmöglichkeiten, weiterhin in der Magernung und der Methode des Brennverfahrens zum Ausdruck kommt. Die handgeformten Gefässe in der Römerzeit sind, im Gegensatz zur früheren Auffassung, nicht zu den niedrigeren Sozialschichten der Bevölkerung zuzuordnen, sondern in Form und in technologischer Verarbeitung ihrer Funktion angepasst.8 Bezieht man die obige Gesichtspunkte ein, ergeben sich räumliche Überdeckungen zwischen den lokalen Gruppen. Für ein allgemein gültiges Ordnungsprinzip kann man aber keinen einzigartigen Gesichtspunkt hervorheben, es ist vielmehr eine umfassende Analyse notwendig. Wird aber in bestimmten Gebieten und bestimmten Zeitabschnitten nur ein einzig technologischer Gesichtspunkt verfolgt, können sich regionale Abweichungen abzeichnen.9

Die für den einfachen Alltagsgebrauch bestimmte Keramik kann, durch die an den zur Verfügung stehenden Ton angepassten Verarbeitungstechniken sowie der überbrachten, auf Erfahrungen basierenden Normen wichtige Hinweise für das Abgrenzen einzelner kultureller und Handelsgebiete liefern. Weiterhin spielt diese Keramik bei der Frage der Fortführung oder Änderung einer für ein bestimmtes Gebiet charakteristischen kulturellen Tradition eine bedeutende Rolle, sowie spiegelt die gegenseitigen Einflussnahmen mit benachbarten Gebieten wider.10

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2 Horváth 1999a, 367-379.
5 Grabungsmaterial von István Welner. Für die Bearbeitung der Stücke habe ich Klára Szabó zu danken.
Um die Eigenheiten voneinander abweichender technologischen Kreisen und ihre Ausbreitung zu bestimmen, ist die systematische Fundaufnahme eines grossen Gebietes nötig, wofür die Bearbeitung des Materials aus der Gegend um Esztergom einen möglichen Ausgangspunkt liefern könnte.

Definition und Schwierigkeiten

Forschungsgeschichte
Im Allgemeinbewusstsein wurde die handgeformte römische Keramik lange der spätrömischen Phase, als materielle Nachlassenschaft der in dieser Zeit in der Provinz sesshaft werdenden barbarischen Bevölkerungsgruppen zugeschrieben oder einfach als urgeschichtlich angesprochen. Der Beginn der Betrachtung dieses Problems setzt mit Publikationen über die frühkaiserzeitlichen (Ende 1. Jh. – Anfang 2. Jh. n.Chr.) Tumuli (Hügelgräber), Töpfersiedlungen und einheimische Siedlungen bzw. mit der Bearbeitung der Vicusbefunde ein. So gut wie in jedem Fall ist neben der Keramik nach römischem Vorbild auch die Grobkeramik vorhanden, welche entweder als oberflächliche Dreh scheibenarbeit oder als handgeformte Keramik bezeichnet wurde. Ihr Vorkommen wurde in den Bearbeitungen als Beweis für die Existenz fremder Bevölkerung auf betrachtetem Gebiet herangezogen.


Anhand einiger Stücke aus dem Vallum und den umliegenden Wohngruben des Lagers Adony verweisen die Verfasser (L. Barkóczi – E. Bonis) darauf,13 dass der Ursprung der formalen und technologischen Elemente dieser Materialgruppe bei den den Römern vorangegangenen Bevölkerungen (Kelten, Illyrer, Germanen) zu suchen ist. Weiterhin stellten sie fest, dass die Nachfrage nach der bodenständigen Keramik nach den Markomannenkriegen auch nicht abnahm, vielmehr ist diese Materialgruppe in den Siedlungen entlang der Donau, so z.B. auch im Fundmaterial vom Ende des 2. Jh. n.Chr. in Albertfalva zu finden.


13 Barkóczi – Bónis 1954, 150.
14 L. Barkóczi: Császářkori kelta edényégető telep Bicsérden (Celtic Pottery Kilns from the Times of the Roman Empire at Bicsérő). FolArch 8 (1956) 72, 74.


18 MRT 5.
20 Kelemen 1988, 167–175, Abb. 6, 1, 3.
Meinung nach wurde diese Ware nicht in zentralen, großen Töpfersiedlungen hergestellt, sondern in kleineren Werkstätten, wo lokale Bedürfnisse befriedigend und dem jeweiligen Geschmack entsprechend, auch Gefässe auf der Töpferscheibe hergestellt wurden.\textsuperscript{22}


Es besteht also kein Zweifel, dass die bodenständige Keramik, die den lokalen Charakter lange bewahrt, entlang der Donau allgemein gebräuchlich war.

Gleichfalls bei Autobahngrabungen wurden in Herceghalom zwei bzw. in Páty ein solcher Fundplatz freigelegt, in denen die beprochene Keramik ebenfalls in großer Zahl vertreten ist. Die Bearbeiterin des Materials, K. Ottományi,\textsuperscript{24} folgt jener Richtung in der Forschung, wonach die handgeformte Keramik nicht an ein einzelnes Ethnikum zu binden ist. Sie hält die im keltischen Fundzusammenhang gefundenen Stücke für ursprünglich dakisch, aber die Fragmente im Kontext mit dem Material der 1.–2. Jh. n.Chr. sollten ihrer Meinung nach von bodenständiger eraviskischer Bevölkerung bzw. einer ursprünglich aus dem Noricum stammenden Volksgruppe getragen werden.


Obige Ansichten sind nicht nur für die pannonische Forschung bezeichnend, sondern spiegeln auch den vorherrschenden Standpunkt bezüglich der ethnischen, sozialen und chronologischen Feststellungen\textsuperscript{26} der provinzialrömischen Forschung wider. Die im Gebiet des Noricum vorkommende römische Grobkeramik erhielt die Bezeichnung „aus norischem Ton gefertigte Ware“\textsuperscript{27} oder „norische Ware“.\textsuperscript{28} Die handgeformte Ware wird als evidenter Begleitfund der römischen Fundverbände betrachtet, was den Schein erweckt, als wäre im Gebiet des Noricum von einer technologisch einheitlichen Ware die Rede. A. Kaltenberger verwies erstmals darauf, dass diese Ware „bezüglich Form und Materialqualität eigene regionale Merkmale aufzeigt“.\textsuperscript{29}

\textsuperscript{22} Stroh 1934, 98–108. Veröffentlicht einen Töpferofen aus Halflingen vom Ende des 2. Jh. n.Chr., welcher ausschließlich handgeformte Keramik enthielt. Aus dem pannonischen Gebiet ist bislang kein Ofen bekannt, welcher allein zum Brand handgeformter Ware verwendet worden wäre.

\textsuperscript{23} Szönyi 1995 bzw. Szönyi 1996.

\textsuperscript{24} Ottományi – Gabler 1985, 213–214.


\textsuperscript{26} Die Zusammenfassung früherer Gesichtspunkte bezüglich des germanischen und rätischen handgeformten Materials, Zainer 1992, 143. 

\textsuperscript{27} Nach der Definition von R. Miglbauer sind die aus diesem Material gefertigten Gefässe "stark gemagert, schwarz gebrannt und weist eine fettige Oberfläche auf: "Kennzeichnend ist ... glimmerhaltige Ton. Er ist oft stark mit Quarzkörnchen und Kalksteinchen gemagert". Miglbauer 1990, 38, 51.

\textsuperscript{28} Nach R. Miglbauer ist die norische Ware neben der jeweiligen Verarbeitung des Tons durch die bodenständigen Formmerkmale zu definieren, Miglbauer 1990, 51; Einen Überblick zu diesem Fragenkomplex s. Tober 2001, 113–117.

\textsuperscript{29} Kaltenberger 1995, 9; Tober 2001, 116 leitet die Aufmerksamkeit auf die Unrichtigkeit der Bezeichnung der als einheitlich behandelten "Norische Ware".

Grundbegriffe bei der Beschreibung der Keramik


Beim Formen der Gefässe mussten die damaligen Töpfer mit der während des Trocknens entstehenden Trockenschwindung rechnen, da das zugefügte Anmachwasser durch die Trocknung das Gefäß schwinden lässt. Ist die Trockenschwindung beendet, ist das Gefäß lederhart. Besonders bei dickwandigen Gefäßen musste darauf geachtet werden, dass die Oberfläche gemessen am Scherbenkern nicht wesentlich schneller trocknete, da die so entstehenden Spannungen dem Gefäß Risse zugefügt hätten. Der magere Ton beansprucht durch die in ihm in geringer Menge enthaltenen Tonmineralen weniger Wasser um formbar zu werden und zeigt beim Trocknen im Verhältnis zur Wasserverdampfung eine kleinere Volumenveränderung. Der fette Ton dagegen braucht zur Bearbeitung mehr Wasser, und sein Volumen sinkt beim Trocknen und im Brand im Verhältnis dazu. Je grösser die Volumenveränderung, um so grösser ist die Gefahr, dass sich das Gefäß verwirft oder reißt. Die nicht plastischen Komponenten des mageren Tons haben hier eine mechanische Wirkung, aber bei höheren Temperaturen setzt sich auch eine chemische Wirkung zu, wodurch die Brandbeständigkeit des Tons sinkt oder erhöht.

35 Petrik 1913, 46.
37 Petrik 1913, 53, 55.
38 Petrik 1913, 83.
39 Petrik 1913, 84.
Das Maß der Neigung zum Rissen und Deformieren während der Trockenschwindung wird in der Keramikindustrie als *Trocknungssensibilität* bezeichnet.40 Je geringer die Trocknungsschwindung des Tones und größer die Porosität des Scherbens ist, um so kleiner ist die Trocknungssensibilität. Das bedeutet, dass bei fetten aber mergeligen bzw. mageren Tonen können solche Fehler besser abgeholfen werden. Die Trocknungssensibilität hängt auch bei mageren Tonen im grossten Maße vom Mengenverhältnis der bildsamen Tonmineralien und der Magerungskomponenten ab.41 Die *Bandschwindung und Festigkeit* hängt von der Zusammensetzung der Tonmineralien und der Körnigkeit ab. Die Bandschwindung, ebenso wie die Trockenschwindung, und die Dichte sind beim mageren, grobkörnigen Ton geringer, als bei fettem, feinkörnigem Ton.42

Die in der Natur vorkommenen Tone sind nicht rein, sondern eine Mischung aus formbarem reinem Ton und nichtplastischen Mineralanteilen, die die Bildsamkeit des Tons herabsetzen, und deshalb diese als *Magerungsmittel* bezeichnet werden.43 Sie spielen eine Rolle bei der Verminderung der Trocknungssensibilität, bei der Erhöhung der Feuchtigkeitsleitungsfähigkeit und bei der Senkung der Trockenschwindung.44 Ob der Magerungsmittelinhalt im Falle einer Töpferprodukt als ursprünglicher Bestandteil des Tons ist oder aber es nachträglich dem Material zugesetzt wurde, lässt sich vielfach nicht mehr feststellen. Aber bei grobkörnigen Zusätzen können wir von einer gewollten Beimischung ausgehen. In der Fachliteratur der Töpferkunst erscheinen Quarz, Kalkstein, Mergel, Kiese und Pirit als im Ton auftretende schädliche Einschlüsse.45

Vor der Übersicht der Auswirkung, der in der archäologischen Literatur bei der Beschreibung der Scherben oft als Magerungsmittel bezeichneten, nichtplastischen Bestandteile des Tons, darf die Tatsache nicht außer acht gelassen werden, dass die chemischen Reaktionen im Scherben um so intensiver sind, je geringer die Korngrösse ist.46

Der Quarzkiese ist mehr oder weniger Siliciumdioxid. Quarz und Glimmer sind seit Anfang an ursprüngliche Komponente des Tons.47 Quarz schwillt im Feuer, wodurch die Schwindung des Scherbens wesentlich herabgesetzt wird. Der grobere, körnige Sand hat auf die Feuerfestigkeit von Kochgeschirr eine positive Wirkung,48 erhöht die Porosität (= Wasser- aufnahmevermögen), wodurch das Gefäss der Erhitzung und schneller Temperatur Schwankungen besser standhält.49 J. Albert zufolge kann der Magerungseffekt von Quarzsand bei einer Korngröße von 0,2–0,5 mm vorteilhaft sein, größere Körner als 2–3 mm den Scherben beim Brennen jedoch versprengen lassen. In archäologischen Keramikfunden sind häufig größere Kieskörner beobachtet, die von der Töpferliteratur eindeutig als Verunreinigungen definiert werden, von denen der Rohton unter allen Umständen zu reinigen ist.

gemagerten Gefäßen die Rissbildung wesentlich sinken lässt. Glimmer widersteht den Wärmeinwirkungen gut.


Im Gegensatz hält E. Schindler-Kaudelka das Entstehen der löffrigen, porösen Oberfläche für eine sekundäre Erscheinungsauswirkung, da der säurehaltigen Boden nämlich die kalkhaltigen Magerungspartikeln ausschwemmt. Die löffrige Oberfläche ist allerdings in jedem Fall nicht ausschließlich als Folge der sekundären Bodeneinwirkungen anzuzeichnen, oft passen in unterschiedlichem Maße löffrige Scherben zusammen.

In dem Fall, wenn sich ein Gefäß aus porösen und weniger porösen Scherben zusammenstellen lässt, muss man auch mit dem Fakt rechnen, dass die Poren am unteren Teil des Gefäßes durch das Kochen zementiert worden sein konnten.

Selten kommt körniger Feldspatsand als Verunreinigung im Ton vor. Eisenpirit zerfällt beim oxydierenden Brand in Eisendioxid und Sulfidendioxid, was in ausgebrennter Scherbe in Form von rotbraunen Körnchen erscheint. Die Farbe des Gefäßes hängt neben dem Brandverfahren (Ofengase) wesentlich von der Zusammensetzung des Tones ab (Eisenoxid – in erster Linie Eisen-, Mangan- und Titanoxid), der Farbton wird auch von der Höhe der Brandtemperatur beeinflusst.


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51 Kardos o.J. 13.
55 Schindler-Kaudelka 1997, 117.
57 Magetti – Kahr 1981, 2; Es ist aber auch „die Abdichtung“ der Scherbe durch Mehlsuppe oder Fett archäologisch nachzuweisen, die die Unebenheiten ausgleicht und die Poren zuschließt, Furger – Deschler Erb 1992, 448.
b) grau-braun-schwarz: Der eisenoxidhaltige Ton erlangt bei reduzierenden Einflüssen die obigen Farbschattierungen.

   c) rot-hellgelb: Der Ton mit fein verteilten Kalkanteilen verhält sich unterschiedlich. Bei höheren Temperaturen wird der Ton hellgelb. Diese Schattierung kommt aber bei handgeformter Keramik nicht vor, da diese Tonart für die Herstellung sog. Tafelgeschirrs geeignet war, nicht aber für die Erfordernisse die an Kochgeschirr zu stellen waren.


Wird relativ wenig Brennmaterial in den Brennofen gegeben und überflüssige Luft zugeführt, verbrennt das Brennmaterial vollständig zu Kohlendioxid und Wasser. Die Flamme hat oxidierende Wirkung, allerdings können so nur geringere Temperaturen erreicht werden, da die entstehende Wärme auf ein größeres Gasvolumen entfällt.62

Die Farbe des Gefäßes, ob grau-schwarz oder roth-braune Schattierungen aufweist, lässt bis zu einem gewissen Grad Schlüsse auf die Brandmethode zu. Es darf aber nicht ausschließlich nur die Oberfläche des Scherbens betrachtet werden. Besonders bei handgeformter Keramik weicht das Innere der Scherben von der Farbe der Oberfläche ab, und beide zusammen betrachtet lassen bessere Aussagen über die Methode des Brandes zu.63

Beim reduzierenden Brennen ist der Scherbenkern dunkler, sein Mantel hellgrau. Dagegen ist beim Oxydationsbrand der Scherbenmantel rot-braun, weogegen der Scherbenkern oft grau bleibt, was in der Keramikliteratur als „partielle Oxydation“ (Bezeichnung nach Shephard 1956, 213) beschrieben wird.64 Der Farbumschlag kann auch während des Abkühlen durch Reoxydationsprozess entstehen.65 Die häufig an den Gefäßen beobachteten Farbflecken können während der Reoxydationsvorgänge infolge einer sekundären Hitzeeinwirkung hervorgerufen worden sein, was indirekt auch auf die funktionale Anwendung weist, d.h. diese Gefässe kamen direkt mit dem Feuer in Berührung, wurden als Kochgeschirr benutzt.

Während des Kochens beim steigenden Temperatur erhöht sich die Wärmeleitfähigkeits bei den Gefäßen mit über 1 mm Porengrösse in größerem Maße, was in diesem Falle wesentlich dem in den Poren die Luft ablösenden Wasser zuschreiben ist.66 Nach den römischen Alltagskeramik scheinen diese Kenntnisse als Erfahrungen beim Herstellen des Kochgeschirrs bekannt zu sein.


60 Petrik 1913, 9–10.
61 Petrik 1913, 151.
62 Petrik 1913, 151.
64 Vossen 1971, 114.
66 Albert 1967, 123–126.
67 Horváth 1999a, 367–379.
68 Horváth 1997, Kat.-Nr. 537–792; 793–859.
Jh. n.Chr. zu datieren.

1. Form, Funktion und typologische Einordnung


In Albertfalva differenziert der Randdurchmesser der Töpfe stark (zwischen 12 und 26 cm); die meisten Gefässe sind aber mit kleineren Maßangaben (12–16 cm) zu bezeichnen, was völlig mit den Werten der Deckel korrespondiert. In Tokod und Uny ist diese Abweichung noch gravierender (8–32 cm), aber die Mehrzahl stimmt auch hier mit den Werten der Deckel, die zwischen 12 und 21 cm liegen, überein. Das erhärtet die Funktion der Töpfe als Kochgeschirr. So muss bei den kleineren und größeren Gefässe auch eine andere Gebrauchsfunktion erwogen werden. Die größeren konnten auch als Vorratsgefäße dienen. Ihre Volumenfläche lässt sich aber an Hand des fragmentierten Materials nicht ermitteln.

Die Zusammenstellung der Typentafel ist für die jeweilige Forschung immer die größte Schwierigkeit, was teilweise dem fragmentarischem Zustand des Materials und der Wechselhaftigkeit der Formen als Folge der Formgebung durch die Hand zuzuschreiben ist. Bei diesem Überblick möchte ich von der Analyse einzelner Formen absehen, dies kann der Materialpublikation detailliert entnommen werden. Im Zusammenhang mit den archäologischen Typen der handgeformten Keramik machten auch mehrere Autoren darauf aufmerksam, dass typochronologisch abtrennbare Charakteristika hinter den abweichenden Randausbildungen nicht in jedem Fall zu suchen sind, wie auch ähnlich geformte Randstücke aus weit von einander entfernten Gebieten nicht zwangsläufig sicher auf ein kontinuierliches Weiterleben der Töpfertradition einer Volksgruppe weisen. Der Definition Ch. Flügels nach ist der Typ eines Ensembles von Gefäßen, welches als eine Gruppe über bestimmte gemeinsame Charakteristika verfügt, jedoch die einzelnen Stücke selbst nicht in jedem Fall jedes einzelne Charakteristikum tragen.

Bei den Esztergomer Gefäßen ist die Formählichkeit einiger Typen der handgeformten Gefäße und der auf der Töpferscheibe hergestellten Varianten unbestreitbar.76

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71 Holmsta 1988, 296.
72 Es ist ein Koch- und Speiseglas nach römischem Vorbild und keine bodenständige Form.
75 Flügel 1996, 345.
2. Verzierungsarten

Die meisten Verzierungsarten kommen für gewöhnlich auf je einem Wandfragment vor, so dass wir nur verzerrte Informationen über den möglichen Zusammenhang zwischen Form und Verzierung erhalten. Deshalb behandeln wir den Charakter der Verzierungsarten und der Gefäßformen getrennt. Bei einigen Formen ist jedoch eine charakteristische Verzierung zu beobachten, wohin eventuell sogar ethnochronologische Merkmale auszumachen sind.

Die bislang vorgekommene Verzierungsarten bei der handgeformten Keramik lassen sich grundlegend in drei Gruppen gliedern: 1. die plastischen Verzierungen (ungegliederte einfache Knubben und Wülste), 2. die eingetieften Verzierungen (Fingereindrücken, durch Fingereindrücke und schräge Einstiche gegliederte Ränder und Sohlenpartie, Einschnitte, eingetiefte Wellenlinie usw.), 3. Kombination von plastischer und eingetiefter Verzierungsarten (mit Fingereindruck gegliederte einfache Knubbe, durch Fingereindrücke gegliederte Leisten, Doppelknubben und Leisten mit Fingereindrücken, mit Fingereindrücken und schrägen Einschnitten gegliederte Leisten und Kammstrichdekor usw.)


77 In seinem Werk über die ungarischen Töpferien reiht M. Kresz diese Verzierungsarten einer gemeinsamen Gruppe zu, bei der die Abwandlung der Oberfläche vom positiven Charakter ist: reliefartige Verzierung oder aber vom negativen Charakter ist: eingetiefte, eingeritzte Verzierungsarten, Kardos o.J. 32.
78 Horváth 1999a, 374, 79.
80 Im Zusammenhang mit dem Kochgeschirr von Magdalenberg weist E. Schindler-Kaudelka jedoch darauf hin, dass in diesem Gebiet die kombinierte Verzierungsart nicht vorkommt, dagegen die eingetiefte Verzierungen auf der Schulter häufig auftreten, Schindler-Kaudelka 1997, 120.
81 Horváth 1999a, 374.
ist, und das leichtere Handhaben kann hier keine Rolle spielen. Solche Behandlung der inneren Oberfläche kommt im Fundmaterial von Uny nicht vor. In Tokod jedoch ist diese Verzierung auf Topfrändern und -deckeln (im Verhältnis 6:2) zu beobachten, wie auch in Albertfalva auf vier Rändern und Schultern sowie auf zwei Deckeln.


Die vertiefte Wellenlinie kommt gleichfalls als Abschluss der Kammstrichverzierungen vor, kann aber auch ein selbständiges Verzierungs element bilden. Es handelt sich um die in der Bronzezeit auftretenden dann in der Hallstatt-bzw. La Tène-Zeit in den Hintergrund gedrängte Verzierung, welche schließlich zwischen Ende des 1. Jh. v.Chr. und Anfang 1. Jh. n.Chr. wieder auf den scheinbegründeten handgeformten Gefäßen erscheint.89 Dabei handelt es sich um eine bzw. mehrere parallel zueinander verlaufende Wellenlinie(n), welche mit einem einheitlich schmalen oder breiteren Gerät oder einem nicht gleichmässig endenden Holzchen eingetieft wurde(n). Meistens befindet sie sich waagerecht auf der Schulter bzw. dem Bauch,
kann aber auch vom Hals herab senkrecht verlaufen. In spätkeltischen Funden ist diese Verzierungsart nicht sehr häufig. Es sind auf einem fassförmigen Topf aus Esztergomi-Szentgyörgymező bzw. auf einer handgeformten Variante eines Graphitontopfes aus Esztergomi-Várhegy bekannt.\textsuperscript{90} Wellenlinien sind auch auf römischen Scheiben zu finden und kann in der Kombination mit anderen Verzierungselementen auftreten.

Aus Úny ist ein Deckel bekannt, der mit Holz eingetieftes, X-förmiges Zeichen trug.\textsuperscript{91} In Szakály ist eine Wanderscheibe mit eingetieftem Tannenzweigmotiv bekannt.\textsuperscript{92}

In besonders großer Menge kommen unter den handgeformten Gefäßen Deckel bzw. Tassen vor,\textsuperscript{93} deren Rand durch Fingereindrücken bzw. Einstiche gegliedert ist. Diese Verzierung an Rändern ist schon in spätbronzezeitlichen und hallstattzeitlichen Funden\textsuperscript{94} zu beobachten, findet man aber auch auf den spätkeltischen Gefäßen in großer Zahl.\textsuperscript{95} In spätromischer Zeit erscheint es bei der markomann-quadische Keramik als Besonderheit.\textsuperscript{96}

Betrachtet man die Funktions- und Formmerkmale, es zeigt sich, dass die Fingereindrücke und Einstiche nicht nur auf Töpfen, sondern auch auf Tassen vorkommen. In unzähligen Fällen ist schwer zu entscheiden, ob die eingetiefte Verzierung mit der Hand oder aber mit einem abgerundten Holz- oder Knochenstäbchen erreicht wurde, meist können nur die Stellen der Fingerabdrücke Aufschluss geben.\textsuperscript{97} Zu den einklemmungsartigen Verzierungen können jene Stücke gerechnet werden, auf denen die rippenartige Verzierung nicht getrennt herausgeformt wurde, sondern direkt aus dem Gefäß selbst herausgeformt wurde und deshalb zu der Gruppe der eingetieften Verzierungen zu rechnen ist. Es handelt sich hier um eine archaische Verzierungsart. Das Muster der eingetieften Reihenverzierung kann dreieckig,\textsuperscript{98} oval-linsenförmig,\textsuperscript{99} rund-blattförmig oder langlegezogene Linien haben. In spätkeltischen Ge- fäßen sind schmale, mit einem senkrechten Einstich versehenen Linien und Wellenlinien in spätromischer Zeit häufiger.\textsuperscript{100}


Bónis 1969, Abb. 25. 14, 38. 17. 58. 25, 104. 9.


Bónis 1969, Abb. 25. 14, 38. 17. 58. 25, 104. 9.

Ungegliederte Knubben\textsuperscript{101} sind aus mehreren spätkeltsischen Fundplätzen bekannt. Häufig ist auf der Gefässinnenseite an der Stelle der Knubbe eine Bauchung festzustellen, welche beim Aufdrücken der Knubbe auf die Gefäßwand entstanden sein kann. Aus einem Seitenbruchstück fiel die aufgeklebte Knubbe heraus und macht erkennbar, wie in die für die Knubbe vorgesehene Stelle ein Grübchen getieft wurde.\textsuperscript{102} Selten unterteilte man die Knubben durch senkrechte Einschnitte.\textsuperscript{103} Häufiger dagegen ist eine Verzierung in der Knubbenmitte durch Fingereindrücke, wofür Beispiele verschiedener Varianten in spätkeltsischen Fundkomplexen bekannt sind.\textsuperscript{104} Meistens stehen die Knubben separat (4-5 Stück) rund um die Schulter herum, wovon bei der Kombination mit dem Kammschädel schon die Rede war.

Die Doppelknubbeaufsicht\textsuperscript{105} kann auch separat stehen, in spätkeltsischen Fundzusammenhängen ist aber die Kombination mit schrägen eingeschnittenen Linien- und mit Fingereindrückreihen häufiger.\textsuperscript{106}

Nach Kammschädel sind die ungegliederten oder durch Fingereindrücke oder schräge Einschnitte gegliederten Leisten das am häufigsten vorkommende Zierelement im vorliegenden Material. Sie ist eine archaische Dekorweise. Relativ selten brachte man ungegliederte Rippen auf die Gefäßwand.\textsuperscript{107} Die durch schräge Einschnitte gegliederte Leiste ist etwas häufiger vertreten.\textsuperscript{108}

Die durch Fingereindrücken gegliederte (vielleicht mit abgerundetem Knochen- oder Holzstäbchen) Leisten sind einerseits charakteristisch für die fassförmigen spätkeltsischen Töpfe von Esztergom nicht. Szentendre-Zementfabrik (Cementgyár):


\textsuperscript{103} Esztergom-Lőwy u.: Horváth 1997, Kat.-Nr. 86; spätkeltsch; Páty-Herceghalom: Ottományi – Gabler 1985, Taf. XXIX. 6, 8: 1. 2. Jh. n.Ch.


\textsuperscript{105} Gellérthegy-Tabán: Bónis 1969, Abb. 70. 89. 30; szen. – Zementfabrik: Ottományi – Gabler 1985, Taf. XXIX. 6, 8: 1. 2. Jh. n.Ch.


\textsuperscript{107} Es sind aus mehreren spätkeltsischen Fundplätzen bekannt. Häufig ist auf der Gefässinnenseite an der Stelle der Knubbe eine Bauchung festzustellen, welche beim Aufdrücken der Knubbe auf die Gefäßwand entstanden sein kann. Aus einem Seitenbruchstück fiel die aufgeklebte Knubbe heraus und macht erkennbar, wie in die für die Knubbe vorgesehene Stelle ein Grübchen getieft wurde. Selten unterteilte man die Knubben durch senkrechte Einschnitte. Häufiger dagegen ist eine Verzierung in der Knubbenmitte durch Fingereindrücke, wofür Beispiele verschiedener Varianten in spätkeltsischen Fundkomplexen bekannt sind. Meistens stehen die Knubben separat (4-5 Stück) rund um die Schulter herum, wovon bei der Kombination mit dem Kammschädel schon die Rede war.

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Tokod gehören zu den muschelgemagerten frühromischen Stücken, wozu auch ein einziges aus Albertfalva zu zählen ist, wogegen sich das Fragment aus Szakály qualitativ gesehen, den vorherigen abhebt.

3. Magerungsarten


4. Brandmethoden

Bezüglich der Brandweise zeigen der erwähnten Fundplätze ein gemischtes Bild. In Budapest-Medve Str., Albertfalva, Tokod und Úny sind Spuren, die auf eine oxydierende Brandmethode deuten in den Hintergrund gedrängt (ein Drittel der untersuchten Stücke). Die auf der Töpferscheibe gefertigten Kochgefäße sind fast ohne Ausnahme im Reduktionsbrand hergestellt, und auch die handgeformten Gefässe gehören in diese Kategorie. Für die Stücke

Dakern, andererseits mit den Sarmaten in Zusammenhang. Die Verzierung ist auf einem kleinen bauchigen Gefäß mit ausladendem Rand aus Ménfőcsanak zu finden, Szönyi 1995, Abb. 2. 2. 4; Bajna, Baját, Esztgrom-Várhegy, Keszölcse, Máriahalom, Mogyorósbánya, Nagysáspilisáró, Sárscsó, Tokod-Erzsébetakna, Úny, Horváth 1997, 44.

111 Horváth 1999a, Kat.-Nr. 14, 2, Abb. 6-7.
112 Gabler Horváth 1996, Kat.-Nr. 97.
113 Gabler Horváth 1999a, Kat.-Nr. 97.
114 Gabler Horváth 1996, 146-147, 158.
115 Für die Informationen in Zusammenhang mit den muschelgemagerten Gefäßen von Ménfőcsanak und Neszmély-Kalinhegy habe ich Andrea Vaday zu danken.
121 Eine Literaturhinweise s. Flügel Joachimski, Flügel 1997, 278.
123 Ähnliche Beobachtungen beim Kochgeschirr machte auch Leckebusch 1998, 382; Schucany et al. 1999, 70.
von Szakály ist die fleckige Farbe bzw. Farbumschlag charakteristisch, wobei im Gegensatz zu den rot-braunen Tönnungen die Anteilnahme der grauen Exemplaren verschwindend ist.126


Es gibt auch Überschlagsberechnungen, wie lange der Brennvorgang gedauert haben könnte. Nach M. Kardos „ist ein ca. 15 cm hohes Gefäß nach einer Stunde ausgebrannt. Stücke von 30–38 cm benötigten etwa zweimal so viel Zeit. Zwei Stunden waren sicher für den Brand jedes Gefäßes ausreichend, dessen Durchmesser 90 cm nicht überschritt.“130

**Sekundäre Spuren**

Betrachtet man den Ursprung sekundärer Spuren, so lassen sie sich in zwei Gruppen teilen. In die eine gehören die Spuren, die sich aus der Funktion ergeben, in die anderen entstehen durch die jahrhundertelangen Bodeneinwirkungen.131 Zur ersten Gruppe gehören die sekundären Brandspuren132, Speisereste, die Herausbildung unterschiedlichen Porenverteilung, weiter die Flickstellen an zerbrochenen Gefässen. Die löcherige Oberfläche kann, wie oben schon erwähnt wurde als Folge der Bodeneinwirkungen entstanden sein, die mit der Änderung der chemischen Zusammensetzung einhergehen. Es ist aber auch zu untersuchen, was für eine Wirkung das Kochen und sekundärer Brand auf die chemische Zusammensetzung ausüben konnten.

Die sekundären Spuren, die sich aus der Benutzung ergeben, geben neben der Wandstärke der Gefäss aufschluss über die Funktion und unterstützen ihre Verwendung als Kochgeschirr. Wo diese Spuren fehlen muss eine Verwendung als Vorratsgefäss erwogen werden.

**Frage der Herstellungswerkstatt**

Die Mehrzahl der handgeformten Gefässe kennen wir aus Siedlungsobjekten, weshalb schwer zu beantworten ist, ob ihre Herstellung von der auf der Töpferäschibe gefertigten Ware getrennt vorgenommen wurde. Es stellt sich die Frage, ob diese innerhalb der Haushalte hergestellt wurden, denn sie erforderte kein größeres Fachwissen bezüglich des Töpferöfen. In der Veröffentlichung der Befunde der Öfen von Balatonfüzfö setzt M. Kelemen133 die Arbeit solcher kleinerer Werkstätten voraus, die die lokale Nachfrage befriedigten und gleichfalls auch scheidegedrehte Gefässe herstellen konnten.

A. Furger deutet darauf hin, dass in den Befunden der rätischen Töpferöfen sehr selten handgeformte Körper vorkommen und schlussfolgert, dass diese vielleicht in extra dafür gebauten Öfen hergestellt wurden.134 Ch. Flügel sieht im Zusammenhang mit den Auerbergtopfen das Fehlen handgeformter Keramik in den Töpferöfenbefunden darin, dass obwohl der Grundrohstoff vor Ort zu finden war, dieser doch aus anderer Tonlagerstätte

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128 Hofmann 1988, 297.
130 Kardos o.J. 44.
133 Kelemen 1980, 58–59, Abb. 6, 7–8.
stammt.\textsuperscript{135} Aus Hailfingen veröffentlicht A. Stroch\textsuperscript{136} einen Töpferofen vom Ende des 2. Jh. n.Chr., der ausschließlich handgeformte Keramik enthielt. Nahe Analogien zu diesen Stücken werden aus den 8 km entfernt liegenden Fundplätzen von Rottenburg und Holzmaden erwähnt, wo sie aber gemeinsam mit auf der Töpferscheibe gefertigten Stücken benutzt waren. Aus Pannonien kennen wir bislang keinen solchen Ofen, der ausschließlich zum Brennen von handgeformter Keramik gedient hätte.

\textit{Zusammenfassung}


\textsuperscript{136} Stroh 1934, 98–102.

\textsuperscript{137} Schucany \textit{et al.} 1999, 70.

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<td>IV. Tonnenförmige Töpfe ohne deutliche Randlippenbildung</td>
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☐ LT D ☐ frühromisch, 1. Jh. n. Chr.

Abb. 1. Formspektrum der bodenständigen Keramik aus der Umgebung von Esztergom (Typen I-VI)
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<td>VII. Bauchige Töpfe mit langem, kräftig ausgebogenem Rand</td>
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<td>XIV. Bauchige Töpfe mit langem, kräftig ausgebogenem Rand</td>
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Abb. 2. Formspektrum der bodenständigen Keramik aus der Umgebung von Esztergom (Typen VII–XIV)
3. Formspektrum der bodenständigen Keramik aus der Umgebung von Esztergom
(Typen XV-XXII)
RECONSTRUCTION OF THE SETTLEMENT STRUCTURE OF THE MEDIEVAL NAGYSZAKÁCSI (SOMOGY COUNTY)

Landscape archaeology, which developed in Western Europe in the 50's and 60's and has become more and more accepted since then, has opened a new field in settlement studies. The methodology of the new approach was developed by the archaeological research of Great Britain, where it could be based on ample sources and a landscape that affords the recognition of medieval settlements features. The sources and some elements of the method, however, could also successfully be applied in territories where the conditions were less favourable. In the present study we try to analyse and reconstruct the medieval structure of the modern Nagyszakácsi (Somogy county) using non-archaeological sources, which were already used in Hungary on the occasion of certain excavations (charters, early maps, aerial photos, toponyms), and with the help of archaeological field walkings.

Since the sources and the landscape conditions in Hungary usually prove barely sufficient for applying the above methods, the success of the study greatly depended on the choice of a suitable settlement. A significant factor was that it should have enough document reference and also that the sources should be of diverse types to afford the testing the method within a range of source environment. It also had to be considered that the settlement should be chosen in a territory where the geographical setting offers a greater opportunity to identify the topographic elements that existed in the Middle Ages (hills, valleys, streams etc). Finally, the sources and methods we intended to use needed that the settlement should be a still existing and inhabited village.

Nagyszakácsi can be found in Somogy county. It has excellent documentation in a Hungarian respect, although it has a different character. We have about one hundred charters from between 1359 and 1521 informing about the donation and the exchange of smaller holdings and the texts of perambulates of bounds encompassing larger territories. Some of the inhabitants of the medieval settlement were raised to the nobility rank from the legal status of servicing people, others came from a villein status.

With the analysis of the structure of the village and the landholding system, we try to find an answer to the question if the special legal status of the inhabitants of Szakácsi influenced the structure of the settlement. The problem of the connection between the populations of diverse legal conditions and the settlement structure has already been raised in archaeological research on the occasion of farmstead-like settlements and small castles of the Árpádian Era and late medieval castles. The archaeological study of the scattered settlement pattern, which rarely appears in historical sources, early feudal private castles connected to praedit, and curiae, which are related to the lesser nobility, has demonstrated that the recognition of the various groups of the medieval society is facilitated by the complex use of various source groups and methods. Lesser nobility, the lowermost layer of nobility, which often differed from villains only in the social legal status, can be grouped in this category.

The study includes the structure of the inner territory of the village and its changes, the landholding pattern on the outskirts of the village and the varieties and changes of the land usage systems. We shall also discuss the problems of settlement typology and questions concerning the relationship between the inner territories and the outskirts. The sources and the

1 The study was prepared with the support of the National Scientific Research Found (OTKA F 19227).
methods we intend to use afford a more complex analysis of the settlement yet do not provide new information concerning certain problems (e.g. house types, material culture etc). Beside the analysis of the medieval settlement structure we also intend to determine the possibilities and limitations of the method in the case of a settlement that has been inhabited since the Middle Ages, and that cannot fully be studied with archaeological methods. For this purpose the sources must be used together and, at the same time, in a complementary analytical way, a method that has not fully been applied in Hungarian research. It is important to analyse the descriptions of the landscape and lands in the historical sources, the elaboration of the data of the early maps and the surviving toponyms, to use the attainable aerial photos and to apply archaeological methods others than excavations.

The analysis of the structure of a village of the lesser nobility can also offer an insight into the settlement pattern of the lesser nobility that rose from the rank of the villeins, which can complete the picture drawn from the study of the upper and middle layers of aristocracy.

Sources and methods
Before starting the discussion of the problems listed in the introduction, we find it important to introduce the source groups used in the study and the main trends and methods of former research in this field. The sources of the present study were the written documents referring to the settlement, the results of archaeological field walking, the manuscript maps and the existing aerial photos.

The primary sources of the present paper were the descriptions of landscapes and landed properties in various documents, extents, perambulates of bounds and records about the donation, exchange and alienation of lands and data referring to the inner territory of the village.

Historians and archaeologists have already called attention to the possibilities of reconstructions after medieval written sources yet the idea of the systematic analysis of the reconstruction of the settlement structure of certain villages came from historical geography. Jenő Major demonstrated that the use of the toponymic, systematic analysis and elaboration of the reconstruction of the settlement structure of certain villages can offer a new possibility for the research of settlements that have continuously existed in the same place. After the clarification of the spatial interrelation of the cartographic elements described in perambulates of bounds and charters on the division of landed properties, the medieval borders and certain details of the early ground plan can be reconstructed. He concluded that sometimes relatively exact and complex ground plans can be drawn depending on how detailed the sources are. Although the sources we have afford the cartographic true-to-scale elaboration he suggested only in the case of the perambulates of bounds, he thought that the same method could be used for the reconstructions of the inner territories as well. In this case, the measurements of certain ground plan elements, as tofts and streets, can be calculated and sketched.

Ferenc Maksay applied the method suggested by Jenő Major at the reconstruction of medieval village types after perambulates of bounds and deeds of land divisions. He grouped the reconstructed village forms after Tibor Mendől’s typology, which followed the German school. He differentiated two main types of villages: street village and agglomeration, and he found the former one characteristic in the 14th–16th centuries. Similarly to Mendől, who beside the typological grouping characterised the various categories according to the functional role they occupied within the settlement structure, Maksay also often regarded the natural conditions, and compared them to cultivation methods (rotation system, forest clearing—street village) or to the social status of the population (lesser nobility—cluster village, agglomeration). He also discovered that the types can be connected to various field systems and several types can be represented within a single settlement. István Szabó studied the medieval roots of modern typology and also differentiated two main types from the descriptions of documents on land divisions in the inner territory. Most of the settlements were regular street villages, the other type was the agglomeration of an irregular arrangement. He studied in details the
relevant terms of the sources and sketched the outlines of villages, the lines of the streets and the directions of the plots. Although he did not prepare a detailed reconstruction containing all the plots, he called attention to the fact that, in a lucky case, even the sketchy ground plan of a village can be reconstructed. Looking for the connections between the shape of a village and the landholding and cultivation systems he found a certain correlation (forest-clearing – single street shape, rotation system – less regular pattern), yet, just like Maksay, he called attention to typological mixtures that can appear within the individual settlements.

The first attempt to reconstruct the medieval natural environment was carried out by the ethnogenetic school of the 30’s and 40’s, and several researchers have since suggested and illustrated the reconstruction possibilities of medieval street and borderline systems based on the comparison of perambulates of bounds and the modern topographical setting. István Szabó applied the method first on the occasion of his studies in Ugocsa county, where he collected the medieval geographical names from the documents of the individual settlements and compared them with cartographic data and sometimes identified them with modern place names. He determined the borders of the individual settlements from the analysis of written documents, reconstructed the medieval road system and marked the names of hills and water courses he had found in the sources. Later he also called attention to the fact that the analysis of perambulates of bounds from various periods can demonstrate the shrinking of the village township parallelly to the establishment of new settlements. István Győrffy has published the most complete collection of the historical sources on the natural environment and topographic setting of the Arpádian Era in his excellent work.

Historical research usually use the topographic descriptions of settlements in the documents for the reconstruction of the inner territories of villages, yet sometimes similar analyses were made regarding arable lands as well. Ferenc Maksay suggested already in 1962 that similarly to the historical, topographic analyses of arable lands applied abroad, the comparative analysis of early cartographic, archaeological and written sources can lead to the recognition of new elements of the usage of arable lands in historical times. He stressed, however, that due to the low number of early maps and the scarcity of the surviving traces of arable lands in Hungary, the agrarian references of the medieval sources deserve special attention. He reconstructed in a few cases the places of the individual arable lands and clearings after the data recorded in the documents and the place names. Discussing Maksay’s field reconstructions, we have to mention the problem of medieval land and length measures, which was already raised by Jenő Major with regard to the inner territories. In his maps, Maksay indicated the lines of the streets, the directions of the plots, their order and the position of the fields as given in the documents, their direction and number, but the sources were not sufficient to make a true-to-scale reconstruction. He owed it, beside the deficiency of the descriptions in the sources, to the difficulty of determining the various land measures, since the size of many of them had already been forgotten. In the case of land measures, it is the unit given not in the royal (regale), but the customary (usuade) or local ingerum that causes the greatest problem. Bogdán, unlike Maksay, differentiated local and customary ingerum, determining the latter as a not royal unit of measure, which was nevertheless commonly used in the entire country. The uncertainties of the three data used in the exact determination of its size and the great divergences of the calculated values cannot provide an ultimate solution to the problem of the size of the customary ingerum (hold) and its common usage in the country.

Beside the reconstruction of the structures of individual settlements, the data of the documents afford the analysis of the general characteristics of the appurtenant lands. The studies have demonstrated that the size of the appurtenant arable lands and meadows, the

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8 Szabó used here first of all records about infiels ("tanor") since he could only suppose the existence of assart settlements in the Middle Ages from the sources.
9 Szabó 1937; Jakó 1940.
10 A few examples: Győrffy 1956; Major 1960; Maksay 1971; Laszlósváry 1986/a; Vályi 1986.
12 Győrffy 1963.
13 Maksay 1962.
14 Major 1960, 41; Major 1961, 6.
15 Bogdán 1978, 177-179.
forms of the lands and the relationship between the surface of the arable lands and all the lands of the village show such a variety that complex analyses of smaller territorial units can bring more exact results.

Documents dealing with the circulation of the landed property and possessory actions were the sources for Márta Belényesy's studies as well. She, however concentrated on the interpretation of agrarian terms found in the sources to determine the cultivation techniques and landholding system of peasant farms. The description of the various field systems, their distribution and their occurrence in the territory of a village led to conclusions about the structure of the entire territory. She defined four groups concerning the cultivation type of the lands in the 15th century: 1. freshly broken lands, 2. regularly fallowed lands, 3. lands in permanent one field system (so-called tanor lands), 4. lands in two- or three field system.

The sources of the study also contain the results of field walkings. The role of archaeological research is increased partly by the relatively low number of documents in Hungary and the casualty of their survival, and partly by the fact that the observations made during field walkings help the interpretation of the data obtained from documents. Excavations play an eminent role in the study of the inner territories of villages, although excavations are usually restricted to the territories of perished villages. In the case of active villages, in the development of which no break led to ultimate devastation, it is usually methods other than excavations that can bring results. At the same time, the present study also deals with the structure of the lands, the investigation of which cannot be solved with excavations due to the extent of the territory and the character of the analysed phenomena. Although we will discuss the perished settlements on the outskirts of the villages and the Pauline monastery, mainly their location, age and character seem to be important from the respect of our analysis. Accordingly, the present study aims at the interpretation of the data of the written sources and finding their place in the modern landscape through comparing these data to the results of the field walkings and vice versa.

Works summing up the methodology, terminology and possibilities of archaeological field walking can be found both in Hungary and abroad. Without repeating their statements, they basically differentiate three field walking methods according to the purpose and the depth. Targeted field walking is used for the localisation of a feature (settlement, castle, monastery etc.) known from other sources, while extensive field walking intends to register all the archaeological sites of a given territory and to sketch the spatially and chronologically most complete settlement pattern of a region. Intensive field walking concentrates on a smaller territory or a site and the systematic surface collection is completed with sedimentological examinations, geophysical and geomorphological analyses. An intensive surface analysis would in certain cases be justified for our study, but the application of the method lies beyond our goal and possibilities. So targeted and extensive field walkings are used in the present study as they seemed best fit to the possibilities provided by the sources and the demands they raised.

The study that marked the start of modern archaeological village investigation was written by István Méri. Similarly to Jenő Major, he called attention to the possibilities hiding in the written sources (perambulates of bounds, maps, depictions) on the one hand, and the fact, on the other, that medieval features, which bear information on certain characteristics of the settlement structure, can be observed during field walkings (hollow roads, medieval road system, places of churches and/or cemeteries, traces of perished houses) and they can be correlated with the data of documents. Thus he differentiated the settlement pattern of the Árpádian Era showing an irregular scattered picture from the elongated, more closed arrangement of the late Middle Ages based on his observations made during field walkings.

16 Belényesy 1954-55; Belényesy 1964.
17 Belényesy 1964, 232.
18 Jankovich-Bésán 1985, 1992 discusses both the Hungarian and the international research history and methods.
19 Major 1961.
20 Méri 1954, 151.
21 Méri 1953, 58.
Studies based on extensive field walkings present a complex settlement picture within an area.22 The settlement history and structure of a region are drawn, the one-time villages and roads are identified and the medieval landscape is illustrated from the archaeological data (excavation and stray finds, field walkings, local surveys) and also from the written sources, early maps and toponyms. In Hungary, the most complete representation of the method can be found in the published volumes of the Magyarország Régészeti Topográfiája [Archaeological Topography of Hungary] series. István Éri suggested, after his experiences in Veszprém county, that the settlement network, the road system and the one-time hydrological situation can be reconstructed from topographic works and the analysis of documents.23 László Blazovich used the results of archaeological topography together with the rich document material for the examination of the geographical setting and the settlement structure in his study on the settlement history of the southern part of the Hungarian Plain.24 Extensive field walkings proved successful in solving certain problems concerning the settlement structure, first of all in the discovery of the farmstead-like settlements of the Árpádian Era, in the differentiation of the scattered and closed settlement types, while researchers repeatedly called attention to the limitations of the method. One should be cautious with affiliating the sites of various sizes and structures to periods. Sherds from the Árpádian Era also occur in the large closed sites even though the settlements were first mentioned only in late medieval documents.25 The phenomenon, which was observed at repeatedly surveyed sites, that the cultivation brings materials of different periods to the surface after each ploughing can also cause difficulties in dating. Observations concerning the extent and the exact place of the sites must also be taken into account since they may “migrate”, occasionally they shift to 5-25 m in consequence of ploughing.26 Yet both the foreign archaeological literature and the Hungarian experiences show that extensive field walkings can help to a relatively exact picture of the sites in a region, which provide general information on the settlement structure and hierarchy, and, completed with the data of documents, some settlements can even be identified.27

Regarding the early maps, we used first of all the First Ordinance Survey from the time of Joseph II and the Second Ordinance Survey from the 19th century. In some cases the fief maps of the settlements and surveys made with economic purposes provided useful pieces of information. Ferenc Maksay demonstrated the limitations and possibilities of ordinance surveys from the end of the 18th century and the beginning of the 19th century, regarding their source value for the study of medieval settlement history and settlement structure. Maksay compared the reconstructions of the inner territories made after documents with the early maps from the 18th–19th centuries supposing, in most of the cases, a formal continuity, and stressed that the occasional changes that had happened between the two periods could not be detected with this method. Similarly to the inner territories, he compared the arable lands with the data of the maps from the 18th century and although he doubted that there existed a continuity without any break, the manuscript maps often proved to be valuable sources regarding the distribution of the cultivation types and the shapes of the fields.

We did not have the opportunity to prepare aerial photos during our investigations. We could only use the aerial photos kept in the FOMI and the ones made for cartographic purposes by the Institute of Military History.

The history of the village and its sources
Nagyszakácsi can be found about 40 km south-west of Marcali in the western part of Somogy county. In the Middle Ages it was known as Szakácsi, Nagyszakácsi, Külsőszakácsi, Felsőszakácsi and Kisszakácsi. The name of the settlement appeared already in the list of the Pauline monasteries in 1263, where the Saint Dominic monastery of Szakácsi was

23 Éri 1969.
27 The activities of the Hungarian archaeological topography have proved that late medieval settlements mentioned in the documents can nearly always be correlated with the archaeological sites. MRT 8, 32; MRT 9, 14; MRT 10, 723–724.
The village itself first appeared in a document in 1331. The priest of Szakácsi was mentioned in 1359, while in 1396 we can read about the cooks of Szakácsi. The early establishment of the village is suggested by the fact that Gusztáv Heckenast included the village in the category of place names denoting professions. He demonstrated that these settlements were founded on princely lands in the early period of the organisation of the state. Gyula Kristó, beside warning for caution regarding the source value of place names referring to the servicing population, affiliated the development of the royal praedium of Segesd, which included Szakácsi as well, with the organisation of royal private estate in the 12th century or around 1200. We cannot determine the circumstance and the exact date of the foundation of Szakácsi, yet it seems certain that it belonged among the villages of the servicing population that can be connected with the royal estate organisation. It was populated sometime in the 11th – 12th centuries. The start of urbanisation, the development of the uniform layer of villeins, the donation of royal and castle estates in the 13th century led to the disintegration of servicing system. The special services given by the settlements working for the royal household usually turned into agricultural service and from a legal aspect the inhabitants got dissolved in the layer of villeins. The servicing people often aspired to gain the privileges of the nobility to strengthen their position. The forefathers of the cooks of Szakácsi appearing in the documents from the 14th century were also raised to the rank of nobility from the legal status of servicing people. This process can be followed in the series of letters patent of nobility preserved in the so-called Tolvaj’s formulary. So transforming the former obligations into privileges, some of the inhabitants of Szakácsi became royal cooks in the status of the layer of lesser nobility, who fulfilled their task in the royal court in a rotation system. This can be read from the royal account books from the end of the 15th century where the names of the members of the lesser nobility of Szakácsi, the ones known from charters, are listed. At that time, they were already paid for the service. A document from 1471 referred to the price of the salt due to the master cooks. A record from 1462 reveals that during wars they fulfilled their task following the ruler in the retinue. The lawsuits of György Veres of Nagyszakácsi and Péter Orros of Kisszakácsi, both master cooks of the royal court, was postponed that year by half a year since they took part in the campaign against the Turks in the retinue of the king. A donation deed from 1466 hints at the significance of the settlement in the 15th century referring to it as a market town.

So Szakácsi was an early settlement the population of which was composed of villeins giving agricultural services and manorial nobility, probably living a farming way of life, who gained the privileges of the nobility for royal service done in a part of the year.

Zsuzsanna Bándi published a very precious group of sources in 1986 under the title “A szakácsi pálos kolostor középkori oklevelei” [Medieval documents of the Pauline monastery of Szakácsi]. The study contains nearly one hundred documents issued between 1359 and 1521, which contain valuable data not only on the Pauline monastery on the outskirts of the village but also on the topography and economy of the medieval Szakácsi. The majority of

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29 Anjou-kori Okmánytár IL 560.
31 "... coci de Zakachy ..." MOL DI 8135, Bándi 1986, 32.
33 Krisó 1995, 263.
35 The servicing people of Águsterdő were raised to the rank of noble serviens in 1283: Heckenast 1970, 87; the royal door-keepers of Ororszi also aspired to gain the rank of nobility: Kubinyi 1995.
37 Kubinyi 1993 Kubinyi has demonstrated that 55 nobles and 30 commoners lived in Szakácsi beside 6 priests in 1505.
38 Engel 1797, 18–181.
39 MOL DI. 17238, Bándi 1986, 53.
40 MOL DI. 15750, Bándi 1986, 49.
41 MOL DI. 16445, Bándi 1986, 51.
the documents tell about land donations and exchanges that happened between the Pauline monastery and the lesser nobility living in Szakácsi and the neighbouring villages. At the indication of the exact place of the very small, 1–2 igerum large lands the name of the area, the nearby road or spring and the cultivation type and owners of the neighbouring territories are mentioned. These minor data, which can often be connected to one-another, afford to draw, at least partially, the field structure of the medieval Szakácsi. Beside the published collection of documents, valuable information is contained in the documents dealing with the lesser nobility of Szakácsi and their landed properties, the copies of which can be found in the so-called Tolvaj’s formulairy.43 The document of the perambulation of the bounds of the Trepk family of the neighbouring Monyorókerék and the Szakácsi family in Szakácsi edited in 137144 and the source from 1470 on the exchange of the forest called Magaskerthwel (Magaskörtvély)45 offer the greatest help in the examination of certain details of the medieval Szakácsi. A document from 1382, which describes the boundaries of the lands of the Pauline order and the nobles of Szakácsi is somewhat more detailed.46

Since the pieces of information contained in the documents are scattered in space and time and as the medieval Szakácsi probably consisted of more than one settlement unit, we carried out an extensive field walking in the entire area of the village. The field walking was accomplished between October 1996 and November 1999 according to the method applied for the preparation of the volumes of the Archaeological Topography of Hungary, that is we inspected every territory that could be reached within the territory of the modern village and marked the sites in a map of a scale of 1:10 000.

Regarding the manuscript maps, we used the map of the First Ordinance Survey from the time of Joseph II, the Second Ordinance Survey from the 19th century47, and we found valuable data in the cadastre map of the village from between 1850 and 1855,48 the survey of the village from the middle of the 19th century49 and the forest map of Szőcsényi pusza from 1864.50

Aerial photos of the territory can be found in the Map Collection of the Institute of Military History and in the Map Collection of the FÖMI. Both series were made with cartographic purposes. The photos of the Institute of Military History were regrettably taken in the height of 3–4000 metres, which is less suitable for archaeological aerial photographic purposes, and they date from March 1961, so only the occasional discolourations of the soil can help. The photos of the FÖMI are more recent (October 12, 1981 and August 12, 1982) and were made from a lower altitude in a scale of 1:13 000. The date of the flight and the photos were not optimal for observing archaeological features, yet the height can afford the recognition of soil discolourations in the ploughed fields, while the traces appearing as relief formations can be identified in the meadows and grasslands.

The inner territory

Due to the limitations of the sources, namely that they inform only about individual plots, we have barely any insight into the structure of the plots. It is clear that we cannot prepare the exact reconstruction of the inner territory. Nevertheless, the existence of several settlement units is suggested by the fact that the documents mark the settlement of Nagyszakácsi by the names Szakácsi, Nagy-, Kis-, Külső- and Felsőszakácsi.

Felsőszakácsi was only once mentioned in the documents in 1462.51 Kozma’s son Bálint sold that year a 3-igerum-large arable land between Megesharazth (Megyeharaszt) and Hathaserdew (Hátaserdő) within the borders of the Felsősakácsi estate to Antal
fig. 1. Inner territory of Nagyszakácsi in the middle of the 19th century
(SML Map collection U 432)
Ivánka’s son György of Külsőszakácsi. The versatility of the names of the settlement units is evidenced by the fact that Megyeharaszt (Megyeharaszt) was called a part of Külsőszakácsi in 1454, while Hátaserdő (Hátaserdő) was a place name in Nagyszakácsi in 1455.

Kisszakácsi mostly appeared as a prefix before persons’ names. Examining these personal names, however, we find that the same person used both the prefix of Kisszakácsi and Külsőszakácsi. Antal of Kisszakácsi’s son György from 1454 can be found with the prefix Külsőszakácsi in 1455, while in 1461 we learn that he lives in his estate at Külsőszakácsi. Jakab Orros’s son Peter uses the prefix Külsőszakácsi in 1463, then Kisszakácsi in 1472. The deeds of the alienation of a toft and a garden also prove the identity of Kis- and Külsőszakácsi. György Tolvaj sold a garden south of the Saint John Church in Külsőszakácsi to Jakab Orros’s sons in 1452. The same place is mentioned again in 1472, when we learn that Jakab’s son Péter Orros sold a quarter of a villein’s plot to György Veres south of the Saint John the Baptist Church at Kisszakácsi.

fig. 2. Szakácsi on the First Ordinance Survey (Collo VII. Sectio 22)

Szakácsi and Nagyszakácsi often occur both as persons’ names and place names. János Gondos of Külsőszakácsi, György Palfy of Szakácsi and Ferenc Thamassa of Nagyszakácsi are mentioned together among the nobility who held witness in a duress case in 1491, which implies the parallel existence of three settlement units. Two settlements containing the word Szakácsi in their names are suggested by the fact that the transfer of a land between the parish and Antal Kisszakácsi’s son György in 1454 was witnessed on behalf of the inhabitants of both Szakácsi’s. The data in the following chart warn us, nevertheless, that the question cannot as yet be closed. In a table we arranged the place names in the fields that are mentioned in the documents with reference to the name of the settlement.

52 MOL Dl. 14820, Bándi 1986, 44, App. 1: 24
54 MOL Dl. 14820, Bándi 1986, 44.
55 MOL Dl. 14913, Bándi 1986, 44.
56 MOL Dl. 15582, Bándi 1986, 48.
57 MOL Dl. 15826, Bándi 1986, 49-50.
58 MOL Dl. 17285, Bándi 1986, 54.
59 MOL Dl. 14546, Bándi 1986, 43.
60 MOL Dl. 17285, Bándi 1986, 54.
61 Borsa 1979, 129.
62 MOL Dl. 14820, Bándi 1986, 44.
63 The toponyms are listed in the chart in a uniform transcription for the sake of an easier comparison.
Table 1. Place names of Szakácsi with the indication of the settlement unit

<table>
<thead>
<tr>
<th>Place name</th>
<th>Külsőszakácsi</th>
<th>Nagyszakácsi</th>
<th>Szakácsi</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kilencdiófaszéle</td>
<td>1451,1452,1463</td>
<td>1453</td>
<td></td>
</tr>
<tr>
<td>Küttő</td>
<td>1444,1444,1453</td>
<td>1453</td>
<td></td>
</tr>
<tr>
<td>Hársberek</td>
<td>1463</td>
<td>1453</td>
<td></td>
</tr>
<tr>
<td>Nagyrét</td>
<td>1451</td>
<td>1453</td>
<td></td>
</tr>
<tr>
<td>Kerekerdő</td>
<td>1428,1428,1444,1451,1463</td>
<td>1453</td>
<td></td>
</tr>
<tr>
<td>Megyeharaszrt</td>
<td>1454</td>
<td>1453</td>
<td></td>
</tr>
<tr>
<td>Kiseresztvényhegy</td>
<td>1451</td>
<td>1453</td>
<td></td>
</tr>
<tr>
<td>Szél</td>
<td>1451,1463,1463</td>
<td>1453</td>
<td></td>
</tr>
<tr>
<td>Nyíres</td>
<td>1444,1471</td>
<td>1453</td>
<td></td>
</tr>
<tr>
<td>Szérkészdí</td>
<td>1451,1463</td>
<td>1453</td>
<td></td>
</tr>
<tr>
<td>Csipánharaszrt</td>
<td>1451,1463</td>
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<tr>
<td>Csakan</td>
<td>1453</td>
<td>1453</td>
<td></td>
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<tr>
<td>Csolyamutó</td>
<td>1453</td>
<td>1453</td>
<td></td>
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<tr>
<td>Demecerdő</td>
<td>1452</td>
<td>1453</td>
<td></td>
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<tr>
<td>János Péter’s forest</td>
<td>1444</td>
<td>1453</td>
<td></td>
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<tr>
<td>Víkonykerdő</td>
<td>1452</td>
<td>1453</td>
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<tr>
<td>Boroshely</td>
<td>1463</td>
<td>1453</td>
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<tr>
<td>Magaskörtvély</td>
<td>1455</td>
<td>1453</td>
<td></td>
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<tr>
<td>Hátaserdő</td>
<td>1455</td>
<td>1453</td>
<td></td>
</tr>
<tr>
<td>Széngetőharaszrt</td>
<td>1480</td>
<td>1453</td>
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<tr>
<td>Szőlőharaszrt</td>
<td>1466,1471</td>
<td>1453</td>
<td></td>
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<tr>
<td>Roketas (beside the border of Szőcsény)</td>
<td>1471</td>
<td>1453</td>
<td></td>
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<tr>
<td>Csohoszért</td>
<td>1471</td>
<td>1453</td>
<td></td>
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<tr>
<td>Tolvaj-völgy</td>
<td>1471</td>
<td>1453</td>
<td></td>
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<tr>
<td>Kerekő</td>
<td>1471</td>
<td>1453</td>
<td></td>
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<tr>
<td>Alexandorbyky</td>
<td>1385</td>
<td>1453</td>
<td></td>
</tr>
<tr>
<td>Berekynészél</td>
<td>1471,1461</td>
<td>1453</td>
<td></td>
</tr>
<tr>
<td>Halmosföld</td>
<td>1480,1480</td>
<td>1453</td>
<td></td>
</tr>
<tr>
<td>Papharaszrt</td>
<td>1453,1453,1453,1453</td>
<td>1453</td>
<td></td>
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<tr>
<td>Horóhfajja river</td>
<td>1402</td>
<td>1453</td>
<td></td>
</tr>
<tr>
<td>Horhoszél</td>
<td>1453</td>
<td>1453</td>
<td></td>
</tr>
<tr>
<td>Horbas, Szél, Viámoszásszél</td>
<td>1453</td>
<td>1453</td>
<td></td>
</tr>
<tr>
<td>Felsőcser</td>
<td>1495</td>
<td>1453</td>
<td></td>
</tr>
<tr>
<td>Újhegy</td>
<td>1453</td>
<td>1453</td>
<td></td>
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<tr>
<td>Vezető</td>
<td>1453</td>
<td>1453</td>
<td></td>
</tr>
<tr>
<td>Szénrét</td>
<td>1495</td>
<td>1453</td>
<td></td>
</tr>
<tr>
<td>Haraszerdő</td>
<td>1475</td>
<td>1453</td>
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<tr>
<td>Hosszzerdő</td>
<td>1459</td>
<td>1453</td>
<td></td>
</tr>
<tr>
<td>Márk’s forest</td>
<td>1507</td>
<td>1453</td>
<td></td>
</tr>
<tr>
<td>Utalaboserdő</td>
<td>1507</td>
<td>1453</td>
<td></td>
</tr>
<tr>
<td>Göthungyepe</td>
<td>1453</td>
<td>1453</td>
<td></td>
</tr>
<tr>
<td>Fővény, Kerekőt</td>
<td>1495</td>
<td>1453</td>
<td></td>
</tr>
<tr>
<td>Bankolcászél</td>
<td>1425</td>
<td>1453</td>
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</tr>
</tbody>
</table>

The table shows three well distinguished groups, that is settlements, which probably suggests that they were independent settlement units. At the same time, overlapping appears at two places in the case of Szakácsi and Nagyszakácsi, at Berekynészél (Bereknyeszél) and Halmosföld, that is they are mentioned at both places. The identity of the territory is further supported by the fact that Roketas, which belonged to Nagyszakácsi, can be found beside Szőcsény, and the modern toponym Cserhát tells that Felsőcser (Felsőcser) of Szakácsi was also situated somewhere there.

The sources mention the parish church dedicated to All Saints from 1378.64 They also report about the donation and alienation of several plots of the nobility and the villeins. The scattered data65 afforded the reconstruction of certain plot groups, which suggest the existence of an east-west and another north-south directed row of plots. They also reveal that the plots of the nobility were often wedged into the row of villeins’ plots in the plot row of the village. The phenomenon that the manors of the lesser nobility, who did not have a castle or a larger allodium, were inserted into the plot system of the village, was not unusual in the Middle

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64 MOL Di. 6515 Bándi 1986, 29.
65 The documents mention altogether 11 plots of the nobility, 9 plots of the villeins, 1 deserted plot and a land suitable for a plot.
Nevertheless, within this system, they can often be found in more favourable places as around the church or slightly separately at the edge of the settlement. Imre Holl observed a similar phenomenon at Sarvaly. The houses of the lesser nobility population of the village, which yielded a rich find material, were found near the street row of a fairly regular plot pattern, yet they were somewhat detached and stood at larger distances from one another. Sometimes, the difference between the villeins’ plots and the mansors of the nobility appeared only in the size. The size or the value of the plots of the nobility was usually identified with those of three or four villein’s plots.

We do not know the exact place of the Szakácsi plots mentioned in the documents. The sources often list the manors of the nobility side by side, so one of them probably lay at the edge of the settlement, since an area suitable for a plot is mentioned beside it. Casting a glance at the map of the inner territory of the village in the middle of the 19th century, one cannot help noticing the differences in the sizes of the plots (fig. I). We can find nearly only narrow strips of plots in the western row of the village, while in the eastern row, especially on the northern side, larger plots are inserted between the narrow tofts. It can also be observed that it is not the name of the owner the map indicates as the possessor of these larger plots but that of a family (Fekete family, Műkor family). It is not excluded, either, that Egyed Fekete of Külsőszakácsi mentioned repeatedly in medieval documents was an ancestors of the Fekete family from the 19th century. The sources do not afford the identification of the medieval manors of the lesser nobility with the large plots of the 19th century, it cannot be excluded, however, that in certain cases the shapes of the medieval manors were preserved.

The picture of the inner territory became even more colourful when in some cases the nobles of Szakácsi donated tofts or manors to the Pauline order, which latter certainly did not use them as residences. It could happen similarly as in Botond village in Heves county where the Pauline monastery operated a farm between the tofts.

The sources often mention gardens behind the tofts. We can hear about the garden of a toft when Pál Végh of Szakácsi sold half a plot with the half of the garden that belonged to the plot in 1467. A duress case in 1475 also suggests that the garden was situated at the back of the plot since János Pap of Szakácsi annexed a part of György Veres and György Korothnai’s garden to his plot held in villeinage at Szakácsi. Certainly the same garden is mentioned in György Veres’s will, where we can read about György Veres’s garden part in Tarroskerth in Szakácsi.

The archaeological field walkings recorded two larger sites near the inner territory of the modern Nagyszakácsi where sherds both from the Árpádian Era and the late Middle Ages were found (fig. 12). Site no. 29 in the central-southern part of modern Nagyszakácsi yielded only late medieval pottery, while we could collect sherds from the Árpádian Era in the approximately 50 cm × 50 cm large spot marked by x in the map. Sherds from the Árpádian Era were also collected in the entire territory of sites nos 21 and 28 south of site no. 29.

The location of Külsőszakácsi can be deduced from a document from 1470 included in Tolvaj’s formulary. At that time, Peter’s son László bought from János Bogdán a part of the Magaskerthvel (Magaskörtvély) forest in Külsőszakácsi, which was situated north of his estate in Külsőszakácsi. The forest called Magaskerthvel (Magaskörtvély) is mentioned elsewhere as well, it could be found north-east of Szakácsi. Accordingly, we have to look for Külsőszakácsi north-east, east of the modern village.

69 Maksay 1971, 123, 209.
70 1431: MOL DL. 12415, Bándi 1986 41.
71 SML Map collection U432: Map of the Szakácsi fields (middle of the 19th century).
72 The Pauline order got a whole toft in 1456: MOL DL. 15038, Bándi 1986 45–46; György Veres donated two manors in Nagyszakácsi: 1471: MOL DL. 17203; Bándi 1986 52–53; the Pauline order was enstated as the new owner of another manor in Szakácsi in 1491: MOL DL. 20578, Bándi 1986, 60.
73 Maksay 1971, 124.
74 MOL DL. 16514, Bándi 1986, 52.
75 MOL DL. 17688, Bándi 1986, 55.
76 1453: MOL DL. 17462, Bándi 1986, 43.
77 Tolvaj’s formulary 128–129.
Two, probably connected archaeological sites can be identified with Külsőszakácsi. The sites are separated by a brook and a forest strip, so they are handled separately. Site no. 1 can be found east of the village in the western corner of Diósdülő, on the northern bank of the Nagyszakácsi stream. A large number of late medieval sherds and some from the Árpádian Era were found in the large site occupying a surface of 800 × 2–300 m. On the dirt road, which had been shifted somewhat to the north from the bank of the stream that intersects the site, we observed several red, burnt spots of hearths probably destructed during the construction of the road. We identified site no. 3 in the Temetői-dülő and the eastern part of the Kis-gáti dülő with the southern part of Külsőszakácsi. A quadrangular, "entrenched" area can be found overgrown with weeds on the northern side of the dirt-road running along the southern border of the Temetői-dülő. Its centre is slightly elevated. Not far from this territory, the place of a house was outlined by a cluster of finds and a burnt spot, which we marked in the map. In the site occupying a surface of about 800 × 350–400 m, a large number of late medieval sherds were collected, and some sherds from the Árpádian Era could be found rather in the northern side of the site.

At the site of the quadrangular territory ignored by agriculture, every manuscript map indicates a cemetery, and the surveys did not indicate a perished settlement (figs 2–4). At the same time, the connection between the names of two fields from the 19th century call attention to an interesting phenomenon. In the cadastral map of the settlement, the part of the modern
Kis-Gáti-dűlő beside Nagyszakácsi is called Karikós-dűlő (XLVIII), while the name of the present Temető-dűlő [Cemetery field], where our site can be found, is Külső-Karikós-dűlő (XXXIV)⁷⁹ (fig. 5). It seems highly probable that the later place name preserved the distinctive attributive hidden in the name of the one-time settlement.

Probably the church dedicated to Saint John the Baptist mentioned in the sources stood in the territory of the modern Old cemetery. The documents report only about an entire plot of a nobleman,⁸⁰ a half plot⁸¹ and a quarter of a villein’s plot and a garden south of the church.⁸² Since they make only a fraction of the settlement and we do not even know their relation to one another, we cannot tell more about the settlement structure of Külsőszakácsi from the sources.

Comparing the site with the aerial photos made of the territory, a discolouration of the soil can be observed in a north-west – south-east oriented zone (fig. 6). The line appearing as a light stripe in the aerial photo made by the FÖMI⁸³ and as a dark one in the one of the Institute of Military History⁸⁴ indicates the edge of the site as well. It can mark a one-time water course on which the village settled. A quadrangular 150 × 150 m large stripe appeared on the eastern side in a lighter colour than the surrounding ploughed area, while in some photos two light spots can be detected. We cannot be certain that they can be dated from the Middle Ages although the structural coincidences do not exclude that they belonged to Külsőszakácsi.

⁷⁹ SML Map collection K352: General cadastre sketch of Nagyszakácsi (1850–55).
⁸¹ 1453: MOL DL 17462, Bándi 1986, 43.
⁸² 1452: MOL DL 14546, Bándi 1986, 43.
⁸³ FÖMI Map collection 1982: No. 140896.
There are no data suggesting when it was founded and depopulated. István Szabó described the characteristic process regarding the castle villeins’ villages turning into villages of the nobility in the 14th–15th centuries when, in consequence of the division of the family estates in the villages of the lesser nobility and the separation of the family with setting up new homes, a new settlement developed within the borders of the village. He cites the case of Köveskál, where thirteen of the noble inhabitants of the village settled over on the outskirts of the village in 1341, they built a church there and gave a new name to their settlement. These so-called manorial villages with small fields, which were mostly inhabited by noble families, often proved incapable of survival. It seems probable that Külsőszakácsi was the result of a similar process. Some members of the lesser nobility perhaps wanted to live closer to the lands they were allotted at the division. They gradually, or at one go, moved to the outskirts of the village and founded there a new settlement. It was last mentioned in 1471. The Ordinance Survey at the end of the 18th century indicated already only the place of the cemetery. It was probably not repopulated after the devastation in the Turkish period.

The reconstruction of the fields

The sources that can be used for the sketching of the fields can be grouped into two categories after the size of the described territory. The two perambulates of bounds tell about larger coherent territories, while the deeds on exchanges and donations of lands come from various dates and inform about smaller units of estates and parts of fields. Since the main task is the

The mapping of the data of the documents

First we reconstructed the outlines of the coherent territories described in the perambulates of bounds, which could be completed with related information from other documents.

The more detailed document from 1382 describes the lands of the Pauline monastery and the estates of the village. At that time, the nobles in Szakácsi affirmed the donation their forefathers had done to the benefit of the monastery and they intended to fix it by the way of a perambulate of bounds. It started in the east at the boundary mark of Léta and Szakácsi. Then it proceeded southwards, westwards and then northwards and finished at one of the boundary marks of Szakácsi and Mónyökérek. On the route it passed by estates of the lesser nobility, roads, forests, coppices and a stream (fig. 8).

The document about the perambulation of the bounds of the estates of the Trepk family of Mónyórókerék and the Szakácsi family of Szakácsi from 1371 – which at the same time describes a section of the boundary of the two villages – can be found in Tolvaj’s formulary preserved in the National Széchenyi Library (Appendix 2).88 The perambulate of bounds in 1382 mentions the village of Mónyórókerék as the western or north-western neighbour of Szakácsi. The name of Mónyórókerék in Somogy county cannot be found either in place names or in the ordinance surveys. Only the documents report about its existence and approximate location. Accordingly, Mónyórókerék was the north-western neighbour of Szakácsi. A road led from the village to the monastery, and it belonged to the parish of Szőcsény village.

In 1371 the perambulate of bounds started from a river called Haas and proceeded from the west to the east. It crossed a road, the Sichwa (Zsitfa) river, which ran across a land called Cheer (Cser), then crossed the Mónyórókerék road. Then they reached first a coppice, then a large protected or prohibited forest (silva custodialis) and a road. The perambulate of bounds was finished at a stream, where the dam of the mill of the monastery could be seen. The document also tells that the place called Chereseuleu (Cserszőlő) can be found south of the route of the perambulate of bounds (fig. 7).

After having made a sketch from the data of the perambulates of bounds, we collected those records from the database that could be connected to any of the items listed in the perambulate of bounds. We made drawings after these records based on the relevant spatial information, then connected them to one another and to the data of perambulates of bounds (figs. 9/a–c; 10/a–c; 11/a–b).

In 1382 the perambulate of bounds started from the north-eastern fields of the village and proceeded southwards, where the forest of the priest of Szakácsi lay east of them, and the coppice of the Pauline monastery stretched in the west. In 1375, a document mentioned

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88 Tolvaj’s formulary 128–129.
89 1382: MOL Di. 6903, Bándi 1986, 30, App. 1: 149.
90 1474: MOL Di. 17556, Bándi 1986, 55. Szűcsény village, to date Szűcsénypuszta north of Nagyszakácsi.
an arable land of ten iugerum south of the forest of the All Saints parish Church, while in 1414 a thicket is mentioned between the forests of the Pauline monastery and the parish, on the northern side of an arable land donated to the Pauline monastery. A certain place called Paperdey, Papharazthya (Priestforest) is repeatedly mentioned in the documents within the borders of Szakácsi, Nagyszakácsi. In 1453 we learn that it lay in an area close to Gadány. Based on the name and the reference to the eastern fields of the village it seems probable that Paperdó was the name of the forest owned by the actual priest. The data tell that the forest was interrupted here and also in the neighbouring territories by arable lands, coppices and vineyards. For example, the coppice called Zenegethewharazthya (Szénégetőharasztja), bordered by a vineyard, can be found in Paperdó (fig. 9/a–c).

Later, the perambulate of bounds reports about the coppice of Szakácsi (virgultum ... remanent ipsis scilicet Nobilibus de Szakács), mentioning a path leading from Szakácsi to Léta west of it. We only mention but did not indicate in the map the uncertain record that the sons of Keres of Nagyszakácsi donated the vineyard they themselves had founded beside the road to Léta and the coppice of the village (virgultum communitatis) to the Pauline monastery in 1385. The sources also tell that beside the above-mentioned path, a main road led from Szakácsi to Léta, so the question is which road they met in 1385. The place of the coppice could help but the coppice of the village and that of the nobility of Szakácsi cannot be identical since the first one refers to the forest that was used by the community of the village or some of the inhabitants, while the latter one was the coppice owned by certain members of the nobility in Szakácsi.

As the perambulate of bounds moved westwards, it arrived to a long prickly thicket called Mege (Megye). The Pauline monastery was given a part of an arable land east of the thicket called Megey in 1411, and the half of another arable land was exchanged in 1454 at a place called Megyeharaszt (Megyeharaszt), on the eastern side of which a public road (via publica) was mentioned. This must be the path to Léta mentioned already in 1382. Further records tell that Hatoserdő (Hátaserdó) lay beside Megyeharaszt (Megyeharaszt), and a forest called Magaskertvél (Magaskörtvély) could be found east of it. We know from the record from 1470 discussed at the inner territory that Kőlőszakácsi lay south of Magaskörtvély. It should be added that Megyeharaszt, Hátaserdó and Magaskörtvély are mentioned in the sources, apart from one, within the borders of Külsőszakácsi or Felsőszakácsi, which means that this stretch of the perambulate of bounds in 1382 could not be far from the above-mentioned settlement (fig. 10/a–c).

Westwards, the perambulate of bounds arrived to the road that led to the monastery. They followed it for a short time, then turned west on the same road. We can also read about the road leading to the monastery and an arable land east of it in 1411. Although we have no more references regarding at which stretch of the road the arable land lay, this record must be mentioned here since at that time Mihály Szakácsi’s son Balázs donated the 1 iugerum large land to the Pauline monastery so it could probably be found near the Pauline estate.

The perambulate of bounds turned here to the north passing between Egyed’s son János’s and Demeter Soldus’s arable lands and the forest of the Pauline monastery. The document states in an appendix that the road leading to Léta ran beside Egyed’s son János’s arable lands, where the Pauline monastery owned a field of 2 iugerum beside Egyed’s son János’s land. It was probably here that the Pauline monastery was donated a four iugerum large arable land, which was bordered by Egyed’s son János’s arable land in the south, Demeter’s son János Soldus’s arable land in the north and the west and a road in the east (fig. 11/a–b).

The road to Léta is the joint element between the perambulates of bounds in 1382 and 1371. The road mentioned in 1371 west of the Sichwa (Zsitfa) river can be identified with the
road to Léta based on the data to be discussed later in the chapter on roads. The documents registered a place called Cheer (Cser), Chereseuleu (Cserszőlő) beside it, south of the route of the perambulate of bounds, where even to date the part of the village called Cserhát is situated. The comparison of the routes of the perambulates of bounds reveals that the Cser part was probably met in 1382 as well. Cser probably lay on the border of the estate of the Pauline monastery, which is corroborated by the data referring to it in the documents. Mihály Kígyó donated 4 arable land parts (altogether 20 ingerum) and a meadow of two scythes (falcastrum) to the Pauline monastery in 1428. The documents remark in the case of nearly every piece of land that they lie between the arable lands of the Pauline monastery, and once we can read that the Pauline monks sowed the donated arable land of 2 ingerum. In 1495, the monastery got an arable land measuring 4 and a half ingerum in an area called Felsőcser, north and south of which lay the arable lands of the Pauline monastery. The next donation was reported in 1500, when Máte Pauline prior gave Antal the officer of the Saint Benedict altar one and a half ingerum of arable land in Nagyőserdő between the arable lands of the Pauline monastery, Janos Bodak’s forest (Bodakhianoserdeje) and Péter Törpe’s forest (Echterpepetererdeje). The last donation came from András Tolvaj in 1539. He gave 12 ingerum arable land to the Pauline monastery in an area called Kiscseri. It is important to note that, apart from a single case, the documents do not mention lands of the nobility between the lands of the monastery. With all these in mind it is perhaps not farfetched to suggest that the mentioned donations can be found at the north-western end of the perambulate of bounds of 1382, between the arable lands of the Pauline monastery south of the Monyorókerék territory. So the joint elements help in the definition of the courses of the two perambulates of bounds in relation to one another.

To place the still schematic drawing on a map we needed points that could be located in the landscape, as the place of the monastery, the roads, the streams, the still existing place names and the settlements mentioned in the sources.

THE MONASTERY

The Pauline monastery dedicated to Saint Dominic and its place play an important role from the respect of the medieval topography of the village. The estate of the monastery partly originated from the territory of Szakácsi by means of donations, which, at least in space, were organically connected to the territory of the village. At the same time, the monastery, which was frequently mentioned in the sources, often served as a point of orientation at the description of the various areas. It should also be remembered that since the majority of the sources tell about land affairs between the nobility of Szakácsi and the Pauline monastery, the donations are probably related first of all to the territory closer to the monastery and here we have a greater opportunity for reconstruction.

There are no data about the exact date of the foundation of the monastery. The Saint Dominic monastery of Szakácsi was already mentioned in the registry made in 1263. The Pauline monastery had a relatively large estate in 1382, and ever new donations had enriched the monastery until in 1550 the monks, since they could no longer live there, leased the lands of the monastery for 12 years to István Gondos and Gergely and Matyás Pálffy.

In the literature, we can find general statements regarding the exact place of the monastery. Tamás Guzsik

100 MOL DI. 11981, Bandi 1986, 40, App. 1: 48.
101 MOL DI. 20358, Bandi 1986, 59, App. 1: 54.
103 Acta Conv. P. 1, no. 64, Rupp 1876, 293.
104 It is mentioned as an addition to the perambulate of bounds in 1382 that the Pauline monastery has 2 ingerum of arable land and a meadow of two scythes beside Poka’s son Janos’s meadows. The above mentioned lands also lie next to the estates of the Pauline monastery.
105 Tolvaj’s formulary 129.
determined the place of the monastery after a field survey, relying mainly on the local traditions told by the villagers. He described that according to the traditions the monastery was near a by now abandoned farm called Barátok 2 km north-east of the village, although the inhabitants of the village could not point to the exact place. The author walked along the spring regions of the side-branches of the stream that flows here but could not find any trace of a medieval building on the surface. He marked the place of the monastery at the stream, about 1 km north of the Barátoki bridge on the sketch of the area drawn out of scale (as the published sketch is out of scale, the distance was deduced from the proportions of the map). I think that although the data in the study contain important information regarding the place of the monastery, the adaptation of the sketch without any remark would prompt an ultimate solution and thus it would be misleading.

We started the localisation of the monastery with the analysis of the sources. Most of them tell only that the monastery stood near the Szakácsi village, on its edge or within its boundaries.109

The register from 1740 tells about the place or rather the ruins of the Pauline monastery. Accordingly, “some of the stone walls of the old Pusztai Church are still standing in the valley, on the western side...” of the Baráti puszta next to Szakácsi, west of Gadány.111 In the area we can find more than one place with the Baráti name or prefix. The Barátok-hill lies north-east of the village within the borders of Nagyszakácsi. The Barátok-hegyi stream runs across it toward south. A part of the forest on the eastern fringe of Somogyzsítta is called Baráti forest, while the field called Baráti-puszta can be found in the southern part of the village toward Nagyszakácsi.

Although the ruins of the Saint Dominic monastery were still certainly standing in the middle of the 18th century, they were not indicated either in the First Ordinance Survey from 1783 or the second one from the beginning of the 19th century.112 It is interesting to note, however, that in the second military map three roads meet along the Barátok-völgyi stream about 500 m north of the spot where the local tradition located the former building of the monastery (fig. 3).

The tradition holds that the Pauline monastery stood east of the Barátok-völgyi stream, about 100 m south of the northern border of Nagyszakácsi, in a lately uninhabited territory called Barátok or Barátok farm. The inhabitants of the farm started to settle over into the village in 1963 when the local agricultural co-operative was founded. The inhabitants have told that the traces of the monastery were found during the construction of the one-time barn.113 The aerial photos made in 1961 still show houses in this place. Later it got depopulated and the forest invaded the territory.

During the field walkings, we could not find any trace of a building in the Barátok-puszta area or its vicinity within the territory of Somogyzsítta. The field walkings proved similarly unsuccessful on the Barátok-hill and in its environment. It must be added, however, that the area to which the local tradition refers is unsuitable for field walking because the surface is partly covered by a dense thicket and also because the farms have strongly disturbed the surface.

The comparison of the documents supports the supposition that the building could stand here. As it has already been mentioned, the monastery was always mentioned within the borders of Szakácsi. The perambulate of bounds in 1371 followed the northern border of Szakácsi, and based on later discussed data, this borderline approximately coincided with the northern border of the modern village. The eastern terminal of the perambulate of bounds was a landmark raised in the north beside the mill of the Pauline monastery. The monastery standing within the border of Szakácsi must have been somewhat to the south from this spot. In 1382, the perambulate of bounds followed the border of the estates of the Pauline monastery, and the monastery must have stood north of this line.

110 1507: MOL DL. 21758, Bándi 1986, 64.
112 Collo VII. Sectio 22.; Colonne XXV. Sectio 59.
113 István Nagy’s (Nagyszakácsi, 79, Kossuth L. street) oral communication. He also moved from the farm to the village in 1963.
All the above suggest that the monastery stood at the northern end of the Barátok hill near the Barátok-hegyi stream. To prove it, further archaeological studies are necessary. Although we could not identify the exact place of the monastery, it could approximately be located and the possible territory of the Saint Dominic monastery was accordingly conditionally marked in the map (fig. 12, 13).

**THE ROADS**

To locate the roads, we compared the data of the early maps, the results of field surveys, the place names and the information gained from the documents (fig. 13). The sources mention roads in altogether 19 cases. For the sake of a better orientation, we grouped them into three categories: 1. Main roads indicated as *via magna* (5), 2. minor roads (*via,semita*), of which at least one terminal is given in the document (7), 3. minor roads (*via, via publica*) the terminals of which are unknown, only some stretches are mentioned in the sources (7). In the table we printed in italics the destinations of the roads that are not mentioned in the texts but can logically be deduced. We have also marked the date of the source and the ordinal number of the given record in Appendix 1.

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Table 2. The roads in Szakácsi mentioned in the documents

The main road from Szakácsi to Léta seems to be the most significant road. The route of the perambulate of bounds in 1382 did not cross it, yet the document mentioned it in the appendix beside Egyed’s son János’s arable lands at the eastern stretch of the perambulate of bounds. Léta was first mentioned in the sources as *terra* in 1268. The priest of Léta was mentioned in 1515. Later the village perished and was not repopulated. The perambulate of bounds revealed that Léta neighboured Szakácsi in the north-east, its place is probably indicated by the Léta-majors dűlő in the fields of Marcali about 5 km north-east of Szakácsi. Regrettably, a larger part of the territory, which is surrounded by forest, is covered by weeds and bushes, and was unsuitable for field walkings. In the ploughed north-eastern part of the field we could not find any trace of a settlement. In the map of the First Ordinance Survey from the time of Joseph II, the territory is covered by forest, in the map of the Second Ordinance Survey from the 19th century, a clearing can be seen in the area of the modern Léta-majori dűlő, in the southern side of which the map indicates the Léta farm (fig. 13). The map also indicates the road stretch, which can still be seen as a hollow road in the forest, and which connects the Léta-majori dűlő with the road that runs to Szőcsénypuszta north of Szakácsi, then turns toward north-east and runs through the Létai forest toward Marcali. The record from 1456, which mentioned the *magna via* from Szőcsény to Léta indicates the stretch between Szőcsénypuszta and Marcali. Lajos Glaser identified this road with a stretch of the road from Marcali to Zákány in 1929. Judged from its position, the road running west of the Zsitfa river mentioned in the document from 1371, the modern national road, is identical with the *via magna* of Léta. Probably the *via magna* mentioned in 1411, on the southern side of which a thicket could be found, also meant the Léta road. The road to the vineyard of the Pauline monastery ran south of it.

114 ÁUO 188–189.
115 MOL DL. 22664, Bandi 1986, 65.
116 MOL DL. 15022, Bandi 1986, 45.
117 Glaser 1929, 277.
118 MOL DL. 9778, Bandi 1986, 36.
A document from 1471 mentioned the main road to Gadány beside Kerektho (Kerektó),\textsuperscript{119} while from 1480 we are informed about the via magna to Mesztegnyő east of the field called Halmosföld.\textsuperscript{120} As no more record refer to these two places, we can only propose that the above-mentioned roads are identical with the roads indicated in the ordinance surveys and the modern ones leading to Gadány and Mesztegnyő. This road starts eastwards in the northern part of the modern Szakácsi, then turns somewhat southwards and leads across the former Külsösázkácsi. From here it runs in the basin of a stream, goes round the vine-hill and leads toward Gadány turning in a north-westerly direction.

The localisation of the road to the monastery mentioned in the perambulate of bounds in 1382 is facilitated by the fact that we know both ends of the road, and that a stretch of the road can be found in the map from 1783 and the entire track in the map from the beginning of the 19th century (figs 2–3). The hollow road, which survived at some places in a depth of 2–3 metres, is still used by the villagers as the road to the Batrátok farm.

The east-west directed small road along the stream crosses the road to the monastery. The mentioned stretch could run along the Barátok-hegyi stream, which crossed the road to the monastery.

The path leading from Szakácsi to Léta, mentioned near the thicket called Mege in 1382, can be identified with the public road east of the place called Megyeharaszt (Megyeharaszt) mentioned in 1454 as a via publica\textsuperscript{121} and with the road to Léta about which it is written in 1385 that the coppice of the village is east of it.\textsuperscript{122} A road can be seen in the map of the Second Ordinance Survey that reaches Léta along the basin of the Barátok-hegyi stream. The perambulate of bounds suggests, however, that the path ran more to the south-west. It is also possible that the road from Léta to the monastery described in the perambulate of bounds in 1382 meant a more northerly stretch of the same road.

A stretch of the road from Szakácsi to Monyorókerék was at the eastern end of the perambulate of bounds in 1382, while the north-south directed stretch running more to the west was mentioned east of the Zsitfa river in the source from 1371.

In 1371 the perambulate of bounds followed the track of an east-west running road in the northern part of the modern Cserhát, at the eastern end of the which the mill of the Pauline monastery and the road that leads there are mentioned. The stream that fed the mill was certainly the modern Barátok-völgyi stream, and the mill and the road could be near the northern border of the modern Nagyszakácsi.

A donation to the Pauline monastery in 1466 reported about the priest’s road, a public road to the forest, west and north of which coppices could be found.\textsuperscript{123} At the same time, the perambulate of bounds in 1382 started on the road between the forests of the parish and the Pauline monastery. All these suggest that the perambulate of bounds started in 1382 on the priest’s road.

The two ends of the road leading from the monastery to Monyorókerék can only approximately be determined. We have no data about the footpath mentioned in Külsösázkácsi in 1451.

RIVERS AND STREAMS

The Haas river, which was the terminal of perambulate of bounds in 1371, can be found in the text of a perambulate of bounds from 1331, when Tamás Transylvanian voivod was initiated, among others, to his estates in Tapsony.\textsuperscript{124} The river is described as a river running from the north to the south east of Tapsony. After these data we can identify the Haas river with the modern Marót-völgyi canal.

The Sichwa river (Zsitfa) is also mentioned in the document from 1371. It runs near the part called Cser east of a road. Cserhát is a still existing geographical name, this is how the northern settlement unit of the village and its environment is called. Zsitfa, accordingly, is

\textsuperscript{119} MOL DL. 17203, Bándi 1986, 52.
\textsuperscript{120} MOL DL. 18312, Bándi 1986, 57.
\textsuperscript{121} MOL DL. 14820, Bándi 1986, 44.
\textsuperscript{122} MOL DL. 7139, Bándi 1986, 31.
\textsuperscript{123} MOL DL. 16445, Bándi 1986, 51.
\textsuperscript{124} Anjoukori Ökumánytár II. 558–560.
RECONSTRUCTION OF THE SETTLEMENT STRUCTURE

the medieval name of the Nagyszakácsi stream. The river (*Sythwa*), which flows northwards toward Somogyzsítha, was also mentioned within the borders of Zsitfa in 1477.125

The stream that ran beside the Pauline mill at the eastern terminal of the perambulate of bounds in 1371 is the northern stretch of the modern Barátok-hegyi stream. The small road mentioned in the document in 1382 followed a more southerly stretch of this stream.

The next step was putting the above listed spots (monastery, roads, settlements, the field called Cser etc.) on a map and delineating the possible route of the perambulate of bounds with the indication of the rest of the data that could be identified. The medieval names are printed in italics in the map (fig. 13). We omitted the cartographic indication of the arable lands indicated in the drawing along the route of the perambulate of bounds since we do not have information about their sizes and often even about their exact location. Consequently, marking them in the map could be misleading.

**Land measures used in Szakácsi**

A diverse use of square measures can be observed in Szakácsi. The most common measure was that of the arable land measured in *iugerum*, although in 1451 the size of the lands was given in customary *iugerum*. It happened that no unit of measure was mentioned or only a piece of arable land was donated,126 and in 1463 we can even read about pieces of land measuring the width of a cart.127 The sources repeatedly mentioned a surface measure of a day’s ploughing. In 1453 we can read about “*haebo medio dietam vilgo zantho feld... comparavi secundum dimidium dietam vilgo zanthofeld*”, that is a land that can be ploughed in half-a-day,128 while in 1480 a piece of land described as “… *terrarum arabilum ad duarum dierum aratra* ...” is referred to at two separate places.129 István Bogdán identified the size of the territory that could be ploughed in a day with the size of a customary *iugerum* especially because of the *vilgo* arable land and other data of the documents.130 A donation deed to the Pauline monastery, however, contained the following in 1471: “… *terram Berekynyezel ad aratra decem et medi dierum simul cum rubetis ibidem habitis ac tria iugera terre Rokethas* …”, that is Berekynyezel land of ten and a half days’ ploughing with the adjacent coppices, three *iugerum* of a land called Rokethas.131 Here the source clearly differentiated the land of a day’s ploughing and the square measure *iugerum*, so the identification of the two units of measurement should be accepted with reservations, at least in the case of Szakácsi. The record from 1453 rather suggests that arable land used as a unit of land measure, which is really often used in the sources without the indication of any unit of superficial measure, can be identified with an arable land of half-a-day’s ploughing. In my opinion, the use of arable land in the sense of a *iugerum* cannot be proved from the listed data, although they do not refute it either. The connection of the medieval land and the capacity of the plough was demonstrated early in the historical studies.132 MáRTA Belényesy discussed it in details that the territory counted by the plough, a land for a plough, is the size of the territory that can be ploughed with a single plough in a year, which gives the average of a day’s work with the plough in a *iugerum*. *Iugerum*, accordingly, was originally a land that could be ploughed in a day.133 Jenő Szűcs, similarly to Belényesy, explained the divergences of the size of the land for a plough and the measurement of *iugerum* in different territories and in various periods with changes of the cultivation technology. He convincingly demonstrated that the territorial capacity of the moulded plough that appeared in the 13th century and turned the land more thoroughly was smaller than that of the former scratch plough. At the same time, the ploughing of the narrow strips of lands was more economic with the new plough type. In consequence, with the shortening of the royal *iugerum*, which had probably developed in a royal land structure, the smaller customary *iugerum* became regularly used. According to his calculations from the

125 MOL DL. 17914., Bandi 1986, 56.
126 1453: MOL DL. 17462., Bandi 1986, 43, App. 1: 119
127 MOL DL. 15903, Bandi 1986, 50, App. 1: 78.
128 MOL DL. 17462, Bandi 1986, 43.
129 MOL DL. 18312., Bandi 1986, 57.
130 Wenzel 1887, 170.
131 Belényesy 1955, 84-85.
use of customary *iugerum* in the documents, with the longitudinal division of a royal *iugerum*, measuring the width of 12 royal fathoms (*ulna*), a *iugerum* measure of a width of 7–8 royal fathoms can be supposed. So the former 1:6 width-length proportion changed to 1:9–10. Jenő Szűcs also called attention to the fact that the process he sketched could best be observed in counties Somogy and Zala where the moulded plough appeared in the 13th century.134

Based on the above, the contradiction between the sizes of a land a day’s ploughing and a *iugerum* observed in Szakácsi can be resolved supposing that *dieta* originally really meant a territory of a *iugerum*, probably a territory closely related to a royal *iugerum*.135 In connection with the above process, it seems probable that, parallelly to the decrease of the size of a *iugerum*, *dieta* preserved its original size and later fixed in this form. If we accept this and that a vulgo arable land is identical, as Bogdán holds, with the size of a *iugerum*, the customary *hold* that became accepted in Szakácsi can be equalled to the half of a royal *iugerum*.

It should be added that Zsuzsana Bándi uses the territorial unit of a *dieta* in his source publication in the sense of a land for a plough. In the sense of the above, I find this solution awkward since a land for a plough as a unit of land measure hints at the cultivation capacity of a plough in a year, which is around 100–150 *iugerum*.

**Forms of landholding and cultivation**

The sources contain several records that refer to certain spots, which are difficult to place within the boundary of the modern village. One of the reasons is, beside the incomplete data gained from the sources, that only a few of the medieval place names have been preserved to our times. The exceptions are the above mentioned Cheer (Cser), Chereseuleu (Cserszőlő) – Cserhát; Kylenchdyofazele (Kilencdiófászéle) – Diós-dűlő; Niresalya (Nyíresalja), Niresalath (Nyíresalatt) – Nyíresi. In some cases it turned out that the identical or nearly identical names mentioned in the documents and observed among the modern names do not mark the same place.136

Due to the scarcity of data and the difficulties in locating the medieval place names, the smaller fields, which cannot be marked in the map, can also call attention to certain characteristics of the fields on the outskirts. It should be stressed, nevertheless, that the sources nearly always tell about the lands of the nobility, and since many of them were donations to the Pauline monastery, they probably lay at the northern part of the outskirts, near the lands of the monastery.

Examining the landholding forms of the lands on the outskirts, the double feature of communal and private landholding forms can be observed in the case of the lands of the nobility. The terminology and the formal traits of the communal land regulation, as it was first described in Hungary by Károly Tagányi137 and as it has ever since been discussed in the literature, can be found at the description of the individual parts of the estates. The essence of the economy based on the periodical redistribution of the land, which partly originated from the pasturing economy called nomadic land community by Tagányi, was that the territory was divided into fields according to the quality of the soil, and, until the next distribution, the members of the village tilled each a parcel in the individual fields. In result, the small strips of land of the various owners were distributed side by side in the various fields following a certain pattern. This type of landholding can equally be associated with rotation and falling cultivation systems from the respect of the cultivation type. The existence of this form of landholding in Szakácsi is suggested by the fact that the individual arable lands were certainly arranged in fields. The sources mention fields (*diverticulum*) in the territory called Kilencdiófa (*in diverticulo novem arborum nucum*)138 and in a place called Halmas.139

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135 Since Szakácsi was the settlement of servicing population included in the royal land organisation, we have every reason to suppose that royal *hold*, which had developed in the royal estates, was used in the early period.
136 Nagreth (Nagyrét) belonged to Külsőszakácsi, while the modern Nagyrét can be found near the inner territory of Nagyszakácsi. 1451: MOL Dl. 14498, Bándi 1986, 42; Végh 1974, 314.
137 Tagányi 1950.
and the same is suggested by the names *Berekynezeel* (Berekynezeszele)\(^{140}\) and *Weresgevrgzele* (Veresgyörgyszéle).\(^{141}\) György Veres’s will from 1453 also hints at a certain arrangement of arable lands when he mentions an arable land that lies *in ordinato vaginatum vulgo zalogon* beside a place called *Papharaztya* (Papharasztja).\(^{142}\) Probably the traces of this structure can be detected in the regularities revealed in the adjacency of some lands of the nobility. György Kis Antal Iwanka of Külösöszakácsi’s son bought some 1–2 *iugerum* large arable lands from Mihály Tolvaj in 1451. At the description of the lands distributed in nine different areas, the neighbouring landholder is mentioned in four cases. The arable lands can be found beside Péter Bor’s land in the territories called *Zel* (Szél) and *KysErethwenhegh* (Kiserszétvényhegy), while at *Zekerhyd* (Szekerhérd), the buyer Antal’s son György himself is the neighbour.\(^{143}\) In György Veres’s above mentioned will from 1453 we can find an arable land that he had bought from Tamás Szabó’s daughter Klára, the neighbours of which were György Biró in the west and he himself in the east. He had certainly bought the vineyard in the *Hwyhegh* (Újhegy) also from Tamás Szabó’s daughter Klára. Here the eastern neighbour was György Biró, while he himself (*solumeth*) was the neighbour in the east.\(^{144}\)

It was not unusual in the Middle Ages that the lands of the nobility were inserted into the communal land structure. The appurtenant lands on the outskirts of the nobility living in the community of villeins did not usually differ from those of the villeins,\(^{145}\) although there are examples indicating that two strips of land were allotted to the manor of a nobleman.\(^{146}\) Land divisions and donations in the 14th–15th centuries often meant the division or donation of only the plots of the nobility, while the lands on the outskirts were left for communal use.\(^{147}\) Putting the lands of the nobility in Paty, Vas county, in 1334 on a map shows that the arable lands measuring 1–2 *iugerum* lay in distant parts of the outskirts of the village.\(^{148}\)

In the course of the periodic redistribution, the lands were distributed at different places, that is the size characterised the appurtenant land of a plot and not its place on the outskirts. In the case of Szakácsi, however, we can see that, on the one hand, the nobles could freely dispose of their lands, and, on the other, the arable lands of the nobility are described at fixed geographical spots, which supposes a permanent ownership. The phenomenon can have several explanations. It is possible that the nobility of Szakácsi used the system of free occupation,\(^{149}\) although the scattered character of the arable lands into strips of 1–2 *iugerum* and the fact that free occupation was characteristic of the early period when free land was abundant and when the nobility of Szakácsi stood close to villeins in a legal status make it improbable that the system could generally be sustained in the case of the lands of the nobility. The data rather suggest that the strips of the former division system became permanently owned holdings at the place of the last distribution. Since there are no data concerning the lands tilled by villeins, it cannot be decided if the appurtenant lands of the villeins’ plots and the lands of the nobility wedged between them got fixed at the same time in the given position or we can see the traces of the process when the distributed lands of the nobility kept their places, while legally they were slowly withdrawn from the communal lands of the village.\(^{150}\)

Beside the traces indicating integration in the former communal landholding system, some data suggest the existence of the permanent estates of the nobility. The frequency of place names containing personal names is conspicuous in the documents: *Petesiamuserdee*,\(^{151}\)


\(^{145}\) Maksay 1971, 209; Szabó 1969, 19.

\(^{146}\) Togányi 1950, 58.

\(^{147}\) Togányi 1950, 57; Maksay 1971, 210.

\(^{148}\) Maksay 1971, 211.

\(^{149}\) In free occupation system the members of the community distributed a chosen meadow on the outskirts and used it until the soil got exhausted. As the free territories diminished the lands slowly turned into parts of a distribution system or were transformed into permanent holdings. *Togányi 1950*, 24–25; *Szabó 1969*, 68.

\(^{150}\) We can find examples how the lands the nobility allotted in the distribution system became permanently owned holdings: 1575: Derzsa, 1620: Bodrogolászi *Togányi 1950*, 59.

The place names contain the personal names of the nobles known from the documents (János Petes, János Bodák, Péter Törpe, György Veres, Mihály Tolvaj, László Bakator’s son Benedek). These names with personal names imply that first of all the forests and also the cultivated lands were private properties. One of the reasons can be the above-mentioned landholding form of the appurtenant lands of the nobility as suggested by the place name Weresgeurgyezle (Verségörgyészél), which name hints at the arrangement of lands into fields and the presence of private property as well. At the same time, some sources interpret the suffix széle (zél) of certain place names as a field (diverticum), while in the case of Barkolchazele it was completed with the expression laneus. The use of laneus as a unit of arable land was observed by Mártá Belényesy in Pozsony, Szepes and Trenceş counties, especially in territories inhabited by German populations, where they indicated the permanent, privately owned appurtenant lands of tofts on the outskirts from the end of the 13th century. The laneus-type arable lands were private properties from the very start. The reason in the mentioned counties was that a long deforestation process had to precede the tilling of the land. Laneus as an appurtenant arable land could mean scattered arable land parts, and also lands around the toft. Regarding the origin of the land marked by the expression laneus in Szakácsi, it certainly cannot be identified with the arable lands created with clearing in the northern counties, although a similarity can be supposed from a legal respect and regarding their spatial consolidation. The place names containing personal names, at the same time, can also mean individually cleared lands, where the law of first occupation was valid, that is the person who first broke the soil, be it a villein or a noble, could use the land as his private property. It is possible that such a private occupation of a once uncultivated land hides behind the names Giwthusgeype and Bakathorgeep. In the latter one we can suppose the property of László Bakator’s son Benedek, who was compelled to pay 25 denar marks for the maiming of a monk’s hand in 1413, or a member of his family. This land was already mentioned as Demeter Hegedűs’s property in 1451, and not on the fringes of the outskirts.

At the same time, the data regarding the alienation and exchange of the lands of the nobility reveal the intention of the lesser nobility of Nagyszakácsi to have their lands close to one another and not scattered. The result of the process that Ferenc Maksay called early consolidation of the land was that the appurtenant lands of the nobility were distributed in twos and threes in a field. This is evidenced by the data that tell about persons who bought or exchanged lands in a given field. Antal Iwanka of Külöszsázkácsi’s son György bought half a iugerum (1/2 of an arable land) from Mihály Tolvaj in 1451, which lay in Külöszsázkácsi, toward Imre’s son Peter’s garden. In 1463, he purchased half a iugerum of arable land, which also lay toward Imre and Péter’s garden. Antal’s son György purchased half a iugerum of arable land in Kerekerdelegath (under the Kerekerdő) in 1444, then each 1 iugerum of arable land at the same place in 1451 and 1463. The same person bought one and a half iugerum of arable land at the Hatoserde (Hátaserdő) in 1455, and 3 iugerum of arable land between Hathaseged (Hátaserdő) and Megesharazth (Megyeharasz) in 1462 from Kozma of Nagyszakácsi’s sons Imre and Bálint. He also bought half a iugerum of arable land from the parish in 1454 at a place called Megeharazth beside the Hátaserdő, Gyep was the name of the uncultivated, wild territory in the Middle Ages: 1257: “...terra inculta que gep vocatur ...” Szűcs 1993, 182.

154 MOL Dl. 21187, Bándi 1986, 63, App. 1: 106.
158 MOL Dl. 17203, Bándi 1986, 52, App. 1: 76.
159 MOL Dl. 20347, Bándi 1986, 58.
160 The place Kylenchdogyezle mentioned in 1451 and 1463, was marked by the expression “in diverticulato novem arborum novem” in 1452.
161 Belényesy 1955, 72-76.
which lay next to his own lands. Another example of the intent to obtain a neighbouring land is when Benedek Kaczó of Szakácsi’s son Miklós gave twice 1 ingerum of arable land to the Pauline monastery in exchange for 2 ingerum of arable land beside his own land. In 1411, Mihály of Szakácsi’s son Balázs donated 1 ingerum of arable land to the Pauline monastery on the western side of his land, north and west of which János Poka’s lands lay. The results of the early consolidation of land is also manifested in the fact that Mihály Kigyó could give the Pauline monastery altogether 18 ingerum of arable land at a place called Cher (Cser) in exchange for the plot and the vineyard that his sister had bequeathed to the monastery, then in 1495 he donated yet 4.5 ingerum of arable land to the monastery together with Marton Vidi and Péter Orros’s widow at Felsewcher (Felsőcser). Lands similarly collected in a field could be seen in 1382, when the perambulate of bounds passed beside Poka’s son János’s sons’ lands, Egyed’s son János’s arable lands and Demeter Soldus’s arable lands. It is not only the consolidation intent of the lesser nobility that can be surmised in the background of lands occupying a larger territory, they can also be lands obtained by private occupation or they can be lands of free occupation, which often existed together with distributional communal landholding. The relevant data are from the fringes of the outskirts of the village. Mihály Kigyó, Egyed’s son János and Demeter Soldus had arable lands in Cserhát or near it, while Poka’s son János’s sons had lands in the north-eastern corner of the outskirts of the village. It frequently occurred in the Middle Ages that in the territories closer to the village the distribution system was applied, while at most distant parts lands occupied by private clearing and originally freely occupied lands can be found that later could be included in the distribution system or become permanent holdings.

The landholding forms of forests also show the coexistence of the private and communal forms in Szakácsi. In 1385, on the occasion of a vineyard donation to the Pauline monastery, the coppice of the village (virgultum communitatis) is mentioned beside György Bechy’s coppice. György Székely mentions this record as an example to the communal forests of farming communities. The coppice of the nobility of Szakácsi (virgultum ... remanent ipsis scilicet Nobiliumus de Szakácos) and forests marked as private properties, like Péto’s son János’s and Egyed’s son János’s forests were mentioned in the perambulate of bounds three years before. Communal forests, accordingly, did not afford an unconditional use of the forest for the entire community of the village. Later data, the alienation and donation of forest parts and the mentioning of forests bearing persons’ names support the theory that the former communal holding of the forests got disrupted, some remained under communal regulation, probably by the villeins, while others became incorporated in the estates of the nobility.

Regarding the landholding forms, the analysis of documents has demonstrated that the lands of the nobility of Szakácsi show characteristics both of the communal regulation of the lands and private holding. Although there are no data concerning the form the villeins owned their lands except for the existence of a communal forest, the mentioned double feature of the lands of the nobility suggests that the elements of the former servicing population that were gradually raised from the villein rank to the rank of the nobility acquired lands on the basis of the landholding rights of the nobility, then aspired to unite their parcels through separating, even territorially, their lands from the communal fields. Yet it seems there existed lands on the fringes of the outskirts that were cultivated according to the rules of the first occupation and/or arable lands that after some time became permanent estates of the nobility.

Some data refer to the cultivation technique. The expansion of arable lands, meadows and vineyards by clearing is indicated by the cultivated areas that can be found in territories marked by names referring to forests. An arable land and a vineyard could be found west

175 Tagányi 1950, 20–21, 26; Szabó 1969, 63.
176 Szabó 1969, 68.
178 Székely 1953, 93.
179 Fejér Cod. Dipl. IX/5, 617–621.
180 1444: MOL Dl. 13763, Bándi 1986, 42, App. 1: 13;
181 1451: MOL Dl. 14498, Bándi 1986, 42, App. 1: 17;
of the Kerekerdő within the boundary of Külsőszakácsi, while east of it, partly at Borsohely (Borsohely), further arable lands\textsuperscript{182} were situated. An arable land and a coppice\textsuperscript{183} are known at a place called Borsohely (Borsohely), a vineyard\textsuperscript{184} and a coppice\textsuperscript{185} at Zewlewiharazthya (Szőlőharaszt), a meadow and a forest\textsuperscript{186} at Niresalath (Nyiresalatt) and the documents mention arable lands at Haidoserdew (Hátaserdő)\textsuperscript{187}, Kyséretwemehg (Kiséresztvény hill)\textsuperscript{188}, Papharazthya (Papharazthya)\textsuperscript{189} and Chyppanharazthya (Csipánharaszt).\textsuperscript{190} The name of the Kylenchdyofaszéle (Kilencdiófaszéle) field in Külsőszakácsi, which is probably identical with the modern Diós-dűlő, also attests to an arable land cut out from a forest.\textsuperscript{191} Smaller arable lands\textsuperscript{192} were exchanged near a spring called Kwthfe (Kútffő) at Hasberky (Hárbserek) also in Külsőszakácsi, and the sources mention a forest, a meadow and an arable land at Hárbserek.\textsuperscript{193} East of it can be found the meadow called Nagghreth (Nagyrét),\textsuperscript{194} which is bordered by a forest in the east. The perambulates of bounds also inform us that the arable lands often alternated with thickets and coppices, which can indicate not only the regular land occupation with clearing but can refer to such a regulated rotation cultivation where the arable lands were sometimes abandoned, left to rest and the former pastures were cultivated instead. Examining the expressions terra fimata, terra arab dis, terra campestris appearing in the sources from the 14th century, Márta Belényesy has demonstrated the basic traits of the fallowing cultivation system.\textsuperscript{195} The essence of the cultivation based on the alternation of arable lands and pastures is that beside the cultivated lands, there were territories on the outskirts, usually next to them, that had been ploughed and left temporarily rest. These fallow lands were used for pasturing, or the forest recaptured them and became thickets or coppices. Such a functional relationship between the arable lands and the fallow lands is suggested by the fact that György Veres donated an arable land of ten-and-half-a-day’s ploughing together with the coppices beside it to the Pauline monastery in 1471.\textsuperscript{196} Regarding the regulation system of land usage, Belényesy indicated the lowlands of Somogy, Zala and Veszprém counties as a characteristic territory of the fallowing system combined with communal land usage.\textsuperscript{197} The above described communal landholding forms suggesting a former distribution system imply regulated land usage. The large number of coppices and thickets and their position between the arable lands suggest that in Szakácsi the fallowing cultivation system seems to have been more common than the fallowing system combined with communal land usage.\textsuperscript{197} The above described communal landholding forms suggesting a former distribution system imply regulated land usage. The large number of coppices and thickets and their position between the arable lands suggest that in Szakácsi the fallowing cultivation system seems to have been more common than the rotation system, which demanded the treatment of the land left to rest.\textsuperscript{198}

\textbf{The results of the archaeological field walkings}

The information the documents contain about the village of Szakácsi are scattered both in space and time. They describe the geographical position of the individual plots, arable lands, meadows and forests, or refer to landholding forms or cultivation types. The archaeological field walking made in the settlement reveals the structure and the hierarchy of the settlements inhabited during the Middle Ages with regard to the entire territory. The different nature of the two source groups afford us to raise questions, while the historical and archaeological data can complete one another owing to the interrelations between the answers.

The data of the field walkings can help in the interpretation of the data and the location of the information in the real landscape. The typical cases are, for example, the identification

\textsuperscript{182} MOL DL. 17203, Bándi 1986, 50, App. 1: 18.;
\textsuperscript{183} MOL DL. 15826, Bándi 1986, 50, App. 1: 18.;
\textsuperscript{184} MOL DL. 15611, Bándi 1986, 47, App. 1: 19;
\textsuperscript{185} MOL DL. 17203, Bándi 1986, 52, App. 1: 20;
\textsuperscript{186} MOL DL. 17203, Bándi 1986, 52, App. 1: 47;
\textsuperscript{187} MOL DL. 16445, Bándi 1986, 51, App. 1: 46;
\textsuperscript{188} MOL DL. 13763, Bándi 1986, 42, App. 1: 57;
\textsuperscript{189} MOL DL. 17224, Bándi 1986, 53, App. 1: 55;
\textsuperscript{190} MOL DL. 14913, Bándi 1986, 44, App. 1: 21;
\textsuperscript{191} MOL DL. 144498, Bándi 1986, 26, App. 1: 26;
\textsuperscript{192} MOL DL. 17462, Bándi 1986, 43, App. 1: 33;
\textsuperscript{193} MOL DL. 14498, Bándi 1986, 43, App. 1: 64;
\textsuperscript{194} MOL DL. 15826, Bándi 1986, 50, App. 1: 65;
\textsuperscript{195} MOL DL. 14498, Bándi 1986, 42, App. 1: 18.;
\textsuperscript{196} MOL DL. 14498, Bándi 1986, 42, App. 1: 18.;
\textsuperscript{197} MOL DL. 14498, Bándi 1986, 42, App. 1: 18.;
\textsuperscript{198} MOL DL. 17203, Bándi 1986, 52, App. 1: 20.
of the perished settlements mentioned in the documents with archaeological sites. At the same time, they offer an insight into the settlement system of territories that are not mentioned in the documents. The question is if the phenomena sketched from the data of the documents can be correlated with the results of the archaeological field walkings and what surplus information they can provide regarding the medieval settlement.

The field walking in the territory of the modern Nagyszakácsi resulted in 58 sites (P/15 sites, P-RP/1 site, P-RP-ÅE/1 site, P-RP-MA/4 sites, Rp/1 site, RP-ÅE/1 site, MP(Avar)/1 site, ÅE/4 sites, ÅE-MA/14 sites, MA/14 sites). Most of the sites contain finds from the Árpádian Era and/or the late Middle Ages, several medieval sites can be found in those parts of the village that are not mentioned in the documents.

Examining the distribution of the sites we find that the sites of the Árpádian Era and the Late Middle Ages cluster in three territories (fig. 12): west, south-west of the inner territory of the modern Nagyszakácsi, in the southern part of the Cserhát and in the territory and the environment of the former Külsősákácsi. The lack of sites was conspicuous in the north-western part of the outskirts, while the repeated field walkings located prehistoric sites in the north-eastern part of Szakácsi.

The largest sites of the Árpádian Era and/or the late Middle Ages (1, 3, 28, 29) covered the territories of the former Szakácsi, Nagyszakácsi and Külsősákácsi, while very small, separate sites dominated in the Cserhát and west of the inner territory.

The quantity and the quality of the collected find material rarely afford the determination of a finer chronology. We could only differentiate with certainty the finds from the Árpádian Era and the Late Middle Ages. Each of the four sites found in the Sámsoni-sűrű-dűlő near the Cserhát contains late medieval pottery. Sites nos 1–5 in the Dős-dűlő, Temetői-dűlő and Kis-gát-dűlő east of the village yielded mostly late medieval pottery and a few finds from the Árpádian Era. West, south-west of the inner territory of modern Nagyszakácsi the finds of the Árpádian Era were found mainly in the southerly territories, while the northern area contained first of all late medieval sherds, similarly to sites nos 28 and 29 indicating the former Szakácsi, Nagyszakácsi, where the sherds of the Árpádian Era clustered in the southerly territories.

Accordingly, the results of the field walkings show that three larger and several smaller settlement units clustered in certain areas of the outskirts existed in the Middle Ages. The two sites in the territory of the modern Nagyszakácsi are separated in space and time as well. The southern settlement unit is characterised by a find material from the Árpádian Era, while the northern one mostly contained late medieval finds. In the case of village reduplications, the individual settlement parts can be called by names based on popular parlance in different periods. The original name of the settlement is often completed by the prefix Nagy (Large), which, in the meaning “old” refers to its earlier foundation. So it cannot be excluded that the Nagyszakácsi mentioned in the documents is identical with site no. 28 in the south-western part of the modern village, while Szakácsi is identical with site no. 29 north of it.

The other large settlement unit east of the village is composed of sites nos 1 and 3, which can be identified with Külsősákácsi mentioned in the sources. Here the two sites are only separated by a stream, they certainly belong together. Finds from the Árpádian Era, however, could be found in site no. 1 and in the northern part of site no. 3, which indicates, on the one hand, that the settlement that appeared in the sources only in the 15th century or its antecedents were inhabited already in the Árpádian Era, and implies, at the same time, that the first settlers inhabited the northern part of the settlement. The observation made in the field and the data of the early maps reveal that the church dedicated to Saint John the Baptist stood on the northern side of the dirt road crossing the middle of site no. 3.

199 The archaeological field walking was carried out within the administrative borders of the modern Nagyszakácsi, which, of course, is not identical with the boundaries of the medieval village. Thus the results of the analysis can refer only to Szakácsi and its environment.


201 The exception is site no. 13, and even here only 3 sherds were collected from the Árpádian Era.

202 Szabó 1966, 123.
Several small sites could be documented along a ridge running in a north-south direction west of the modern village and the large sites that can be identified with the medieval Szakácsi. They are separated by find-free zones and most of them contained late medieval pottery. A similar site concentration can be observed in the western side of the settlement part known to date as Cserhát in the northern side of the village. They are distributed at a distance of 100–200 metres from one another along a ridge, and nearly all are very small, occupying a territory of 50–100 × 50–200 m. Very few, mostly uncharacteristic pottery could be collected in these spots. Their distribution and size are very similar to those of the small settlements of the Árpádian Era, which was noted by the research already in the 50's. In a larger number they were documented by the topographic works in Pest and Békés counties. In Nagyszakácsi, however, every site, except for site no 35, contained late medieval pottery, while no sherds were found from the Árpádian Era at most of the sites. Similar small sites with late medieval pottery were also found in Pest county. They are regarded to be the last representatives of the earlier scattered settlement structure or, after their geographical position, to be small manors, the dwellings of animal keepers. The field walkings carried out for the archaeological topography of Békés district also found late medieval farmstead-like settlements characterised by few sherds. Historical records and the fact that they were situated in the small islands of marshlands imply that they were temporary settlements used as refuges.

Regarding the south-eastern territory of the village, the sources do not provide information, while the place called Cser (modern Cserhát) is repeatedly mentioned. Although the sources do not refer to dwellings in the Cserhát, a record published by Dezső Csáni shows that smaller estates, used also as housing sites, could exist on the outskirts in the Middle Ages. The Eresztvény estate was mentioned in the territory of Szakácsi in 1479: "Possessio Erezthewen in territorio possessionis Nagzakachy." The estate is first met in Gede of Eresztvény's son Ferenc's name in 1428. Sometime in the middle of the century, Lőrinc Gede exchanged 2 arable lands with his brother-in-law György Veres at Horozelegeh, and a deed mentions Gede's sons' plots in 1467. On the occasion of a duress case in 1471 we learn that Pál Szegedi's armed men attacked the Kisszakácsi, Gede and Nagyszakácsi settlements (possessio) in Somogy county, and they set on fire the houses of Gede (dicti) Simon and Lőrinc in Gede. It means that the Gede family had a manor (possessio) at a place called Eresztvény at the beginning of the 15th century, and the fact that the place name was added to the name of the family indicates that the territory was a habitation site already at that time. They also had smaller lands in other parts of the outskirts of the village, and other members of the family (perhaps Ferenc Gede's sons) lived on smaller tofts in Szakácsi. Yet another interesting record refers to the feature of the Eresztvény manor. In 1498, the Pauline monastery and János Gondos had a lawsuit over Mihály Törpe's goods, who had died without inheritors and had bequeathed his property to the monks, since János Gondos, who was charged with the transfer, did not pass the property to the monks. The next year we learn that János Gondos had King Ulászló II grant the above-mentioned lands to him. At that time he was already mentioned as János Gondos of Gedeháza. We cannot tell if the property of the former Gede family was obtained by the Törpe family and this is how it got in János Gondos's possession (this is suggested by the adoption of the place name) or he himself had obtained it earlier. What is important for us is that the name of the former owner has been preserved in the name of the territory completed with the suffix háza.

204 MRT 9, 15; MRT 8, 31.  
205 MRT 9, 15.  
206 MRT 10, 27.  
207 Csáni 1909, 579.  
208 MOL Dl. 11981, Bándi 1986, 40.  
209 1463: MOL Dl. 15826, Bándi 1986, 49.  
210 1453: MOL Dl. 17462, Bándi 1986, 43.  
211 MOL Dl. 16514, Bándi 1986, 52.  
212 MOL Dl. 17268, Bándi 1986, 54.  
213 János Gondos got Péter Törpe's holdings in Szakácsi already earlier and also János Gondos and Gergely and Mihály Pálffy leased all the lands of the Pauline monastery in 1550. Consequently he had the intent and the possibility to obtain lands.
Hungarian historical and ethnographic research, which was launched with the analysis of the development of plots, regards the settlements hiding behind place names ending with *laka, háza, telke, ülése, földje* as a form of plots on the outskirts, farmstead-like settlements characteristic of the Árpádian Era. Their development is due partly to the dispersion caused by the natural population increase and the advance of cultivation technique and partly to the division of family estates. They got widespread in the 13th and the 13th-14th centuries. Most of the settlements with limited outskirts got depopulated in the course of the devastation process in the 14th century, and 80% of the place names ending in *laka, háza* and *telke* disappeared from the sources. The surviving settlement were often preserved as settlements of the lesser nobility, and the *terra*, which can be identified with the names ending in *földje* in the sources, appear as possessio on the outskirts of the villages from the last decades of the 13th century. According to István Szabó, the occupancy of the *terra-possessio* type settlements has not been proved, in our case, however, the documents imply that Eresztvény possessio indicated an inhabited settlement. Along with the generally observable devastation process of villages in the 14th century, the division of lands, which often led to the birth of small settlements on the outskirts of villages, was carried on until the 15th century in the villages of the lesser nobility that had been raised from the rank of castle serfdom. In consequence, the appearance of settlements bearing the suffix *háza* in their name was frequent on the outskirts of larger villages in these territories even in the 14th-15th centuries.

The feature of the small sites observed in Szakácsi and the data of the documents suggest that this is another phenomenon connected to the landholding system of the lesser nobility. In result of field walkings in the region of the ‘szeg’ villages in Göcsej, Róbert Müller delineated the characteristic settlement pattern of the local population that was raised to the rank of lesser nobility from the castle serfdom status. He observed usually small settlements, although some stretched to several hundred metres, near larger villages with churches, which were inherited from the Árpádian Era to the Turkish period. He found that the inhabitants of the settlements the names of which contain the expression *szer* or *szeg* and a personal name were members of the lesser nobility, who in order to keep their lands left the larger villages before the end of the Árpádian Era and moved to their lands on the outskirts. We do not intend to interpret the settlements of the Árpádian Era and the late Middle Ages found in similar positions in Szakácsi after the examples of the *szer* settlements, yet is seems possible that these sites are the results of a similar movement from Szakácsi to the lands on the outskirts of the families of the lesser nobility.

The comparison of the sketch made after the documents and the results of the field walking calls attention to yet another interesting coincidence. Despite the repeated field walkings, we did not find late medieval sites in the north-eastern part of the village. The data of the documents suggest that this territory was in the possession of the Pauline monastery, which explains the lack of sites (fig. 12).

We could use documents for the analysis of Szakácsi that tell about the land circulation of the lesser nobility who owed services to the king even in the 16th century, so we could get a glimpse into certain details of the outskirts of the village from data referring to a special social group. First we tried to locate the roads, streams and the place of the monastery mentioned in the sources to learn about the general structure of the lands, and to get spatial points for a later reconstruction. We could not at all use the modern place names in the identification of medieval fields, which caused difficulties. The followings can be told about the lands on the outskirts after the systematisation and analysis of the data of the documents about territories on the outskirts of the village and the areas that could not be located, the manuscript maps and the results of the archaeological field walkings. The 1-2 ingerum large scattered arable lands, sometimes arranged in fields, which are repeatedly mentioned in the sources, imply a distribution system of communal regulation. This form can be connected with the rotation of communal cultivation.

214 The summary of the research history see e.g. in: Laszlovszky 1986b.
216 Szabó 1969, 145.
217 Szabó 1969, 96-98; Ila 1976; Maksay 1940.
218 Müller 1971.
the fallowing cultivation type. At the same time, we could follow the process and the result of the process in the course of which the spatial organisation of the distribution system was slightly broken by the intent of the lesser nobility to gather their lands in a single unit. With regard to the spatial distribution of the lands gathered in larger units and the parcels arranged in fields, the sources indicate lands created with the unification of two or three parcels, permanent estates gained by clearing and smaller manors as well.

Summary

The sources about Szakácsi did not afford the preparation of a relatively exact reconstruction encompassing a large part of the settlement, although the characteristic features of the village structure could be sketched.

The data of the documents already intimated the segmentation of the inner territory, while the field walkings have demonstrated, on the one hand, that it was not an inner segmentation but, using István Szabó’s term, a real reduplication of the village, and located, on the other hand, the three settlement units. It is characteristic of the inner structure of all the three village parts that the plots were arranged in rows, the manors of the nobility were wedged between the plots of the villeins. No records refer to the size of the plots, but we know that there were gardens behind the houses. Both the documents and the maps and also the results of the field walkings suggest that beside the larger settlements with churches there were smaller settlements, inhabited manors on the outskirts. Probably Külsőszakácsi was such an estate of a noble family with a couple of buildings at the start. Later as the population increased, a church was built, and it became an independent settlement unit.

The observed reduplication of the village and the inhabited manors on the outskirts also raise the problem of the definition of the inner territory. Szakácsi, Nagyszakácsi and Külsőszakácsi are certainly villages regarding the number of the plots, the size of the sites and the existence of churches, either as independent settlements or as a polyfocal settlement. The inhabited places on the outskirts can also be accepted as independent small settlements (see the szer settlement structure), but regarding their origin, they were certainly the scattered elements of Szakácsi or Nagyszakácsi. The agreement reached in archaeological practice in the course of the field walkings says that usually 5 sherds are enough to indicate a site, that is a settlement. In historical research, these farmstead-like settlements, appearing in a similar form during field walkings, also appear in the description of scattered villages. The clarification of the problem goes beyond the frames of this study. We found it important to make this remark because our case provided a characteristic example to this terminological problem.

The methods that could be used at the examination of the lands and the results we could reach were strongly influenced by the possibilities offered by the source types. We could not deduce consequences concerning the entire settlement, the fragmentary data on the lands of the nobility carried information concerning certain characteristics of the lands of the village through the description of the lands of a special social group. We could differentiate two basically different landholding forms, which existed side by side in the village. One was the system of small parcels arranged in fields, which supposes a communal regulation, the other comprised private landed properties, which were often gathered in units. This double feature is excellently characterised by the position of the forests. Some of them were used by the community of the village, some were the estates of the lesser nobility. It seems evident that the observed double feature of the lands on the outskirts should be explained by the double feature of the legal status of the inhabitants of the village. Since nearly all the sources tell only about the lesser nobility layer of the village, the only thing we can tell with certainty is that some of the inhabitants of the village who had been raised to the rank of nobility used the possibilities offered by the landholding rights of the nobility and made efforts to have lands less scattered. Two forms could be differentiated among the lands of the lesser nobility gathered in units. Some were adjusted to the row of smaller arable lands within the field system and they

219 Róbert Müller observed that the building of a church meant the first step toward the development of an independent settlement in the case of the szer settlements as well. Müller 1971, 83.
probably followed the cultivation pattern of the village, while another part of the lands were also spatially differentiated from the lands of the village cultivated in a rotation system, houses were built on them and they functioned as the manors of the lesser nobility. The field surveys suggested that they clustered in two groups on the small ridge rising above the environment. The dwelling places were probably not all contemporary, so it is difficult to estimate how far they were from one another, although the territory they could use shows that a manor of this type must have been surrounded by a land of a couple of ingerum.

The other purpose of the study mentioned in the introduction was to determine the possibilities and limitations of the application of the sources and the methods. Here, naturally, we can only sum up the conclusions drawn from the analysis of Nagyszakácsí. It is evident that another settlement can raise other problems.

The possibilities are largely determined by the fact that we had the descriptions of spatially dispersed small lands both in the inner territory and on the outskirts from approximately one hundred years. What is more, the sources discussed only a special group of the inhabitants of the settlement: the royal cooks who had gradually emerged from the once uniform servicing people to the rank of manorial nobility, who, however, still owed service to the king. In this case the analysis of the records seemed indispensable in order to reveal the connections between the minor details so that the possible connections and the resulting conclusions could be found.

Owing to the nearly total lack of surviving place names, the medieval fields and the places mentioned in the sources could be put on a map only when the cross-references of the fragmentary data in the sources delineated a certain territory. The determination of the relative position of the lands on the outskirts, which always belonged to the lesser nobility, also seemed problematic since they were probably scattered among the parcels of the villeins, which are not mentioned in the sources. In some parts of the outskirts, the position of the estates of the nobility could be reconstructed yet due to the above difficulties of the identification of the fields, they could not be put on a map. Nevertheless, we had the documents of two perambulates of bounds that describe relatively coherent territories. The course of the perambulates of bounds can be followed in the earlier mentioned manuscript maps, or it could be put on a map with the help of medieval roads that survived as hollow roads, water courses and the identification of the single surviving place name (Cserhát). The other related data were marked in a sketch because of the above mentioned problems. Since there was no possibility to make a reconstruction of the larger part of the outskirts of the settlements, yet the records scattered in time offered a possibility to demonstrate certain tendencies, we intended to make conclusions regarding some characteristics from the distribution pattern and changes of the lands of the lesser nobility on the outskirts.

We think the case of Szakácsi is a good illustration of how the analysis of the documents and the data of archaeological field walkings can, in some cases, interpret and complete one another. The archaeological results concerning the inner territories made it certain that the segmented inner territory appearing in the sources was actually a real village reduplication. Archaeological finds marked the place, the extensions and the inner chronology of the medieval villages of Szakácsi, Nagyszakácsí and also Külsőszakácsí. The characteristics of the plot system could be deduced from the data of the documents and the manuscript maps. The distribution of the hamlet-like settlements on the outskirts, their location and age are known from archaeological data, the circumstances of their foundation and the social status of the inhabitants were implied by the data of the written documents. At the same time, we expected the location of the Pauline monastery from the archaeological field walkings, yet the characteristics of the surface formations and the probably strong disturbance of the building of the monastery proved the method of field walking insufficient. So in this respect we could only rely on the records, the data of the manuscript maps and the observations made by the inhabitants of the village.

Since the various groups of sources influence the results of the study to different degrees and in different ways, for the sake of getting positive results in similar analyses, a conscious choice must precede the analysis that examines the targeted settlement from various aspects and considers the type of the village as well.
ÁUO

Árpád-kori Új Ökmánytár = Codex Diplomaticus Arpadianus Continuatus. III. Pest, 1862.

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Fejér Cod. Dipl.


Gál 1992


Galánta – Vályi 1984


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Györffy 1956

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Kovalovszki 1965

Kristó 1988

Kristó 1995

Kubinyi 1986

Kubinyi 1995

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Lászlovázy 1986b

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Tagányi 1950

Taylor 1974

Valter 1974

Vályi 1986

Végh 1974

Wenzel 1887

ABBREVIATIONS

FÖMI
Földmérési és Távérzékelési Intézet (Institute of Ordinance Survey and Remote Sensation)

MOL.Dl.
Magyar Országos Levéltár, Diplomatikai Levéltár (Diplomatic Archives of the National Archives of Hungary)

OMF
Országos Műemléki Felügyelőség (National Inspectorate of Monuments)

SML
Somogy megyei Levéltár (Archives of Somogy county)
Appendix 1.
Database of documentary evidences referring to Szakácsi

SERIAL NUMBER 001
CULTIVATION arable land
QUANTITY 2 usu.
PLACE NAME Kylenchdyofaszéle
UNIFIED PLACE NAME Kilenediófaszéle
MODERN PLACE NAME 59 Diós, 66 Diósi forest
SOUTH Antal’s son Pál
PREVIOUS POSSESSOR Mihály Tolvaj
NEW POSSESSOR Antal Iwanka’s son György of Külsőszakácsi
DATE 1451
SETTLEMENT Külsőszakácsi
RELATIONS 001–003 (Kilencdiófaszéle)

SERIAL NUMBER 002
CULTIVATION arable land
QUANTITY 1 iugerum
PLACE NAME Kilencdiófa dülő
UNIFIED PLACE NAME Kilenediófaszéle
MODERN PLACE NAME 59 Diós, 66 Diósi forest
PREVIOUS POSSESSOR György Tolvaj’s son Mihály
NEW POSSSESSOR sons of Jakab Orros of Külsőszakácsi
FIELD-SYSTEM in diverticulo, field
DATE 1452
SETTLEMENT Külsőszakácsi
RELATIONS 001, 003–004 (Kilenediófaszéle)

SERIAL NUMBER 003
CULTIVATION arable land
QUANTITY 1 iugerum
PLACE NAME Kylenczfadyozeel
UNIFIED PLACE NAME Kilenediófaszéle
MODERN PLACE NAME 59 Diós, 66 Diósi forest
PRECISE POSITION on the east
NEW POSSESSOR György Veres, Orros Jakab, Miklós Orros
FIELD-SYSTEM field
DATE 1463
SETTLEMENT Külsőszakácsi
RELATIONS 001–002, 004 (Kilenediófaszéle)

SERIAL NUMBER 004
CULTIVATION arable land
QUANTITY 1 iugerum
PLACE NAME Kylenczfudyozeeel
UNIFIED PLACE NAME Kilenediófaszéle
MODERN PLACE NAME 59 Diós, 66 Diósi forest
PREVIOUS POSSESSOR will of György Veres
FIELD-SYSTEM secundum dimidium dietam vulgo zanthofeld
DATE 1453
SETTLEMENT Külsőszakácsi
RELATIONS 005–006, 008 (Kütfő)

SERIAL NUMBER 005
CULTIVATION arable land
QUANTITY 0,5
PLACE NAME Kuthfe
UNIFIED PLACE NAME Kütfő
PREVIOUS POSSESSOR will of György Veres
FIELD-SYSTEM secundum dimidium dietam vulgo zanthofeld
DATE 1453
SETTLEMENT Külsőszakácsi
RELATIONS 005–006, 008 (Kütfő)

SERIAL NUMBER 006
CULTIVATION arable land
QUANTITY 1,5 iugerum
PLACE NAME Kuthfe
UNIFIED PLACE NAME Kütfő
PREVIOUS POSSESSOR will of György Veres
FIELD-SYSTEM beside the east
DATE 1444
SETTLEMENT Külsőszakácsi
RELATIONS 005, 007–008 (Kütfő)

SERIAL NUMBER 007
CULTIVATION arable land
PLACE NAME Kuthfe
UNIFIED PLACE NAME Kütfő
PREVIOUS POSSESSOR widow of István Jank of Külsőszakácsi
NEW POSSESSOR Péter Szakácsi’s son Egyed
DATE 1444
SETTLEMENT Külsőszakácsi
RELATIONS 005–006, 008 (Kütfő)

SERIAL NUMBER 008
CULTIVATION arable land
PLACE NAME Kuthfealath
UNIFIED PLACE NAME Kütfő
PREVIOUS POSSESSOR widow of István Jank of Külsőszakácsi
NEW POSSESSOR Péter Szakácsi’s son Egyed
DATE 1444
SETTLEMENT Külsőszakácsi

220 The numbers are referring the serial numbers of place names in Nagyszakácsi in the volume Végh 1974.
RECONSTRUCTION OF THE SETTLEMENT STRUCTURE

RELATIONS 005–007 (Kútfő); 009–012, 121 (Hárshberk)

SERIAL NUMBER 009
CULTIVATION forest
PLACE NAME Hasberek
UNIFIED PLACE NAME Hársberek
MODERN PLACE NAME 73, 85, 86, 99 Berek
NEW POSSESSOR György Veres, Péter Orros, Miklós Orros
DATE 1463
SETTLEMENT Külsőszakácsi
RELATIONS 008, 010–012, 121 (Hárshberk)

SERIAL NUMBER 010
CULTIVATION meadow
QUANTITY 2 scythes (falcastrum)
PLACE NAME Hasberek
UNIFIED PLACE NAME Hársberek
MODERN PLACE NAME 73, 85, 86, 99 Berek
PRECISE POSITION beside
NEW POSSESSOR György Veres, Péter Orros, Miklós Orros
FIELD-SYSTEM grove
DATE 1463
RELATIONS 009, 011–012, 121 (Hárshberk)

SERIAL NUMBER 011
CULTIVATION arable land
QUANTITY 1 iugerum
PLACE NAME Hasalath
UNIFIED PLACE NAME Hársberek
MODERN PLACE NAME 99 Berek alatti
PREVIOUS POSSESSOR Mihály Kígyó nővére Klára
NEW POSSESSOR Antal Iwanka's son György
DATE 1463
SETTLEMENT Külsőszakácsi
RELATIONS 013–014, 016–018, 121 (Kerekerdő)

SERIAL NUMBER 012
CULTIVATION arable land
QUANTITY 0.5 iugerum
PLACE NAME Kerekerdealath
PREVIOUS POSSESSOR Borbála, widow of István Jank of Külsőszakácsi
NEW POSSESSOR Péter Szakácsi's son Egyed
DATE 1444
SETTLEMENT Külsőszakácsi
RELATIONS 014–018, 129 (Kerekerdő)

SERIAL NUMBER 014
CULTIVATION szőlő
QUANTITY 1
PLACE NAME Kerekerdew
UNIFIED PLACE NAME Kerekerdő
PRECISE POSITION beside
PREVIOUS POSSESSOR Mihály Kígyó nővére Klára
NEW POSSESSOR Pauline monastery
DATE 1428
SETTLEMENT Külsőszakácsi
RELATIONS 013,015–018,129 (Kerekerdő)

SERIAL NUMBER 015
CULTIVATION vine
QUANTITY 1
PLACE NAME Kerekerdew
UNIFIED PLACE NAME Kerekerdő
PREVIOUS POSSESSOR Mihály Kígyó
NEW POSSESSOR Pauline monastery
DATE 1428
SETTLEMENT Külsőszakácsi
RELATIONS 013–014, 016–018, 129 (Kerekerdő)

SERIAL NUMBER 016
CULTIVATION arable land
QUANTITY 1 iugerum
PLACE NAME Kerekerdew
PREVIOUS PLACE NAME Kerekerdő
NEW POSSESSOR Antal Iwanka’s son György and his daughters
DATE 1463
SETTLEMENT Külsőszakácsi
RELATIONS 013–015, 017–018, 129 (Kerekerdő)

SERIAL NUMBER 017
CULTIVATION arable land
QUANTITY 1 usu.
PLACE NAME Kerekerde
UNIFIED PLACE NAME Kerekerdő
PRECISE POSITION on the west
PREVIOUS POSSESSOR Mihály Tolvaj
NEW POSSESSOR Antal Iwanka's son György
DATE 1451
SETTLEMENT Külsőszakácsi
RELATIONS 013–016, 018, 129 (Kerekerdő)
404
CSILLA ZATYKÓ

SERIAL NUMBER 018
CULTIVATION arable land
QUANTITY 1 iugerum
PLACE NAME Kerekerdew
UNIFIED PLACE NAME Kerekerdő
PRECISE POSITION on the east, partly in Borsohely
EAST Borsohely
NEW POSSESSOR György Veres, Péter Orros, Miklós Orros
DATE 1463
SETTLEMENT Külsőszaakácsi
RELATIONS 013–017, 129 (Kerekerdő); 129 (Borsohely)

SERIAL NUMBER 019
CULTIVATION arable land
QUANTITY 5 iugerum
PLACE NAME Berekenyezele
UNIFIED PLACE NAME Berekenyeszéle
MODERN PLACE NAME 73 Berek, 99 Berek alatti
PRECISE POSITION towards east and west
NORTH arable lands of Péter Veres’s son György
SOUTH arable lands of György Iwanka Kis
PREVIOUS POSSESSOR Péter Kígyó
NEW POSSESSOR György Veres
DATE 1461
SETTLEMENT Szakácsi
RELATIONS 020 (Berekenyeszéle); 035, 060, 123–125 (György Veres)

SERIAL NUMBER 020
CULTIVATION arable land, coppice
QUANTITY 10,5 diéta
PLACE NAME Berekenyezeel
UNIFIED PLACE NAME Berekenyeszéle
MODERN PLACE NAME 73 Berok, 99 Berek alatti
PREVIOUS POSSESSOR György Veres
NEW POSSESSOR Pauline monastery
FIELD-SYSTEM diéta
DATE 1471
SETTLEMENT Nagyszaakácsi
RELATIONS 019 (Berekenyeszéle); 019 (György Veres)

SERIAL NUMBER 021
CULTIVATION arable land
QUANTITY 1,5 iugerum
PLACE NAME Hatoserdew
UNIFIED PLACE NAME Hátaerdő
PRECISE POSITION towards south and east
NORTH Péter (Gedő?)
SOUTH Péter (Gedő?)
EAST Magaskörötvény forest
PREVIOUS POSSESSOR Kozma’s son Imre of Nagyszaakácsi
NEW POSSESSOR Antal Iwanka’s son György of Külsőszaakácsi
FIELD-SYSTEM arable lands towards south and east
DATE 1455
SETTLEMENT Nagyszaakácsi
RELATIONS 022, 140 (Hátaerdő); 140 (Magaskörötvény); 023 (Péter Gedő?)

SERIAL NUMBER 022
CULTIVATION arable land
QUANTITY 3 iugerum
PLACE NAME Hathaserdew
UNIFIED PLACE NAME Hátaerdő
PRECISE POSITION beside
BESIDE Megyeharaszt
PREVIOUS POSSESSOR Kozma’s son Bálint of Nagyszaakácsi
NEW POSSESSOR Antal Iwanka’s son György of Külsőszaakácsi
FIELD-SYSTEM towards east and west
DATE 1462
SETTLEMENT Felsőszaakácsi
RELATIONS 021, 140 (Hátaerdő); 023, 024 (Megeharaszt); 111,112 (Megye);

SERIAL NUMBER 023
CULTIVATION arable land
QUANTITY 0,5 iugerum
PLACE NAME Megyeharaszt
UNIFIED PLACE NAME Megyeharaszt
NORTH Péter Gedő
SOUTH Antal’s son György
EAST road (via publica)
PREVIOUS POSSESSOR parish church
NEW POSSESSOR Antal Iwanka’s son György of Külsőszaakácsi
DATE 1454
SETTLEMENT Külsőszaakácsi
RELATIONS 022, 024 (Megyeharaszt); 111, 112 (Megye); 058 (Antal’s son György)

SERIAL NUMBER 024
CULTIVATION road
PLACE NAME via publica
UNIFIED PLACE NAME public road
WEST Megyeharaszt
DATE 1454
SETTLEMENT Külsőszaakácsi
RELATIONS 022–023 (Megyeharaszt); 111–112 (Megye); 091, 146 (road to Léta)

SERIAL NUMBER 025
CULTIVATION arable land
QUANTITY 1 usu.
PLACE NAME gyaloghwth
UNIFIED PLACE NAME foot path
BESIDE a foot path leads on it
PREVIOUS POSSESSOR Mihály Tolvaj

NEW POSSESSOR Antal Iwanka’s son György of Külsőszaakácsi
FIELD-SYSTEM arable lands towards south and east
DATE 1455
SETTLEMENT Nagyszaakácsi
RELATIONS 022, 140 (Hátaerdő); 140 (Magaskörötvény); 023 (Péter Gedő?)
RECONSTRUCTION OF THE SETTLEMENT STRUCTURE

NEW POSSESSOR György Iwanka of Külsőszakácsi
DATE 1451
SETTLEMENT Külsőszakácsi
RELATIONS 122 (foot path)

SERIAL NUMBER 026
CULTIVATION arable land
QUANTITY 0.5 usu.
PLACE NAME KysErlethwenhegh
UNIFIED PLACE NAME Kiseresztvényhegy
PRECISE POSITION on the south
BESIDE Péter Bor
PREVIOUS POSSESSOR Mihály Tolvaj
NEW POSSESSOR Antal Iwanka’s son György of Külsőszakácsi
DATE 1451
SETTLEMENT Külsőszakácsi
RELATIONS 044 (Péter Bor)

SERIAL NUMBER 027
CULTIVATION arable land
QUANTITY 1 dieta
PLACE NAME Halmosföld
UNIFIED PLACE NAME Halmos
EAST main road (via magna) to Mesztegnyő
PREVIOUS POSSESSOR György Veres
NEW POSSESSOR István of Nagyszakácsi’s son János
FIELD-SYSTEM dieta
DATE 1480
SETTLEMENT Nagyszakácsi
RELATIONS 028–029 (Halmos); 028, 151 (road to Mesztegnyő)

SERIAL NUMBER 028
CULTIVATION arable land
QUANTITY 1 dieta
PLACE NAME Halmos föld
UNIFIED PLACE NAME Halmos
PRECISE POSITION towards east and south
WEST György Vidi (sponsor of Ferenc Kakas)
BESIDE main road to Mesztegnyő
PREVIOUS POSSESSOR György Veres
NEW POSSESSOR István of Nagyszakácsi’s son János
FIELD-SYSTEM dieta
DATE 1480
SETTLEMENT Nagyszakácsi
RELATIONS 028–029 (Halmos); 028, 151 (road to Mesztegnyő)

SERIAL NUMBER 029
CULTIVATION arable land
PLACE NAME Halmos
UNIFIED PLACE NAME Halmos
PREVIOUS POSSESSOR Will of György Veres
FIELD-SYSTEM in three fields
DATE 1453
SETTLEMENT Szakácsi
RELATIONS 027, 028 (Halmos)

SERIAL NUMBER 030
CULTIVATION vine
PLACE NAME Mesztegnyőhegy
UNIFIED PLACE NAME Mesztegnyőhegy
MODERN PLACE NAME Mesztegnyő
PREVIOUS POSSESSOR will of cook Péter Szakácsi
NEW POSSESSOR cook Péter Szakácsi’s sister Anna
DATE 1503

SERIAL NUMBER 031
CULTIVATION coppice
QUANTITY 1 piece
PLACE NAME Zenegethewharazthya
UNIFIED PLACE NAME Szénégetőharaszt
WEST vine of Gál Kaczo, Paperdő
EAST Paperdő, (Papharaszt)
PREVIOUS POSSESSOR István of Nagyszakácsi’s son János
NEW POSSESSOR György Veres
DATE 1480
SETTLEMENT Nagyszakácsi
RELATIONS 032–036 (Papharaszt)

SERIAL NUMBER 032
CULTIVATION arable land
QUANTITY 1,5 iugerum
PLACE NAME Banchazafew
UNIFIED PLACE NAME Bancházafő
BESIDE between arable lands of János’s son Péter and Paperdő (Papharaszt)
PREVIOUS POSSESSOR Demeter Soldos’s daughter Zsuzsanna
NEW POSSESSOR János Szakácsi’s son Péter
DATE 1429
RELATIONS 031, 033–036 (Papharaszt); 110, 111 (János’s son Péter)

SERIAL NUMBER 033
CULTIVATION arable land
QUANTITY 0,5
PLACE NAME Papharazthya
UNIFIED PLACE NAME Papharaszt
PRECISE POSITION beside on the east
PREVIOUS POSSESSOR Demeter Soldos’s daughter Zsuzsanna
NEW POSSESSOR János Szakácsi’s son Péter
DATE 1453
SETTLEMENT Szakácsi
RELATIONS 031, 032, 034–036 (Papharaszt)

SERIAL NUMBER 034
CULTIVATION arable land
QUANTITY 0,5
PLACE NAME Papharazthya
UNIFIED PLACE NAME Papharaszt
PRECISE POSITION beside, towards Gadány
SERIAL NUMBER 035
CULTIVATION arable land
QUANTITY 1 funiculus
PLACE NAME Papharazthya
UNIFIED PLACE NAME Papharaszt
PRECISE POSITION beside, in ordinato
WEST György Veres
EAST György Bíró
PREVIOUS POSSESSOR Will of György Veres
FIELD-SYSTEM in ordinato vaginatum vulgo zalagon
DATE 1453
SETTLEMENT Szakácsi
RELATIONS 031–033, 035, 036 (Papharaszt); 084–086 (Gadány)

SERIAL NUMBER 036
CULTIVATION arable land
QUANTITY 0.5
PLACE NAME Papharastya
UNIFIED PLACE NAME Papharaszt
PREVIOUS POSSESSOR Will of György Veres
DATE 1453
SETTLEMENT Szakácsi
RELATIONS 031–034, 036 (Papharaszt); 019, 060, 123–125 (György Veres); 060 (György Bíró)

SERIAL NUMBER 037
CULTIVATION arable land
QUANTITY 2 iugerum
PLACE NAME ditch
UNIFIED PLACE NAME ditch
PRECISE POSITION on the place where the millrace is being built
BESIDE place of mill on the land of János’s son Egyed
PREVIOUS POSSESSOR János’s son Egyed, Miklós Szakácsi’s son János, Mihály’s son Balázs
NEW POSSESSOR Pauline monastery
DATE 1453
SETTLEMENT Szakácsi
RELATIONS 037, 136 (Horohalja); 107 (Horohszéle); 037, 039, 080, 082, 130 (mills)

SERIAL NUMBER 038
CULTIVATION arable land
QUANTITY 4 iugerum
NORTH arable land of János Soldus
WEST Demeter’s son
SOUTH arable land of Egyed’s son János
EAST road

SERIAL NUMBER 039
CULTIVATION arable land
QUANTITY 1 iugerum
PLACE NAME Horohalya river
UNIFIED PLACE NAME Horohalja
PRECISE POSITION on the place where the millrace is being built
BESIDE 2 iugerum arable land
DATE 1402
SETTLEMENT Szakácsi
RELATIONS 047, 078, 126 (ditch); 037, 040, 080, 082, 130 (mills); 097, 117 (Miklós Kaczo)

SERIAL NUMBER 040
CULTIVATION mill
PLACE NAME Horohalya river
UNIFIED PLACE NAME Horohalja
PRECISE POSITION on the place of the prospective millrace
BESIDE 2 iugerum arable land
DATE 1402
SETTLEMENT Szakácsi
RELATIONS 037, 136 (Horohalja); 107 (Horohszéle); 037, 039, 080, 082, 130 (mills)

SERIAL NUMBER 041
CULTIVATION arable land
QUANTITY 1
PLACE NAME Horhas, Zeel, Vizmosaszel
UNIFIED PLACE NAME Szél
PREVIOUS POSSESSOR Will of György Veres
NEW POSSESSOR György Veres, Péter Orros, Miklós Orros
DATE 1453
SETTLEMENT Szakácsi
RELATIONS 042–044 (Szél); 045 (Folyőszéle)

SERIAL NUMBER 042
CULTIVATION arable land
QUANTITY 1 iugerum
PLACE NAME Zel
UNIFIED PLACE NAME Szél
PRECISE POSITION on the west
DATE 1463
SETTLEMENT Külsőszakácsi
RELATIONS 041, 043, 044 (Szél); 045 (Folyőszéle)
RECONSTRUCTION OF THE SETTLEMENT STRUCTURE

SERIAL NUMBER 043
CULTIVATION arable land
QUANTITY 1 iugerum
PLACE NAME Zel
UNIFIED PLACE NAME Szél
PRECISE POSITION on the east
NEW POSSESSOR Antal Iwanka's son György of Külsőszakácsí
DATE 1463
SETTLEMENT Külsőszakácsí
RELATIONS 041, 042, 044 (Szél); 045 (Folyószéle)

SERIAL NUMBER 044
CULTIVATION arable land
QUANTITY 2 usu.
PLACE NAME Zel
UNIFIED PLACE NAME Szél
NORTH Péter Bor
PREVIOUS POSSESSOR Mihály Tolvaj
NEW POSSESSOR Antal Iwanka's son György of Külsőszakácsí
DATE 1451
SETTLEMENT Külsőszakácsí
RELATIONS 041-043 (Szél), 045 (Folyószéle); 026 (Péter Bor)

SERIAL NUMBER 045
CULTIVATION arable land
PLACE NAME Fölosczele
UNIFIED PLACE NAME Folyószéle
BESIDE Gergely Gondos
PREVIOUS POSSESSOR will of Péter Szakácsi the cook
DATE 1503
RELATIONS 041-044 (Szél); 120 (Vidi Gondos)

SERIAL NUMBER 046
CULTIVATION coppice
QUANTITY piece
PLACE NAME Zewlewharazth
UNIFIED PLACE NAME Szőlőharaszt
NORTH vine of the monastery
WEST river
SOUTH public road to the forest
EAST priest's road, public road to the forest
PREVIOUS POSSESSOR György Veres
NEW POSSESSOR Pauline monastery
DATE 1466
SETTLEMENT Nagyszakácsí
RELATIONS 047, 123–125, 143 (Szőlőharaszt); 087, 089 (vine of the monastery); 124, 125 (road); stream-1382?

SERIAL NUMBER 047
CULTIVATION vine, coppice
QUANTITY 1.5
PLACE NAME Zelcharazthya

SERIAL NUMBER 048
CULTIVATION arable land
QUANTITY 2 iugerum
PLACE NAME Cher
UNIFIED PLACE NAME Cser
MODERN PLACE NAME 47 Cserhát
PRECISE POSITION between arable lands of the Pauline monastery
BESIDE near the monastery
PREVIOUS POSSESSOR Mihály Kígyó
NEW POSSESSOR Pauline monastery
DATE 1428
RELATIONS 049-054 (Cser); 049-051, 054, 104–105 (arable lands of Pauline monastery); 052, 104 (near the monastery)

SERIAL NUMBER 049
CULTIVATION arable land
QUANTITY 1,5 iugerum
PLACE NAME Nagcheer
UNIFIED PLACE NAME Cser
MODERN PLACE NAME 47 Cserhát
PRECISE POSITION between arable lands of the Pauline monastery
BESIDE Bodakhonianoserdeje, Echterpeperederdeje
PREVIOUS POSSESSOR Máté the pauline prior
NEW POSSESSOR Antal the officer of Saint Benedict altar
DATE 1500
RELATIONS 048, 050-054 (Cser); 048, 050-051, 054, 104–105 (arable lands of the Pauline monastery); 118 (arable land of János Bodak); 047 (land of Péter Therpe); 061 (Saint Benedict altar)

SERIAL NUMBER 050
CULTIVATION arable land
QUANTITY 12 iugerum
PLACE NAME Cher
UNIFIED PLACE NAME Cser
MODERN PLACE NAME 47 Cserhát
PRECISE POSITION between arable lands of the Pauline monastery, towards east and west
BESIDE land of Mihály Vas's son
PREVIOUS POSSESSOR Mihály Kígyó
NEW POSSESSOR Pauline monastery
DATE 1428
RELATIONS 048, 049, 051, 054 (Cser); 048, 049, 051, 054, 104, 105 (arable lands of the Pauline monastery) 057 (Jakab Vas)

SERIAL NUMBER 051
CULTIVATION arable land
QUANTITY 2 iugerum
PLACE NAME Cher
UNIFIED PLACE NAME Cser
MODERN PLACE NAME 47 Cserhát
PRECISE POSITION between arable lands of the Pauline monastery, towards east and west
FIELD-SYSTEM sowed by pauline monks
PREVIOUS POSSESSOR Mihály Kígyó
NEW POSSESSOR Pauline monastery
DATE 1428
RELATIONS 048–050, 052–054 (Cser); 048–050, 054, 104, 105 (arable lands of the Pauline monastery)

SERIAL NUMBER 052
CULTIVATION arable land
QUANTITY 4 iugerum
PLACE NAME Cher
UNIFIED PLACE NAME Cser
MODERN PLACE NAME 47 Cserhát
BESIDE near the monastery
PREVIOUS POSSESSOR Mihály Kígyó
NEW POSSESSOR Pauline monastery
DATE 1428
RELATIONS 048–051, 053, 054 (Cser); 048–104, 105 (arable lands of the Pauline monastery)

SERIAL NUMBER 053
CULTIVATION meadow
QUANTITY 2 scythes (falcastrum)
PLACE NAME Cher meadow
UNIFIED PLACE NAME Cser
MODERN PLACE NAME 47 Cserhát
DATE 1428
RELATIONS 048–051, 053, 054 (Cser); 048, 104 (monastery)

SERIAL NUMBER 054
CULTIVATION arable land
QUANTITY 4.5 iugerum
PLACE NAME Felsewcher
UNIFIED PLACE NAME Cser
MODERN PLACE NAME 47 Cserhát
NORTH arable lands of the Pauline monastery
SOUTH arable lands of the Pauline monastery
PREVIOUS POSSESSOR Mihály Kígyó, Márton Vidi, Péter Orros’s widow
NEW POSSESSOR Pauline monastery
DATE 1495
SETTLEMENT Szakácsi
RELATIONS 048–053 (Cser); 048–051, 104, 105 (arable lands of the Pauline monastery)

SERIAL NUMBER 055
CULTIVATION meadow
PLACE NAME Nyresálya reeth
UNIFIED PLACE NAME Nyires
MODERN PLACE NAME 72 Nyíresi
NORTH meadow of Bálint Tolvaj’s sons
SOUTH meadow of Bálint Tolvaj’s sons
PREVIOUS POSSESSOR Egyed Fekete of Különszakácsi
NEW POSSESSOR György Veres
DATE 1471
SETTLEMENT Különszakácsi
RELATIONS 056, 057 (Nyíres)

SERIAL NUMBER 056
CULTIVATION arable land
QUANTITY 1 iugerum
PLACE NAME Nyrus
UNIFIED PLACE NAME Nyires
MODERN PLACE NAME 72 Nyíresi
PREVIOUS POSSESSOR György Tolvaj’s son Mihály
NEW POSSESSOR Jakab Orros’s sons
DATE 1452
RELATIONS 055, 057 (Nyíres)

SERIAL NUMBER 057
CULTIVATION meadow, forest
PLACE NAME Nyrkus
UNIFIED PLACE NAME Nyires
MODERN PLACE NAME 72 Nyíresi
SOUTH László (?Vas)
EAST Jakab Vas
PREVIOUS POSSESSOR György Tolvaj’s son Mihály
NEW POSSESSOR Jakab Orros’s sons
DATE 1452
RELATIONS 055, 056 (Nyíres)

SERIAL NUMBER 058
CULTIVATION arable land
QUANTITY 0,5 iugerum
PLACE NAME Zekerhyd
UNIFIED PLACE NAME Szekérhid
WEST Antal’s son György
PREVIOUS POSSESSOR Mihály Tolvaj
NEW POSSESSOR Antal Ilvanka’s son György of Különszakácsi
DATE 1451
SETTLEMENT Különszakácsi
RELATIONS 059 (Szekérhid); 023 (Antal’s son György)

SERIAL NUMBER 059
CULTIVATION arable land
QUANTITY 0,5 iugerum
PLACE NAME Zekerhyd
UNIFIED PLACE NAME Szekérhid
NEW POSSESSOR Antal Iwanka’s son György of Külsőszakácsi
DATE 1463
SETTLEMENT Külsőszakácsi
RELATIONS 058 (Szekérhíd)

SERIAL NUMBER 060
CULTIVATION vine
QUANTITY piece
PLACE NAME Hwuyegeh
UNIFIED PLACE NAME Újhgey
W EST György Veres
EAST György Biro
NEW POSSESSOR György Veres
DATE 1453
SETTLEMENT Szakácsi
RELATIONS 061 (Újhhegy); 019, 035, 123-125 (György Veres); 035 (György Biro)

SERIAL NUMBER 061
CULTIVATION arable land
QUANTITY 1,5 iugerum
PLACE NAME Vyheggh
UNIFIED PLACE NAME Újhegy
PRECISE POSITION towards east and west
NORTH vine of Saint Benedict altar
PREVIOUS POSSESSOR Máté the pauline prior
NEW POSSESSOR Antal the officer of the Saint Benedict altar
DATE 1500
RELATIONS 060 (Újhgey); 049 (Saint Benedict altar)

SERIAL NUMBER 062
CULTIVATION arable land
QUANTITY 1 iugerum
PLACE NAME Thwyssessark
UNIFIED PLACE NAME Tóvisessark
MODERN PLACE NAME 74 Tövisessark
NEW POSSESSOR György Veres, Péter Orros, Miklós Orros
DATE 1463
RELATIONS 061 (Újhgey); 049 (Saint Benedict altar)

SERIAL NUMBER 063
CULTIVATION arable land
QUANTITY 3 iugerum
PLACE NAME Rokethas
UNIFIED PLACE NAME Rokétás
BESIDE border of Szécsény
NEW POSSESSOR György Veres
DATE 1471
SETTLEMENT Nagyszakácsi

SERIAL NUMBER 064
CULTIVATION arable land
QUANTITY 1 usu.
PLACE NAME Chypanharazthlya

UNIFIED PLACE NAME Cspánharaszt
PRECISE POSITION beside, on the east
PREVIOUS POSSESSOR Mihály Tolvaj
NEW POSSESSOR Antal Iwanka’s son György of Külsőszakácsi
DATE 1451
SETTLEMENT Külsőszakácsi
RELATIONS 065 (Cspánharaszt)

SERIAL NUMBER 065
CULTIVATION arable land
QUANTITY 0,5 iugerum
PLACE NAME Chypanharazthlya
UNIFIED PLACE NAME Cspánharaszt
PRECISE POSITION beside, on the east
NEW POSSESSOR Antal Iwanka’s son György of Külsőszakácsi
DATE 1463
SETTLEMENT Külsőszakácsi
RELATIONS 064 (Cspánharaszt)

SERIAL NUMBER 066
CULTIVATION arable land
QUANTITY 10 iugerum
NORTH forest of the Parish Church of All Saints
PREVIOUS POSSESSOR Péter Szakácsi’s son Benedek
NEW POSSESSOR Tamás Szakácsi’s son Jakab and György
FIELD-SYSTEM with its all appurtenances and use
DATE 1375
RELATIONS 067, 068, 144 (forest of the parish church)

SERIAL NUMBER 067
CULTIVATION arable land
QUANTITY 1 iugerum
NORTH coppice between the forest of the Pauline monastery and the forest of the parish church
PREVIOUS POSSESSOR László Bakator’s son Benedek
NEW POSSESSOR Pauline monastery
DATE 1414
SETTLEMENT Szakácsi
RELATIONS 066, 068, 144 (forest of the parish church); 068, 087, 089, 111, 112, 149 (coppice); 089 (Bakator)

SERIAL NUMBER 068
CULTIVATION coppice
PRECISE POSITION between the forest of the Pauline monastery and the forest of the parish church
SOUTH 1 iugerum arable land (B. Bakator - Pauline monastery)
PREVIOUS POSSESSOR László Bakator’s son Benedek
NEW POSSESSOR Pauline monastery
DATE 1414
SETTLEMENT Szakácsi
RELATIONS 066, 067, 144 (forest of the parish church); 067, 087–089, 111, 112, 149 (copice); 089 (Bakator)
SERIAL NUMBER 069
CULTIVATION meadow
PLACE NAME Chakan
UNIFIED PLACE NAME Csakan
BESIDE Csolyanustó
PREVIOUS POSSESSOR Will of György Veres
DATE 1453
SETTLEMENT Külsőszakácsi
RELATIONS 070 (Csolyanustó)

SERIAL NUMBER 070
CULTIVATION lake
PLACE NAME Cholyanustho
UNIFIED PLACE NAME Csolyanustó
BESIDE in Csakan
PREVIOUS POSSESSOR Will of György Veres
DATE 1453
SETTLEMENT Külsőszakácsi
RELATIONS 069 (Csakan); 071, 073, 085 (lake)

SERIAL NUMBER 071
CULTIVATION lake
PLACE NAME fish pond in Chohosreth
UNIFIED PLACE NAME Csolyanustó
BESIDE in Csakan
PREVIOUS POSSESSOR Will of György Veres
NEW POSSESSOR Pauline monastery
DATE 1471
SETTLEMENT Nagyszakácsi
RELATIONS 070, 073, 085 (lake)

SERIAL NUMBER 072
CULTIVATION arable land
QUANTITY 2
PLACE NAME Vezejto
UNIFIED PLACE NAME Vezejtó
PREVIOUS POSSESSOR Will of György Veres
DATE 1453
SETTLEMENT Szakácsi
RELATIONS 073 (Vezejtó)

SERIAL NUMBER 073
CULTIVATION lake
PLACE NAME Vezejto
UNIFIED PLACE NAME Vezejtó
PREVIOUS POSSESSOR Will of György Veres
DATE 1453
SETTLEMENT Szakácsi
RELATIONS 072 (Vezejtó); 070, 071, 085 (lake)

SERIAL NUMBER 074
CULTIVATION meadow
EAST spring
PREVIOUS POSSESSOR Mihály Hagyó of Monyorókerék (exchange)
NEW POSSESSOR Pauline monastery
DATE 1460
RELATIONS 006, 075 (spring)

SERIAL NUMBER 075
CULTIVATION spring
WEST meadow of Mihály Hagyó of Monyorókerék
DATE 1460
RELATIONS 006, 074 (spring)

SERIAL NUMBER 076
CULTIVATION meadow
QUANTITY 2 scythes (falcastrum)
PLACE NAME Tolvaj valley
UNIFIED PLACE NAME Tolovaj valley
PREVIOUS POSSESSOR György Veres
NEW POSSESSOR Pauline monastery
DATE 1471
SETTLEMENT Nagyszakácsi
RELATIONS 055 (Tolvaj meadow)

SERIAL NUMBER 077
CULTIVATION meadow
PLACE NAME Zenrethe
UNIFIED PLACE NAME Szénrét
PREVIOUS POSSESSOR Mihály Kigyó, Márton Vidi, Péter Orros's widow
NEW POSSESSOR Pauline monastery
DATE 1495
SETTLEMENT Szakácsi

SERIAL NUMBER 078
CULTIVATION arable land
QUANTITY piece
PLACE NAME Seregélyfogo forest
UNIFIED PLACE NAME Seregélyfogó
PRECISE POSITION piece of land measuring the width of a cart
BESIDE along the drain to the mill of the Pauline monastery
PREVIOUS POSSESSOR Bálint Kozma's son Péter of Nagyszakácsi
NEW POSSESSOR Pauline monastery
FIELD-SYSTEM piece of land measuring the width of a cart
DATE 1463
RELATIONS 039, 047, 126 (ditch or drain)

SERIAL NUMBER 079
CULTIVATION meadow
BESIDE mill of Mihály Szabó
PREVIOUS POSSESSOR will of Péter Szakácsi
the cook

PREVIOUS POSSESSOR Will of György Veres
DATE 1453
SETTLEMENT Szakácsi
RELATIONS 073 (Vezeytó); 070, 071, 085 (lake)
DATE 1503
RELATIONS 080 (mill of Mihály Szabó)
037, 039, 040, 082, 130 (mills)

SERIAL NUMBER 080
CULTIVATION mill
PLACE NAME mill of Mihály Szabó
UNIFIED PLACE NAME mill of Mihály Szabó
BESIDE meadow of Péter Szakácsi the cook
PREVIOUS POSSESSOR Mihály Szabó
DATE 1503
RELATIONS 079 (mill of Mihály Szabó); 037, 039, 040, 082, 130 (mills)

SERIAL NUMBER 081
CULTIVATION meadow
SOUTH mill of Mihály Hagyó of Monyorókerék
NEW POSSESSOR Mihály Hagyó of Monyorókerék
PREVIOUS POSSESSOR Pauline monastery
DATE 1460
RELATIONS 082 (mill of Mihály Hagyó)

SERIAL NUMBER 082
CULTIVATION mill
PLACE NAME Mihály Hagyó of Monyorókerék
UNIFIED PLACE NAME Mihály Hagyó of Monyorókerék
BESIDE meadow of the Pauline monastery
PREVIOUS POSSESSOR Mihály Hagyó of Monyorókerék
DATE 1460
RELATIONS 081 (mill of Mihály Hagyó); 037, 039, 040, 080, 130 (mills)

SERIAL NUMBER 083
CULTIVATION meadow
BESIDE below of the mill of Gergely Szakácsi’s son Miklós
PREVIOUS POSSESSOR Gergely Kelenizi’s wife Zsuzsanna
NEW POSSESSOR János Szakácsi’s son Péter
DATE 1431
SETTLEMENT Szakácsi
RELATIONS 130 (mill of Gergely Szakácsi’s son Miklós)

SERIAL NUMBER 084
CULTIVATION arable land
QUANTITY 3 iugerum
PLACE NAME Kerektő
UNIFIED PLACE NAME Kerektő
PRECISE POSITION beside
BESIDE main road to Gadány
PREVIOUS POSSESSOR György Veres
NEW POSSESSOR Pauline monastery
DATE 1471
SETTLEMENT Nagyszakácsi

RELATIONS 085 (Kerektő); 085, 086, 151 (road to Gadány-Mesztegnyő)
SERIAL NUMBER 085
CULTIVATION lake
PLACE NAME Kerektő
UNIFIED PLACE NAME Kerektő
BESIDE road to Gadány
DATE 1471
SETTLEMENT Nagyszakácsi
RELATIONS 084 (Kerektő); 084, 086, 151 (road to Gadány-Mesztegnyő)
SERIAL NUMBER 086
CULTIVATION road
PLACE NAME main road (via magna) to Gadány
UNIFIED PLACE NAME main road (via magna) to Gadány
MODERN PLACE NAME road to Gadány
BESIDE Kerektő
DATE 1471
SETTLEMENT Nagyszakácsi
RELATIONS 084, 085 (Kerektő); 084, 085, 151 (road to Gadány-Mesztegnyő)

SERIAL NUMBER 087
CULTIVATION coppice
NORTH via magna
SOUTH road to the vine of the Pauline monastery
PREVIOUS POSSESSOR János Szakácsi’s son Egyed
NEW POSSESSOR Pauline monastery
DATE 1411
RELATIONS 090, 091, 146, 150 (via magna)

SERIAL NUMBER 088
CULTIVATION road
PLACE NAME via magna
UNIFIED PLACE NAME main road
SOUTH coppice, (vine of János Szakácsi’s son Egyed)
PREVIOUS POSSESSOR János Szakácsi’s son Egyed
NEW POSSESSOR Pauline monastery
DATE 1411
RELATIONS 087, 090, 091, 146, 150 (via magna)

SERIAL NUMBER 089
CULTIVATION road
PLACE NAME road to the vine of the Pauline monastery
UNIFIED PLACE NAME road to the vine of the Pauline monastery
NORTH coppice and arable land of János’s son Egyed
SOUTH Bakator
DATE 1411
RELATIONS 087 (road to the vine of the Pauline monastery); 046 (vine of the Pauline monastery)
monastery); 037, 088, 092 (János’s son Egyed); 067, 068 (Bakator)

SERIAL NUMBER 090
CULTIVATION vine
PLACE NAME Alexandorbyky
UNIFIED PLACE NAME Alexandorbyky
NORTH trunk of an oak-tree
WEST coppice of György Bechy
SOUTH road to Léta
EAST coppice of the village
PREVIOUS POSSESSOR Keres of Nagyszakácsi’s sons Bekes and Mihály
NEW POSSESSOR Pauline monastery
DATE 1385
SETTLEMENT Nagyszakácsi
RELATIONS 146 (coppice of nobles); 087, 088, 091, 146, 150 (road to Léta)

SERIAL NUMBER 091
CULTIVATION road
PLACE NAME road to Léta
UNIFIED PLACE NAME road to Léta
NORTH vine of Keres of Nagyszakácsi
DATE 1385
SETTLEMENT Nagyszakácsi
RELATIONS 087, 088, 090, 146, 150 (road to Léta); 090 (Keres)

SERIAL NUMBER 092
CULTIVATION arable land
QUANTITY 1 iugerum
NORTH arable land of Kereztus’s son Kozma
WEST road to the monastery
SOUTH arable land of Kereztus’s son Kozma
EAST arable land of János of Szakácsi’s son Egyed
PREVIOUS POSSESSOR Mihály Szakácsi’s son Balázs
NEW POSSESSOR Pauline monastery
DATE 1411
RELATIONS 021, 022, 078 (Kozma); 093, 147, 148 (road); 037, 088, 089 (János’s son Egyed)

SERIAL NUMBER 093
CULTIVATION road
PLACE NAME road to the monastery
UNIFIED PLACE NAME road to the monastery
PRECISE POSITION towards the north and the south
EAST arable land of Mihály Szakácsi’s son Balázs
DATE 1411
RELATIONS 092, 147, 148 (road); 113 (Mihály Szabó’s son Balázs)

SERIAL NUMBER 094
CULTIVATION forest
PLACE NAME Demeerdew
UNIFIED PLACE NAME Demeerdő
DATE 1452
SETTLEMENT Külsőszakácsi

SERIAL NUMBER 095
CULTIVATION forest
PLACE NAME Haraszterdew
UNIFIED PLACE NAME Haraszterdő
PREVIOUS POSSESSOR György Veres (György Korotnai)
DATE 1475
SETTLEMENT Szakácsi

SERIAL NUMBER 096
CULTIVATION arable land
QUANTITY 1 iugerum
NORTH land of György Gekes’s widow
WEST land of Egyed’s son Bálint
SOUTH land of Miklós Kaczo
EAST Hosszú forest
PREVIOUS POSSESSOR Miklós Kaczo
NEW POSSESSOR Pauline monastery
DATE 1459
SETTLEMENT Szakácsi
RELATIONS 092, 147, 148 (road); 113 (Miklós Kaczo)

SERIAL NUMBER 097
CULTIVATION forest
PLACE NAME Hwzyw forest
UNIFIED PLACE NAME Hosszú forest
DATE 1459
SETTLEMENT Szakácsi
RELATIONS 096 (Hosszú forest); 039, 117 (Miklós Kaczo)

SERIAL NUMBER 098
CULTIVATION arable land
QUANTITY 1 iugerum
PLACE NAME Petesianuserdeme
UNIFIED PLACE NAME forest of János Petes
DATE 1459
SETTLEMENT Szakácsi
RELATIONS (forest of János Petes - 1382)

SERIAL NUMBER 099
CULTIVATION forest
PLACE NAME Petesianuserdee
UNIFIED PLACE NAME forest of János Petes
DATE 1444
SETTLEMENT Külsőszakácsi
RELATIONS (forest of János Petes - 1382)
PLACE NAME Vekonerdew
UNIFIED PLACE NAME Vékony forest
DATE 1452
SETTLEMENT Külsőszakácsi

SERIAL NUMBER 101
CULTIVATION arable land
QUANTITY 1 iugerum
PLACE NAME Markerdeye
UNIFIED PLACE NAME forest of Márk
NORTH Utaslabos forest
SOUTH forest of Márk
PREVIOUS POSSESSOR Benedek Tolvaj’s son András, Tamás Szakácsi
NEW POSSESSOR Péter Tóth
FIELD-SYSTEM towards the east and the west
DATE 1507
SETTLEMENT Szakácsi

SERIAL NUMBER 102
CULTIVATION forest
PLACE NAME Wthaslaboserdew
UNIFIED PLACE NAME Utaslaboserdő
SOUTH Péter Tóth
DATE 1507
SETTLEMENT Szakácsi

SERIAL NUMBER 103
CULTIVATION forest
PLACE NAME Markerdeye
UNIFIED PLACE NAME forest of Márk
NORTH Utaslaboserdő
DATE 1507
SETTLEMENT Szakácsi

SERIAL NUMBER 104
CULTIVATION arable land
QUANTITY 3 iugerum
PRECISE POSITION between the lands of the Pauline monastery
BESIDE monastery, forest of D. Szécsényi’s son László
PREVIOUS POSSESSOR Mihály Kígyó
NEW POSSESSOR Pauline monastery
DATE 1428
RELATIONS 048–051, 054 (arable lands of the Pauline monastery); 082 (meadow of the Pauline monastery)

SERIAL NUMBER 105
CULTIVATION forest
PLACE NAME forest of D. Szécsényi’s son László
UNIFIED PLACE NAME forest of D. Szécsényi’s son László
BESIDE lands of the Pauline monastery, arable land of Mihály Kígyó
DATE 1428

RELATIONS 048–051, 054 (arable lands of the Pauline monastery); 082 (meadow of the Pauline monastery)

SERIAL NUMBER 106
CULTIVATION arable land
QUANTITY 3 iugerum
PLACE NAME Weresgervghzcle
UNIFIED PLACE NAME Veresgyörgyszéle
PREVIOUS POSSESSOR Péter Szakácsi the cook
NEW POSSESSOR Péter Szakácsi’s sister Anna and her sons, parish church
DATE 1503

SERIAL NUMBER 107
CULTIVATION arable land
QUANTITY 2 iugerum
PLACE NAME Horozelegh
UNIFIED PLACE NAME Horohszéle
PREVIOUS POSSESSOR will of György Veres
DATE 1453
SETTLEMENT Szakácsi
RELATIONS 037, 040, 136 (Horohalja)

SERIAL NUMBER 108
CULTIVATION arable land
QUANTITY 0,5 iugerum
PLACE NAME Giwthusgyepe
UNIFIED PLACE NAME Giwthusgyepe
PREVIOUS POSSESSOR will of György Veres
DATE 1453
SETTLEMENT Szakácsi

SERIAL NUMBER 109
CULTIVATION meadow
QUANTITY 2
PLACE NAME Fewen, Kerekreth
UNIFIED PLACE NAME Föveny, Kerekrét
PRECISE POSITION Kerekrét
PREVIOUS POSSESSOR Mihály Kígyó, Mártón Vidi, Péter Orros
NEW POSSESSOR Pauline monastery
DATE 1495
SETTLEMENT Szakácsi

SERIAL NUMBER 110
CULTIVATION arable land
QUANTITY 2 iugerum
PLACE NAME Barkolezazele
UNIFIED PLACE NAME Barkolcsaszéle
PRECISE POSITION on the east
NORTH land of János Szakácsi’s son Péter
PREVIOUS POSSESSOR János Poka of Szakácsi
NEW POSSESSOR János Szakácsi’s son Péter
FIELD-SYSTEM laneus
DATE 1425
SETTLEMENT Szakácsi
RELATIONS 032, 111 (János’s son Péter); 111, 113, 144 (János Poka)

SERIAL NUMBER 111
CULTIVATION arable land
QUANTITY 1 iugerum
NORTH arable land of László’s son János’s son Péter
WEST coppice called Megye
SOUTH son of János
EAST arable land of János Poka
PREVIOUS POSSESSOR Lőrinc Szakácsi’s son Domokos
NEW POSSESSOR Pauline monastery
DATE 1411
RELATIONS 032, 110 (János’s son Péter); 110, 113, 144 (János Poka)

SERIAL NUMBER 112
CULTIVATION coppice
PLACE NAME Megye
UNIFIED PLACE NAME Megye
EAST arable land of Lőrinc Szakácsi’s son Domokos
DATE 1411
RELATIONS 067, 068, 087-089, 149 (coppice)

SERIAL NUMBER 113
CULTIVATION arable land
QUANTITY 1 iugerum
NORTH land of János Poka of Szakácsi
WEST land of János Poka of Szakácsi
EAST arable land of Mihály Szakácsi’s son Balázs
PREVIOUS POSSESSOR Mihály Szakácsi’s son Balázs
NEW POSSESSOR Pauline monastery
DATE 1411
RELATIONS 110, 111, 144 (János Poka); 092 (Mihály’s son Balázs)

SERIAL NUMBER 114
CULTIVATION arable land
QUANTITY 1 iugerum
WEST land of Jakab Veres
EAST land of Pál Pokocz
PREVIOUS POSSESSOR János Szakácsi’s son Péter
NEW POSSESSOR Pál Pokocz of Szakácsi
DATE 1436
SETTLEMENT Szakácsi

SERIAL NUMBER 115
CULTIVATION arable land
QUANTITY 1 usu.
PRECISE POSITION towards the garden of Imre’s son Péter
BESIDE Külsőszaékácsi
PREVIOUS POSSESSOR Mihály Tolvaj

NEW POSSESSOR Antal Iwanka’s son Györgyó of Külsőszaékácsi
DATE 1451
SETTLEMENT Külsőszaékácsi
RELATIONS 116 (garden of Imre’s son Péter)

SERIAL NUMBER 116
CULTIVATION arable land
QUANTITY 0.5
PRECISE POSITION towards the garden of Péter and Imre
NEW POSSESSOR Antal Iwanka’s son Györgyó of Külsőszaékácsi and his daughters
DATE 1463
SETTLEMENT Külsőszaékácsi
RELATIONS 115 (garden of Imre’s son Péter)

SERIAL NUMBER 117
CULTIVATION arable land
QUANTITY 1 iugerum
NORTH land of László Szakácsi’s son Györgyó’s widow
SOUTH Egyed Szakácsi’s son Bálint
EAST arable land of János Bodak
PREVIOUS POSSESSOR Gergely Kelenizi’s wife and Demeter Soldos’s daughter Zsuzsanna
NEW POSSESSOR János Szakácsi’s son Péter
DATE 1429

SERIAL NUMBER 118
CULTIVATION arable land
QUANTITY 1 iugerum
WEST land of János Bodak
EAST arable land of Márton’s son Tamás
PREVIOUS POSSESSOR Gergely Kelenizi’s wife and Demeter Soldos’s daughter Zsuzsanna
NEW POSSESSOR János Szakácsi’s son Péter
DATE 1459
SETTLEMENT Szakácsi
RELATIONS 096 (Egyed’s son Bálint); 038, 150 (Egyed’s son János); 039, 097 (Miklós Kaczo)

SERIAL NUMBER 119
CULTIVATION arable land
QUANTITY piece
BESIDE (arable land of) László Zereger
PREVIOUS POSSESSOR will of György Veres
DATE 1453
SETTLEMENT Szakácsi
RELATIONS 134 (László Zereger)

SERIAL NUMBER 120
CULTIVATION arable land
QUANTITY 8.5 iugerum
PREVIOUS POSSESSOR Mihály Tolvaj (Warazloi)
NEW POSSESSOR Antal’s son ..., Simon Finta ..., Vidi Gondos
DATE 1461
SETTLEMENT Külsőszaékácsi
RECONSTRUCTION OF THE SETTLEMENT STRUCTURE 415

SERIAL NUMBER 121
CULTIVATION forest
PLACE NAME Hasberky
UNIFIED PLACE NAME Hársberek
MODERN PLACE NAME 73, 99 Berők
WEST Nagyrét
PREVIOUS POSSESSOR Mihály Tolvaj
NEW POSSESSOR Antal Iwanka’s son György of Külsőszakácsi
DATE 1451
RELATIONS 009–011 (Hársberek); 012 (Nagyrét)

SERIAL NUMBER 122
CULTIVATION road
PLACE NAME gyalogwth
UNIFIED PLACE NAME foot path
BESIDE it leads across 1 iugerum arable land
PREVIOUS POSSESSOR Mihály Tolvaj
NEW POSSESSOR Antal Iwanka’s son György of Külsőszakácsi
DATE 1451
RELATIONS 025 (foot path)

SERIAL NUMBER 123
CULTIVATION river
EAST coppice called Szőlőharaszt of György Veres
DATE 1466
SETTLEMENT Nagyszakácsi
RELATIONS 046, 047, 124–126 (Szőlőharaszt); 019, 035, 123, 124 (György Veres)

SERIAL NUMBER 124
CULTIVATION road
PLACE NAME plebanoswth’a
UNIFIED PLACE NAME priest’s road
PRECISE POSITION leading to forest
WEST coppice called Szőlőharaszt of György Veres
DATE 1466
SETTLEMENT Nagyszakácsi
RELATIONS 046, 047, 124–126 (Szőlőharaszt); 019, 035, 123, 124 (György Veres)

SERIAL NUMBER 125
CULTIVATION road
PLACE NAME via publica
UNIFIED PLACE NAME public road
PRECISE POSITION leading to forest
NORTH coppice called Szőlőhara and Szőlőharaszt of György Veres
DATE 1466
SETTLEMENT Nagyszakácsi
RELATIONS 046, 124 (road); 046, 047, 123, 124, 126 (Szőlőhara and Szőlőharaszt); 019, 035, 123, 124 (György Veres)

SERIAL NUMBER 126
CULTIVATION drain
PLACE NAME esővízelvezető árok
UNIFIED PLACE NAME drain
NORTH vineyard called Szőlőhara
EAST vineyard called Szőlőharaszt
DATE 1471
SETTLEMENT Nagyszakácsi
RELATIONS 046, 047, 123–125 (Szőlőharaszt)

SERIAL NUMBER 128
CULTIVATION road
UNIFIED PLACE NAME road
WEST arable land of Pál Szakácsi’s son Ferenc
DATE 1411

SERIAL NUMBER 129
CULTIVATION arable land
QUANTITY part of 1 iugerum
PLACE NAME Borsohely
UNIFIED PLACE NAME Borsohely
PRECISE POSITION on the east
WEST Kerekerdő
NEW POSSESSOR György Veres, Péter Orros, Miklós Orros
DATE 1463
SETTLEMENT Külsőszakácsi
RELATIONS 018 (Borsohely); 013–018 (Kerekerdő)

SERIAL NUMBER 130
CULTIVATION mill
PLACE NAME mill of Gergely Szakácsi’s son Miklós
UNIFIED PLACE NAME mill of Gergely Szakácsi’s son Miklós
BESIDE meadow of Gergely Kelenizi’s wife
PREVIOUS meadow of Gergely Kelenizi’s wife
PREVIOUS POSSESSOR Gergely Szakácsi’s son Miklós
DATE 1431
SETTLEMENT Szakácsi
RELATIONS 037, 039, 040, 080, 082 (mills)

SERIAL NUMBER 131
CULTIVATION forest
PREVIOUS POSSESSOR will of Péter Szakácsi
the cook
DATE 1503

SERIAL NUMBER 132
CULTIVATION meadow
PREVIOUS POSSESSOR will of György Veres
DATE 1453
SETTLEMENT Külsőszakácsi

SERIAL NUMBER 133
CULTIVATION meadow
PREVIOUS POSSESSOR will of György Veres (Egyed Fekete)
416 CSILLA ZATYKÓ

DATE 1453
SETTLEMENT Külsőszakácsi

SERIAL NUMBER 134
CULTIVATION arable land
PREVIOUS POSSESSOR will of György Veres
(László Zereger)
DATE 1453

SERIAL NUMBER 135
CULTIVATION arable land
QUANTITY 1 iugerum
PREVIOUS POSSESSOR will of Péter Szakácsi
the cook
DATE 1503

SERIAL NUMBER 136
CULTIVATION meadow
PLACE NAME Horohalya
UNIFIED PLACE NAME Horohalja
PREVIOUS POSSESSOR Miklós Szakácsi’s
son János, János Szakácsi’s son Egyed, Mihály’s
son Balázs
NEW POSSESSOR Pauline monastery
DATE 1402
SETTLEMENT Szakácsi
RELATIONS 037, 040 (Horohalja); 107
(Horohszéle)

SERIAL NUMBER 137
CULTIVATION arable land
QUANTITY 1,5 iugerum
BESIDE at the edge of the village Szakácsi
PREVIOUS POSSESSOR Gergely Kelenizi’s
wife and Demeter Soldos’s daughter Zsuzsanna
NEW POSSESSOR János Szakácsi’s son Péter
DATE 1429
SETTLEMENT Szakácsi

SERIAL NUMBER 138
CULTIVATION forest
QUANTITY piece
PREVIOUS POSSESSOR will of György Veres
DATE 1453
SETTLEMENT Külsőszakácsi

SERIAL NUMBER 139
CULTIVATION vine
PREVIOUS POSSESSOR György Veres
DATE 1453
SETTLEMENT Külsőszakácsi

SERIAL NUMBER 140
CULTIVATION forest
PLACE NAME Magaskerthuel
UNIFIED PLACE NAME Magaskörtvély
BESIDE Hátaserdő
PREVIOUS POSSESSOR Mihály Tolvaj
(Warazlói)

NEW POSSESSOR daughters of Antal Iwanka’s
son György of Külsőszakácsi
DATE 1455
SETTLEMENT Külsőszakácsi
RELATIONS 021 (Hátaserdő, Magaskörtvély)

SERIAL NUMBER 141
CULTIVATION meadow
QUANTITY 1 scythe (falcastrum)
DATE 1461
SETTLEMENT Külsőszakácsi

SERIAL NUMBER 142
CULTIVATION vine
QUANTITY 0,5
PLACE NAME Therpechegye
UNIFIED PLACE NAME Terpechesegye
WEST Egyed Fekete
EAST Péter Orros
NEW POSSESSOR Péter Orros, Miklós Orros
DATE 1463
RELATIONS 133 (Egyed Fekete)

SERIAL NUMBER 143
CULTIVATION vine, coppice
QUANTITY 0,5
PLACE NAME Zeleharazthya
UNIFIED PLACE NAME Szőlőharaszt
WEST Egyed Fekete
PREVIOUS POSSESSOR György Veres
NEW POSSESSOR Pauline monastery
DATE 1471
SETTLEMENT Nagyszakácsi
RELATIONS 046, 047, 123–125 (Szőlőharaszt)

SERIAL NUMBER 144
CULTIVATION road
PLACE NAME road to Monyorókerék
UNIFIED PLACE NAME road to
Monyorókerék
PRECISE POSITION on the east, near Léta
WEST forest of the parish priest of Szakácsi
BESIDE land of Poka of Szakácsi’s son János,
coppice
DATE 1382
SETTLEMENT Szakácsi
RELATIONS 149 (road to Monyorókerék); 066–068 (forest of the parish church); 110, 111, 113 (János Poka)

SERIAL NUMBER 145
CULTIVATION road
PLACE NAME road from Léta to the monastery
UNIFIED PLACE NAME road from Léta to the
monastery
PRECISE POSITION on the east
BESIDE linden-tree marked by a cross, coppice
DATE 1382
SETTLEMENT Szakácsi
SERIAL NUMBER 146  
CULTIVATION road  
PLACE NAME path to Léta  
UNIFIED PLACE NAME path to Léta  
WEST coppice and arable lands of the monastery  
EAST coppice of the nobles of Szakácsi  
DATE 1382  
RELATIONS 024, 090, 091 (road)  

SERIAL NUMBER 147  
CULTIVATION road  
PLACE NAME small road along the stream  
UNIFIED PLACE NAME small road along the stream  
PRECISE POSITION towards the east and the west  
BESIDE forest of the Pauline monastery  
DATE 1382  
RELATIONS 092, 093, 148 (road)  

SERIAL NUMBER 148  
CULTIVATION road  
PLACE NAME road to the monastery  
UNIFIED PLACE NAME road to the monastery  
BESIDE forest of Péter Szakácsi’s son János, near a stream  
DATE 1382  
RELATIONS 092, 093, 147 (road)  

SERIAL NUMBER 149  
CULTIVATION road  
PLACE NAME road from the monastery to Monyorókerék  
UNIFIED PLACE NAME road from the monastery to Monyorókerék  
PRECISE POSITION towards the east and the west  
BESIDE coppice  
DATE 1382  
RELATIONS 144 (road to Monyorókerék)  

SERIAL NUMBER 150  
CULTIVATION road  
PLACE NAME road to Léta  
UNIFIED PLACE NAME road to Léta  
BESIDE land of Egyed’s son János  
DATE 1382  
RELATIONS 087, 088, 090, 091, 146 (road); 038 (Egyed’s son János)  

SERIAL NUMBER 151  
CULTIVATION road  
PLACE NAME via magna to Meszetegnyő  
UNIFIED PLACE NAME main road to Meszetegnyő  
WEST arable land for a plough on Halmos  
BESIDE Ferenc Kakás’s sponsus György Vidi  
DATE 1480  

SETTLEMENT Nagyszakácsi  
RELATIONS 086 (road to Gadány)  

SERIAL NUMBER 152  
CULTIVATION forest  
PLACE NAME Magaskörtvély  
SOUTH curia of Péter’s son László in Külsőszakácsi  
PREVIOUS POSSESSOR János Bogdán  
NEW POSSESSOR Péter’s son László  
DATE 1470  
SETTLEMENT Külsőszakácsi  
RELATIONS 021, 140 (Magaskörtvély)  

SERIAL NUMBER 153  
CULTIVATION vine  
NORTH vine of Kelemen Seres of Szőcsény  
WEST main road (via magna) from Szőcsény to Léta  
SOUTH main road (via magna) from Szőcsény to Léta  
EAST vine of Márk Zsitvai’s son Lukács  
PREVIOUS POSSESSOR László Szőcsényi  
NEW POSSESSOR Pauline monastery  
DATE 1456  
SETTLEMENT Szőcsény
Appendix 2.
Perambulation of the bounds of the estate of the Trepk family of Monyorókerék and the Szakácsi family of Szakácsi from 1371.

Collectio styliorum saeculo XV in Foris Hungariae usu receptorum. Ex dono Illustrissimi Domini Comitis Franciscci Tolvaj

Nos Conventus monasterii Sancti Aegidii de Simigio memoriae commendamus quod cum iuxta continentiam litterarum comitis Capelle Regie arbitratoriarum quatuor probi et nobiles viri ....... nostro testimonio inter partes infrascriptos, videlicet Nicolaum filium Joannis, Bekus filium Kezes (?), Joannem filium Egidii, Demetrium filium Elek, Petrum filium Joannis, et Petrum filium Nicolai de Zakachy actores ab una, item magistros Dominicioum, Joannem, Isyp (?) et Leukus filios Stephani filii Trepk, in causam attractos parte ab altera, super facto metarum inter possessiones Zakach predictam ipsorum actorem et Moniorokerek dictorum in C(omitatu) distinguishu. In octavius festi Nativitatis Beatae Virginis proxime pereditis (szept. 15.) arbitrarie et ipsas partes componere debuissent. Nosque secundum earundem litterarum tenorem ad ipsum arbitrium audiendum et dictam compositionem videndam, unam ex nobis virum religiosum, fratrem Jacobum Sacerdotem pro nostro testimonio duximus destinandum. Tandem idem homo noster una cum predictis Nicolao filio Joannis Bekus et Petro filio Nicolai, qui pro se personaliter et pro predictis aliiis corum proximis omnis eorum in se assumentes, item annotatis magistris Dominico, Joanne et Isyp, qui similiter pro se personaliter et pro dicto Leukus frater ipse, omnis eiusdem, si in infrascripta compositione persistere velit, super se accipiendo (?), coram nobis adierebat, et in nullo infrascripte compositioni contradicentebant, sed eadem suo modo affirmabant, ad nos redeundo retulit eo modo: quod ipse partes secundum ordinationem et dispositionem arbitrariam proborum et nobilium viarum per ipsos adductorum taliter concordassent super metas inter predictas possessione earum distinguenteribus: Quod ipse partes presente ipso nostro testimonio in predictis ........ Ad facies dictarum possessionum ipsarum accedendo metas in se invicem eadem possessiones perpetuo separantes taliter reamplauisset et ipsas possessiones per has metas ab invicem distinxissent, quod primo incepissent a fluvio Haas vocato et penes eundem fluvium unam metatem terrae erexissent, et ab hinc versus orientem per vi...... et valde prope agrediendo, duas antiquas metas terrae, unam videlicet in ...... ilicis, et aliam in arbore simuliter ilicis reperissent, penes quas tertia novam erexissent, deindeque versus eandem plagam orientalem ............. eundo pervenissent ad unammetam antiquam ad radicem ciusdam arboris ilicis cumulatam, iuxta quam novam metatem terrae elevassent. Ab hinc vero similiter ad eadem partem vadendo, pervenissent ad unam magnam arboris ilicis, meta terrea circumfusa in arbore que existentem, et penesipsam novam metatem terrae cumulassent, et ab hinc p............. eundo similiter unam arboris ilicis, meta terrea circumfusa reperissent, iuxta quam novam erexissent, modicumque ab inde semper ad eadem partem transeundo, similiter unam arboris ilicis in radice metatem terrae habentem inveriebant, quam renovassent, et deinde per bonum spaciem ad eandem plagam orientis eundo pervenissent ad unam viam (Oeseguso) transitiu prebentem, ex utraque parte metatem terrae habentem, penes quas tertia metatem terrae erexissent, deinde directe ad fluvium Sichwa (?) mancipatum detendo ipsumque fluvium ad terram Cheer vocatam saliendo ac semper ad dictam plagam procedendo et ad unam viam de Moniorokerek distinguentes, penes quas novas elevassent, transeunte pervenissent ad quandam arbores ilicis meta terrea circumdata, quam renovassent, indeque ad angulum ipsius virgultii partitum declinando ad quandam ........... ilicis vocatam novam metatem terrae erexissent, et inde prope eundo in medio ciusdem terre arable, unam metatem terrae cumulassent, et de hinc ad angulum unius silve magne custodialis prope eundo, penes unam viam novam metatem terrae elevassent et abinde semper penes latius ipsius sylve per quam plures continuae metas terrae de novo erectas euntes pervenissent ad quandam rivulum, iuxta quem supra clausuram molendini Heremitarum Ecclesiae Sancti Dominici unam metatem terrae de novo cumulassent. Ibique mete partium predictam ipsam terram Chereurseleu ac terras ipsius possessiones Moniorokerek separantes terminantur.

“Quemquidam omnes mete a principio usque ad finem semper ad partem meridionalenm ipsi possessioni Zakach et ad partem septemtrionalenm ad Zakach transitum prebentem perveniendo ipsaque viam transiliendo, penes eandem in rubetis sub quodam arbore Piri sylvestriunam metatem terrae reperissent, iuxta quam novam erexissent et in eisdem novam erexissent, et in eisdem rubetis seu virgultis, ulterius modico transeundo unam metatem terrae invenissent antiquam, penes quae nova cumulassent et ab inde in eodem virgulte semper ad predictam partem per continuas tres metas terrae antiquas ipsam terrae Cheer ac terris dicte possessionis Moniorokerek distinguentes

... trionalem dicte possessioni Moniorokerek separarent et distinguenter. Hoc etiam declaranto quod super.... habite

Anno domini millesimo trecentesimo septuagesimo primo. 1371
fig. 6. Site of Külsőszakácsi on aerial photos
fig. 7. Sketch of the perambulation of the Trepk family of Monyorókerék and the Szakácsi family in Szakácsi issued in 1371
fig. 8. Sketch of the perambulation of the lands of the Pauline monastery issued in 1382

RECONSTRUCTION OF THE SETTLEMENT STRUCTURE
fig. 9/a–c. First section of the perambulation from 1382 with other available documentary data
SERIAL NUMBER 066
CULTIVATION arable land
QUANTITY 10 iugerum
NORTH forest of the Parish Church of All Saints
PREVIOUS POSSESSOR Péter Szakácsi's son Benedek
NEW POSSESSOR Tamás Szakácsi's sons Jakab and György
FIELD-SYSTEM with its all appurtenances and use
DATE 1375
RELATIONS 067, 068, 144 (forest of the parish church)

SERIAL NUMBER 067
CULTIVATION arable land
QUANTITY 1 iugerum
NORTH coppice between the forest of the Pauline monastery and the forest of the parish church
PREVIOUS POSSESSOR László Bakator's son Benedek
NEW POSSESSOR Pauline monastery
DATE 1414
SETTLEMENT Szakácsi
RELATIONS 066, 068, 144 (forest of the parish church); 068, 087, 089, 111, 112, 149 (coppice); 089 (Bakator)

SERIAL NUMBER 032
CULTIVATION arable land
QUANTITY 1.5 iugerum
PLACE NAME Bancházafew
UNIFIED PLACE NAME Bancházafő
BESIDE between arable lands of János's son Péter and Paperdó (Papharaszt)
PREVIOUS POSSESSOR DemeterSoldos's daughter Zsuzsanna
NEW POSSESSOR János Szakácsi's son Péter
DATE 1429
RELATIONS 031-033, 035, 036 (Papharaszt); 110, 111 (János's son Péter)

SERIAL NUMBER 034
CULTIVATION arable land
QUANTITY 0.5
PLACE NAME Papharazthya
UNIFIED PLACE NAME Papharaszt
PREVIOUS POSSESSOR Will of György Veres
DATE 1453
SETTLEMENT Szakácsi
RELATIONS 031-033, 035, 036 (Papharaszt); 084-086 (Gadány)

SERIAL NUMBER 067
CULTIVATION arable land
QUANTITY 1 iugerum
NORTH forest of the Parish Church of All Saints
PREVIOUS POSSESSOR Péter Szakácsi's son Benedek
NEW POSSESSOR Tamás Szakácsi's sons Jakab and György
FIELD-SYSTEM with its all appurtenances and use
DATE 1375
RELATIONS 067, 068, 144 (forest of the parish church)
SERIAL NUMBER 035
CULTIVATION arable land
QUANTITY 1 funiculus
PLACE NAME Papharazthya
UNIFIED PLACE NAME Papharaszt
PRECISE POSITION beside, in ordinato
WEST György Veres
EAST György Bíró
PREVIOUS POSSESSOR Will of György Veres
FIELD-SYSTEM in ordinato vaginatum vulgo zalagon
DATE 1453
SETTLEMENT Szakácsi
RELATIONS 031-034, 036 (Papharaszt); 019, 060, 123-125 (György Veres); 060 (György Bíró)

SERIAL NUMBER 036
CULTIVATION arable land
QUANTITY 0.5
PLACE NAME Papharastya
UNIFIED PLACE NAME Papharaszt
PRECISE POSITION beside on the east
PREVIOUS POSSESSOR Will of György Veres
FIELD-SYSTEM in ordinato vaginatum vulgo zalagon
DATE 1453
SETTLEMENT Szakácsi
RELATIONS 031, 032, 034-036 (Papharaszt)

SERIAL NUMBER 033
CULTIVATION arable land
QUANTITY 0.5
PLACE NAME Papharazthya
UNIFIED PLACE NAME Papharaszt
PRECISE POSITION beside on the east
PREVIOUS POSSESSOR Will of György Veres
FIELD-SYSTEM in ordinato vaginatum vulgo zalagon
DATE 1453
SETTLEMENT Szakácsi
RELATIONS 031, 032, 034-036 (Papharaszt)

SERIAL NUMBER 031
CULTIVATION coppice
QUANTITY 1 piece
PLACE NAME Szenegethewharazthya
UNIFIED PLACE NAME Szénégetőharaszt
WEST vine of GáI Kaczo, Paperdó
EAST Paperdó, (Papharaszt)
PREVIOUS POSSESSOR István of Nagyszakács's son János
NEW POSSESSOR György Veres
DATE 1480
SETTLEMENT Nagyszakácsi
RELATIONS 032-036 (Papharaszt)

1480
Nagyszakácsi: Szénégetőharaszt
(Zenegethewharaszt)
fig. 10/a-c. Second section of the perambulation from 1382 with other available documentary data

1382
111: HLL*
23:
UM
•
21
U 5 5
22: 1462
152: 1470

HÁTASERDŐ
1462; 1455

Külsőszakácsi

RECONSTRUCTION OF THE SETTLEMENT STRUCTURE 425
SERIAL NUMBER 021
CULTIVATION: arable land
QUANTITY: 1.5 iugerum
PLACE NAME: Hatoserdő
UNIFIED PLACE NAME: Hátsaerdő
PRECISE POSITION: towards south and east
NORTH: Péter (Gedo?)
SOUTH: Péter (Gedo?)
EAST: Magaskörtvély forest
PREVIOUS POSSESSOR: Kozma’s son Imre of Nagyszakács
NEW POSSESSOR: Antal Iwanka’s son György of Külsőszačács
FIELD-SYSTEM: arable lands towards south and east
DATE: 1455
SETTLEMENT: Nagyszakács
RELATIONS: 022, 140 (Hátsaerdő); 140 (Magaskörtvély); 023 (Péter Gedo?)

SERIAL NUMBER 140
CULTIVATION: forest
PLACE NAME: Magaskörtvély
UNIFIED PLACE NAME: Magaskörtvély
BESIDE: Hátsaerdő
PREVIOUS POSSESSOR: Mihály Tovaj (Varazló)
NEW POSSESSOR: Péter’s son László
DATE: 1470
SETTLEMENT: Külsőszačács
RELATIONS: 021, 140 (Hátsaerdő, Magaskörtvély)

SERIAL NUMBER 152
CULTIVATION: forest
PLACE NAME: Magaskörtvély
SOUTH: curia of Péter’s son László in Külsőszačács
PREVIOUS POSSESSOR: János Bogdán
NEW POSSESSOR: Péter’s son László
DATE: 1470
SETTLEMENT: Külsőszačács
RELATIONS: 021, 140 (Magaskörtvély)
The third section of the perambulation from 1382 with other available documentary data.
<table>
<thead>
<tr>
<th>SERIAL NUMBER</th>
<th>CULTIVATION</th>
<th>QUANTITY</th>
<th>PLACE NAME</th>
<th>UNIFIED PLACE NAME</th>
<th>PRECISE POSITION</th>
<th>PREVIOUS POSSESSOR</th>
<th>NEW POSSESSOR</th>
<th>DATE</th>
</tr>
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<tbody>
<tr>
<td>038</td>
<td>arable land</td>
<td>4 iugerum</td>
<td>NORTH</td>
<td>arable land of János Soldus</td>
<td>WEST arable land of Demeter's son Pál</td>
<td>Szakácsi Pál's son Ferenc</td>
<td>Pauline monastery</td>
<td>1411</td>
</tr>
<tr>
<td>092</td>
<td>arable land</td>
<td>1 iugerum</td>
<td>NORTH</td>
<td>arable land of Kereztus's son Kozma</td>
<td>EAST arable land of János Szakácsi's son Egyed</td>
<td>Mihály Szakácsi's son Bálint</td>
<td>Pauline monastery</td>
<td>1411</td>
</tr>
<tr>
<td>144</td>
<td>arable land</td>
<td>1 iugerum</td>
<td>WEST</td>
<td>arable land of Petes' widow Borbála</td>
<td>SOUTH arable land of Petes' son Egyed</td>
<td>István Jank of Külsőszakácsi's widow Borbála</td>
<td>Péter Szakácsi's son Egyed</td>
<td>1444</td>
</tr>
</tbody>
</table>

**RELATIONS**

- 150 (Egyed's son János, road to Léta);
- 096, 117 (Egyed's son Bálint)

**RECONSTRUCTION OF THE SETTLEMENT STRUCTURE**

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fig. 12. Archaeological sites from Nagyszakács
fig. 13. Medieval roads, place names and the possible route of the perambulation in 1382
OPPONENT’S REMARKS ON ISTVÁN GAÁL’S DOCTORAL THESIS

Nándor Kalicz

István Gaál’s name is well known in the research of the Central European Neolithic. In a number of large-scale studies, he discussed the problems of cemeteries, cultic phenomena, cultic objects and diverse articles of use of the Middle and Late Neolithic and even the Early Copper Age, in a Hungarian sense, and sketched the solutions he could derive from his own investigations. He has really laid the foundations for such a work. He spent, all in all, about 4 years in foreign institutions (Austria, Bulgaria, Germany), from which we can mention the Humbolt grant in Germany as the one that offered an excellent opportunity to do research work in major institutions and to learn the latest theoretical analytical methods.

After finishing his university studies, the candidate acquired a university doctoral degree. His chose the Transdanubian Lengyel culture for the topic of his thesis with a special stress on the problems of diffusion and chronology. He had more experience when he prepared his candidate thesis, in which he analysed all the known Neolithic cemeteries of Central Europe, a larger geographical unit, within certain social archaeological frames. In this dissertation, we could already meet the elements of his later perfected analytical method.

The academic doctoral dissertation he has handed in for this discussion encompasses a more restricted territory, he returns to the Lengyel culture. He himself conducted a series of smaller and larger excavations and rescue excavations, the most significant of which was the excavation of the Mórágy settlement and cemetery of the Lengyel culture. It is understandable that the settlement and the cemetery uncovered within authentic circumstances, and especially the latter one, offered an excellent opportunity for a deeper analysis and the application of modern methods. The work, which he has perfected for years, reflects the candidate’s knowledge of statistics and seriation. This knowledge has created a new foundation in the analytical methods of excavation results, first of all of cemeteries and appears to be a pioneering work in Hungary. It should be emphasised that before him, nobody carried out the analysis of the burials of the Lengyel culture in Hungary in such details. The dissertation discusses only those find units that are considered the most authentic in archaeology, the burials, and he extended his investigations to all the burials uncovered in Southern Transdanubia from the same period. From these sites we can mention the Zengővárkony site as the best known cemetery, which contains the largest number of graves. He mentions as the basic principle of the monumental work, which he prepared with exemplary diligence and energy: “…from the respect of the history of science, burials represent the oldest and most important sources for the recognition of human history, although only a complex analysis including the results of settlement and environmental archaeological investigations can form a really true picture of the contemporary conditions.” We wholly agree with this idea and hope that he extends his method

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The Hungarian proceeding in conferring the degree of Doctor of the Hungarian Academy of Sciences is different than the practices in most of the European countries. During the procedure three opponents – specialists of the given subject – explain in writing their opinion on the thesis, whereupon the candidate has the opportunity to reply. Here, the opponents’ remarks on István Zalai-Gaál’s thesis defended in 2003, titled “The history of the Late Neolithic in Southern Transdanubia. Typology – Chronology – Socialarchaeology” and the candidate’s answer, are published.
to the settlements that form a coherent unit with the burials and the cemeteries. His results were born from a new, multi-aspectual cemetery analysis method, which is based on attribute analysis, a method that makes the most complex use of statistics. The very complicated method is based on absolute data and their comparison with each other in the most diverse correlations and groupings. This method can bring two important results. It can help the determination of the relative chronology of the examined graves, grave groups and cemeteries (?) and to establish the hierarchy presumed in the analytical units, which, at the same time, can mirror the status of the buried persons within the community from the quantitative and qualitative interrelations of the grave finds. As the sizes of the examined units are highly different, it is uncertain to what degree the presumed position, especially within the cemetery, and the hierarchy suggested from the combination of the finds appears in the entirety of the settlements linked with these units.

Here I would like to mention two things. The Várna cemetery is unique (also from the respect of its geographical location) not only in Bulgaria but also in the whole of Europe. Its extreme richness and ritual specifics set it apart from every contemporary cemetery. It also represents a younger phase than the analysed Southern Transdanubian burials. A similar tendency to richness seems to have appeared perhaps only in the contemporary Tiszapolgár – Bodrogkeresztúr phase. At the same time, the complex publication of the cemetery is not yet known, which would be indispensable for an analysis. The very high level of hierarchy is really obvious in this cemetery, which, however, rooted in different geographical, economical and social conditions than the ones presumed in the Lengyel culture. A great difference is also reflected in the circumstance that at Várna the graves can be found in a huge cemetery unit, while the burials in the eastern territory of the Lengyel culture were uncovered in groups of diverse sizes both in the north and in the south. Perhaps the existence of hierarchy itself and its grades, which the multi-aspectual analyses of the author also demonstrated in the Lengyel culture, can provide a base for certain comparisons, although in the latter case they naturally appear on a very low level.

Another, less significant problem roots in the classification of burials. When can we speak of independent cemeteries or only of groups of graves and how can we evaluate the settlement burials? The population of the western (Central European) Linear Pottery culture already established large uniform cemeteries in its vast occupation zone, as it can be read in the dissertation. The candidate mentions that such cemeteries are not known or barely known in the territory of the later Lengyel culture. Nevertheless, the Nitra cemetery with 76 unearthed graves does not really seem unique in the light of the 96 graves at Vedrovice in Moravia, the 24 graves of Rüting in Austria, the more than 60 graves rescued from the coherent cemetery of Kleinhadersdorf and the rest of the smaller grave groups. Thus it seems highly probable that we can expect grave groups and cemeteries of the Linear Pottery culture in Transdanubia as well beside the already known settlement burials. The question is, which I myself cannot as yet answer, if all the grave groups that are differentiated within a larger unit can be treated as independent cemeteries or they are the constituents of a larger cemetery. We can certainly agree with the candidate in that the grave groups formed some kind of an independent unit within the larger structural units formed by the inhabitants of the settlements. Accordingly, their separate analysis seems reasonable and the name is not crucial.

Before the detailed analysis, the author shortly describes, together with the history of the research, the actual state of the relative chronology in the occupation zone and the ideas connected with this issue. Some elements of this sketch may be debated like, for example, the role of the early Lengyel expansion, from which the territory of Southern Transdanubia was left out even though the importance of this territory appears more and more emphatically in the evolution and further development of the Lengyel culture. I am also uncertain in the question of the extension of the role of white painting to the Sopot culture, since vessel painting is not evidenced in this culture in Croatia apart from the younger Brezovljani phase and the imported Lengyel wares. It is true, at the same time, that this is not only the phase of the disintegration into groups but also the period of a second major expansion, which can be detected first of all
in Karinthia and Slovenia. The only Croatian site is known from the Slovenian border zone. The Drava–Sava Interfluve does not belong to the border zone.

The subsequent large chapters contain the most thoroughly elaborated, most important part of the dissertation. Analyses that use the basic elements of the metric and quantitative data already appeared in István Gaál’s early works. Formerly, typological evaluations, which reflected the personal subjective approach of the researcher, provided the base for archaeological research, and they often led to contradictory results. The exact, measurable and mathematically controllable data mirror the real situation and conditions, which can be learned from the various correlations of these data. The candidate carries out the necessary analyses from a great variety of approaches concerning the burial rite, the cemeteries themselves, the graves, the buried persons and their place in the grave, the finds put into the graves etc. He differentiated no less than 16 versions only of the body positions. The kinship links of the buried persons were determined with serologic analyses applied in the 70’s and 80’s. This time, however, he himself emphasizes that DNA analyses must be used in archaeology to meet the modern demands.

The classification and analysis of grave furniture offering customs and the grave furniture itself like ceramics, tool and jewellery finds, and the establishment of the broadest correlations, combinations and multidirectional chains of the individual find types of finds are first discussed regarding the find materials. The candidate applies everything that the specialists of modern archaeology have developed, especially in Germany, in respect of this method based on natural sciences and mathematics, and sometimes he himself modifies and completes it to fit it to the Hungarian conditions. Perhaps he divides the type groups of the finds to be analysed into too many elements. It is questionable if it is always justified to suggest the hierarchy of the buried persons from the quantitative and qualitative differences of the individual combinations, especially in simple cases. This question also emerges when seemingly evident traces of certain divergences appear repeatedly within the “cemeteries”, which may indicate the existence of a hierarchy. One of the (published) grave groups from Aszód offers an interesting example to prove this presumption. Here the richest grave no. 2 furnished with prestige goods is situated in the centre encircled by numerous children, a number of women and a few men. The grave group, which occupies a long stretch beside it, differs not only in its shape, but also in the fact that men with pairs of boar tusks and women with Spondylus beads alternate without a person placed in the centre. In the case of Aszód, the position (shape) of the two grave groups and their finds reflect two different types of community conditions within the same settlement. It should also be added that the Aszód cemetery and the similar northern burials have yielded much less grave furniture than the ones in Southern Transdanubia and they are more similar to the ones in Eastern Hungary. This means that a great diversity can be experienced in the burial rites and the grave furniture, just as the candidate described it, not only in larger units as the eastern group of the Lengyel culture but also in the Southern Transdanubian cemeteries. I find it doubtful that the number of vessels within a burial can be counted among the categories indicating hierarchy, since settlement finds imply that anybody could get vessels. In this case, the number of the vessels and their combination seem to have a secondary, complementary role. Their role in the burial rite is diverse in Southern Transdanubia as well, the candidate observed no less than 29 combinations of only the vessel types. From the grave furniture groups he differentiates persons of a special status, who were buried in the centre or at the edge of the grave group, sometimes in smaller clusters. Such meticulous and manifold analyses often point to details that the traditional analyses usually fail to notice. The evolution of the grave groups (“cemeteries”) is an interesting problem just like the questions if the central burials were the first ones in these groups or the deceased had a predetermined place and if the burials of eminent statuses were at the edge of the group why was it so?

In the typological categorisation of the finds, ceramics are discussed at the greatest length. The author grouped the vessels into two classes, and differentiated each 3 vessel-types within these classes. The types are further divided into series and then in the next phase established morphological groups and versions. The examination of the hollow-footed
vessels is instructive from this respect. He divided the vessel type of the first class into four groups, and determined the typological units of the hollow-based vessels, that is the series and morphological groups, by certain attributes, the number of which is about 70. I feel, however, that although the distinguishing features manifested in these categories are recognisable, they are so minimal in the ultimate phase of the categorisation that they do not express the intention of the producers of the hollow-based vessels nor the divergences rooting in their function. A classification to such a depth seems superfluous since I think the necessary information can be reached already in the earlier phases of the analysis. The question is if the determination of the relative chronological order demands such a detailed classification.

The “Butmir type” vessels described among the 6 main vessel types need mentioning. The candidate’s opinion is that the tradition of the “bomb-shaped” vessels of the Linear Pottery culture survived in them. Nevertheless, not the bomb shape but a strongly segmented pot shape is characteristic of the earliest representatives of this specific type, which appeared in the Protolengyel horizon without an antecedent, and which became characteristic in the early Lengyel period. The candidate’s analysis made it clear how the shape of the vessel, which was probably prepared to fulfil the same function, changed in the younger phases and started to remind of the bomb-shaped vessels of the Linear Pottery period, the production of which ceased after the Protolengyel and the early Lengyel periods.

It is remarkable that with the applied method he convincingly demonstrated the modifications of the individual vessel types in time. The author dedicates a significant chapter to the attribute analysis of the Southern Transdanubian cemeteries, where he deals with the problem of group evolution and “order of rank” based on the combinations of the burial custom groups and the find groups. He set up 11 find ranges from the “richness”, the divergences deduced from the combinations of 85 find groups determined by the analysis of 285 graves. These find ranges help orientation in hierarchy and, comparing them with their distribution in the cemetery, a new social archaeological factor can be determined. The combination analysis of the shapes and ornaments of the vessels, the definition of the find horizons occupy again discussed at a length in this chapter, which contribute to the determination of the relative chronology. Accordingly, he separates 5 phases of the Southern Transdanubian cemeteries from the early to the late ones (early, early-transitional, transitional and transitional-late). We can agree with the results of the analyses, which reveal that the Southern Transdanubian cemeteries were first opened in the earliest Lengyel phase, which matches the early phase (1a–2) represented by the Lower Austrian Fribritz and Wilhelmsdorf sites. The combination analysis also pointed out that the transitional phase was the organic continuation of the early phase, although already significant changes appeared (1b). The changes were so significant in the transitional-late phase that the author found the definition of a new phase justified (2a). The candidate found it partly contemporary to Pečenad. He regarded the latest horizon of the cemeteries (2b) to have been the fulfilment of the preceding late phase. He identified it with the “copper horizon” and found it contemporary to the Moravány phase. According to him, this period survived until the traditionally determined phase III. This phase is, however, still missing in Southern Transdanubia. István Gaál’s relative chronology, as opposed to the earlier approximate determinations, is based on the above described analyses, which reach deeper than ever before, and this can be accepted as a basis for the analysis of similar burials and even the settlement features of other territories as well (e.g. Aszód).

The last but one chapter deals with the relationship between the Lengyel culture and the neighbouring cultures, which means the Vinča, the Sopot, the Tisza and the Herpály cultures. He discusses this question with the traditional method and gives a short recapitulation of the results of the last decade. He focuses first of all on the problems of relative chronology, and his conclusions, apart from the dubious suggestion concerning a few less important details, match the results he reached in the previous chapters of his dissertation. The importance of absolute chronology seems to have evaded his attention in this energy-intensive working process. Data of this type are only mentioned in a few short notes and even there the conventional and the calibrated data are mixed (because of this e.g. Aszsód and Svodín would be hundreds of years
younger than Zalaszentbalázs of the latest phase, and the same is repeated in the case of the Sopot culture as well). Since this aspect is not among the aims of the dissertation, I accept them as minor inaccuracies. I judge his remark concerning the Sopot culture the same way, which doubts that the Sopot culture could be the antecedent of the Lengyel culture since it was parallel to it south of the Drava. This is true just like the fact that it started much earlier and expanded to Transdanubia in a certain early period. Naturally it is not known why the Lengyel culture evolved only north of the Drava. Perhaps the fact that one of the antecedents of the Lengyel culture was the Central European Linear Pottery culture, the southern border of the occupation zone of which was the Drava may have played some role in it. Only a specific local variant of the Linear Pottery culture the Male Korenovo evolved in Croatia. Its characteristic finds appeared north of the Mura together with the younger so-called Brezovljani phase of the Sopot culture. Its problem, together with ceramic painting, will perhaps be solved by the results of recent excavations conducted on large surfaces, where the transition of the two cultures is clearly reflected.

The author discusses the problems of the Tisza culture in details. He describes most of the published or mentioned burials but does not go beyond the earlier published data (Banner, Bognár-Kutzián, Korek etc.). From the respect of the contacts between the Lengyel and the Tisza cultures, he owes a larger significance to two sites beside Aszód. One is Bicske, the finds of which, affiliated to the Tisza culture, cannot sufficiently be estimated from an inner chronological aspect because of their fragmented condition and common ornamental motives. The other site is Mórágy, where the candidate collected and published the earlier unknown fragments that represent the Tisza culture, which had been found in the settlement partly as stray finds. Regrettably, we do not know in what a ceramic context they lay. A few fragments were found above graves dated from phase 1b. It is suggestive that the best analogues are known from Gorzsza, according to which the candidate propounds that, the Lengyel 1b–2a, that is the copper horizon, and the oldest D–C phases of Gorzsza were contemporary. It means that this is the proof of an E–W contact system in the north, manifested through Aszód and in the south in the region of Mórágy, which can get sufficient emphasis in a historical evaluation in the future.

The extremely detailed analyses and their correlations, which are built on each other in a logical order and which complete each other, provide a safer and more detailed base to the determination of the relative chronology, which is an essential condition in the description of historical processes. The significant novelty is, among others, that the mistakes of the former typological analyses, which came from the subjective visual judgement of the researchers and thus led nearly each scientist to diverse conclusions, are eliminated and this hopefully exact method places the analyses on a realistic foundation. This offers the opportunity to the candidate to make a detailed chronological differentiation and draw conclusions that are different from the traditional ones or modify our ideas about the subsequence of historical processes. I think that the candidate’s method can generally be applied on other geographical territories and at the finds of other periods as well.

A part of the last chapter contains the recapitulation of the substantial conclusions of the dissertation. In the other part, the candidate tries to give a sketch of the social archaeological conditions of the population of Southern Transdanubia. István Gaál examines the contacts that can be demonstrated with the cemeteries of the Lengyel culture unearthed in other territories from the above aspects and dedicates long pages to the analysis of the community conditions of the Southern Transdanubian Late Neolithic population from the family the smallest unit to larger organisational units. Especially the explicit stratification of the cemetery of Varna in Bulgaria provides analogues for him to prove the existence of an initial social hierarchy from the simpler find circumstances of the Lengyel culture.

I cited only a few examples from the rich content of the dissertation, which demanded much energy to accomplish. The greatest merit of the work is the new method based on mathematics-statistics-seriation, which will hopefully help to reach the accuracy we missed until now and to provide a safe base for the new results deduced with the help of a
comprehensive analysis. These results are partly different from the earlier ones, partly modify or shade them. We can definitely rely on these conclusions and use his method and results in our works of a similar character. We emphasise that István Gaál has already published details of the problems discussed in the dissertation in a number of progress reports. The latest one was the elaboration of the Mórágy cemetery on the same basis, which appeared in the form of a book just a few days ago. The work is supported by about 1000 items in the reference list, and I would especially like to call attention to the exemplary construction of the rich illustration, which gives a stress to the theme. Even if we do not estimate the significant and important work István Gaál accomplished until this dissertation, which is amply illustrated in the reference list, the objectives of the dissertation and the new and convincing results obtained with the consequent application of a new method are enough to match the demands of the academic doctoral degree and render the dissertation in itself suitable to be submitted to discussion, which I propose to the Committee.

Tibor Kemenczei

The thesis contains partly more and partly less than the title suggests. To begin with the latter one, the data obtained exclusively from the cemetery analyses cannot alone reflect the history of the Late Neolithic in Southern Transdanubia since the concept of “history” covers more than the fragmentary picture of a community, which the thesis sketched. We can add that the morphological assortment of the handicraft products of the characteristic Late Neolithic culture of Southern Transdanubia, the chronological position of the individual phases, the connections of the culture and its settlement structure are all discussed in the study. These special topics, however, could not yet be integrated into a unified history at the present state of research.

The description of the social structures of the Southern Transdanubian Lengyel culture and their changes from the analysis of the cemetery finds, which was the ultimate aim of the thesis, was evidently successfully accomplished. The base is provided by not really many graves: 658 burials in 628 graves at 12 sites. Most of them were uncovered at three sites, Zengővárkony, Lengyel-sánc and Mórágy. Only the last site was unearthed with modern methods where the author recorded all the details of the excavation. The thesis very meticulously analyses the relatively small source material, regarding both the phenomena that evidence the burial customs and the objects that were placed in the graves. His methods meet the requirements of our days. He used computer programs to affiliate the individual data of the discussed source material into attribute groups, which afforded chronological differentiation between the individual parts of the cemetery. This provided a base to the demonstration of the social structures reflected in the burial customs of the community that used the cemetery.

The literary citations at the start of the work intend to prove that onetime social conditions, ethnicity and ideology can be deduced from the analysis of burials. The burial rite, the features and numbers of the objects in the graves can really offer clues to the social status of the dead, but it is never more than a dim reflection of the reality. The same is implied in the thesis when the author declares that the data of the settlement and environment archaeological investigations need to be integrated to be able to draw a more complex social picture. It can also be pointed out that in certain periods and cultures the social status of the dead was marked in a way that was not manifested in the objects that were preserved to our days. Anyhow, the Lengyel culture is not one of them. The grave finds of this culture offered a really favourable condition to the application of any form of cemetery analyses.

We have to be careful with the cited opinions of researchers who think that prehistoric grave furniture marked ethnicity and who identify prehistoric cultures with ethnic groups. The thesis seems to agree with these researches, at least this is what the following sentence suggests: “Ethnic groups that consider themselves as members of the same ethnicity can be found behind different archaeological cultures and this can be supposed in the case of the cultures of the Lengyel complex.” The series of doubts starts with the question if prehistoric communities had ethnic consciousness and what the concept of ethnicity was in the prehistory. To carry on the train of thought, the next question that emerges is what elements of the preserved material and
spiritual cultures characterise only a specific ethnicity. The thesis mentioned the specific traits of the ceramics as such an element. Some researchers really consider it an important criterion in the separation of cultures, cultural groups yet we can cite a number of examples when the potters modified the shapes and the ornamental motives of their products in a period when there was certainly no population exchange in the territory. Prehistoric burial rites do not offer unanimous proofs on ethnicity either. It is enough to remind of the fact that a population of a specific culture can practise diverse burial rites or modify them in the course of time. Thus it could have been another subject what reasons stood behind the application of diverse burial rites within a cultural entity, like the practice of cremation in the Lengyel culture. The number of the studies that discuss this problem could fill a library, and the thesis did not produce new arguments in this respect. We could not learn what kind of a unit the communities of the Lengyel culture formed in Southern Transdanubia, in what features their material and spiritual culture differed from those of other units of the Lengyel entity and what the reasons of these divergences were. So the discussions on the general problems of archaeological culture, ethnicity and burial rites cannot be ranked among the accomplishments of the thesis.

The thesis chose the Copper Age cemetery of Varna to illustrate the social differences that existed in the communities that used the Late Neolithic cemeteries of Southern Transdanubia. Nevertheless, the similar and different social conditions evolved independent of each other at the communities living in distant regions depending on the local economic, cultural and natural conditions. Thus the social classification in the Southern Transdanubian communities of the Lengyel culture evolved without the influence of the Varna population. The Varna example based on the really bulky technical literature published in this topic cannot replace the missing description of the natural and economic conditions and communication system in consequence of which the Lengyel culture evolved, flourished and its social differentiation developed.

The thesis analyses and compares all the details and specifics of the burial rites to learn more about the social and economic conditions of the Lengyel culture. Regarding the description of the rites of prehistoric population groups composed from the archaeological literature we have to point out, however, that the survived relics of the burial cult of prehistoric populations are not always suitable to draw conclusions concerning the social differentiation. From the comparison, for example, of the number of Bronze Age graves that contained weapons or implements of tool production with the ones without such objects we could conclude that the populations, which had an evidently more differentiated society, had less pronounced leader and handicraft layers.

The description of the history of the research of the Lengyel entity from the western part of the Carpathian Basin to Moravia, which was composed from the archaeological literature, defines the chronological and geographical place of the remains of the Southern Transdanubian late Neolithic, and profitably contributes to the accomplishment of the objectives of the thesis.

Beside the general description of the burial rites, the customs, the grave shafts, the sepulchral structures and the depths of the graves, the work discusses in details all the similar phenomena observed in the cemeteries of the Lengyel culture. The analysis of the objects placed in the graves and the classification of their characteristic features proved to be a method that provided a firm base for the observation of the chronological differences between the individual grave groups and changes in the grave furniture.

In the cemeteries of the Lengyel culture, the type and the number of the objects placed in the graves matched the social status of the buried persons. The elements of the grave furniture compose a separate group, objects that bear symbolic meaning like ceramics, anthropomorphic or zoomorphic clay idols, food offerings, dog skeletons, pig jaws, querns. The second group is constituted of the objects used or worn in life, like stone tools, bone and antler tools, copper jewellery, marine bivalve shell beads, tusk lamella pendants. The number of the different types in the individual burials, and their composition led to the differentiation of grave furniture groups. The proportionate difference of these objects reflects the higher or lower status of the individual within the community. The final results of the analysis, however, are similar
to those deduced from the cemetery finds and burial rites of other prehistoric communities that were not analysed with this method, namely that the individuals buried with more or unique grave furniture occupied an eminent role in the community and certain elements of the grave furniture could have symbolic meanings. One of the problems that can be raised here is the spiritual background hiding behind then position of querns in the graves. Other prehistoric communities also practised this custom, like e.g. the population that lived in the Great Hungarian Plain in the Early Iron Age. Even if we accept János Makkay’s interpretation that the querns were offerings, we have to ask to what layer of the community the people whose grave contained querns belonged in the cultivating and animal breeding populations that lived in the mountains and in the plain. Another question that demands an answer is what exactly the “privileged position” of an individual buried with idols and specific burial vessels of the fertility rite meant within the community. It is certainly not sufficient to say that this status could be connected with the contemporary beliefs and cult. Although a few sentences refer to the supposed spiritual background of the idols, a complex religious historical analysis all over Europe would reveal more about the ideology of the Late Neolithic communities.

According to the data of the thesis, 6.5% of the graves had special grave furniture. This datum, however, refers to the entire duration of the cemetery and it cannot be told how the ratio changed in the individual phases of the Lengyel culture. Without this the changes of the society cannot be followed, if ever it changed. Thus the only thing we can learn from the analysis of the grave furniture groups is that there were rich and poor people and individuals of special, undetermined statuses in the communities that used the cemeteries.

The finds were classified according to typology, one of the basic methods of archaeology, where the analysis of the ceramic material stood in the focus. This naturally comes from the source material in which clay vessels are represented with the largest number and variety. After the general description of the vessel types and production technology from the literature, which does not contain any novelty, we can find a detailed description of the types of funeral ceramics separated by the profiles, that is morphologically. The thesis further separated them into 4-3 genres within the two classes that were metrically determined in a hierarchical poligenetic system borrowed from biology and then morphological groups and versions were differentiated within these genres. It means the author succeeded in grouping the not really many vessel kinds (hollow-based vessels, glasses, cups, jugs, vessels of inverted mouths, mugs) found in the graves of the Lengyel culture into seven types. In the followings, the typological attributes helped the determination of the clay vessels and the ornamental motives prepared during the individual periods of the Lengyel culture.

The description of the function of the other significant group of objects found in the graves, which contains polished stone axes, maces, adzes, chisels and flaked stone tools, and their comparison with other objects convincingly support the theory that these objects also reflect the social status of the buried individuals. It can be added in this respect that stone maces preserved this function until the Early Iron Age, while the polished trapezoid stone chisels can be found in graves even in the Late Bronze Age and the Hallstatt period. Thus we think that more data is needed to prove the conclusion that the stone weapons and tools placed in the graves evidence social division of labour.

The attribute analysis of the cemeteries of the Lengyel culture demanded a really substantial evaluation work. The differentiation of the burial custom groups including diverse object types, the find groups of tools, jewellery and articles of wear and their combination tables led to the demonstration of grave groups in the individual cemeteries and the establishment of the proportion of graves furnished with a richer grave furniture than the rest, from which we can draw conclusions concerning the social differentiation in the community that used the cemetery.

The definition of the periods of the cemeteries of the Lengyel culture and the object types that characterise these periods is a significant conclusion of the thesis. The combined occurrence of certain vessel types and the distribution of the ceramic groups determined with this method in the map of the cemetery convincingly support these results. The changes that
led to the differentiation of a new period in the evolution of the Lengyel culture appeared in the morphological variety of the ceramics of the early phase in the transitional–early phase. Nevertheless, the question in what other constituents of the culture this so-called development manifested itself beside the changes demonstrated in ceramics has not been answered.

Research usually divides prehistoric cultures into early, classical and late phases. The morphological and motive assortments of the objects produced by the handicrafts, among them the potters, changed during these phases. Nevertheless, the individual object types were usually longer used than the phases of the cultures, so it is impossible to affiliate the handicraft products, including potteries, into sharply distinguished horizons characterised with drastically new morphological and motive assortments. The thesis differentiated the various periods by the profiles of the vessels, that are by the combinations of the shapes, determining the clay vessels characteristic of these periods in percentage ratios. The description of the vessel shapes and their versions could be even more suggestive if they were illustrated in type tables. Owing to the analysis of the ceramics, which needed a really serious analytical work, the periods of the individual cemeteries could be determined.

The separation of periods in the Lengyel culture is supported by data cited from other territories and cultures. The summary based on the archaeological literature illustrates a similar picture regarding the burials of the Late Neolithic cultures around Southern Transdanubia (Vinča, Sopot, Lužianky) as the one drawn from the analysis of the grave finds of the Lengyel culture. The proportions of the graves with rich and poor grave furniture are nearly identical. The discussion of the finds showing links with the late Neolithic cultures of the Great Hungarian Plain (Tisza, Herpály, Csőszhalom cultures) covers first of all the definition of the chronologically corresponding periods.

More space could have been dedicated to the discussion of the economic, technical historical, geographical and perhaps ethnic components that resulted in the evolution of the corresponding features of the social conditions, the burial customs, the cult and the handicrafts in the mentioned cultures. The character of the direct contacts, which are more than simply analogous phenomena rooting in the similar economic and social conditions, and their possible influence on the development of the culture could also have deserved more attention. We are sufficiently informed about the finds of the Tisza culture from Mórágy, which enabled the verification of the synchronicity with the younger phases of the Lengyel culture. The results are not significantly different from the chronological comparison of the different periods of the Lengyel culture from Southern Germany to the Tisza region published by Juraj Pavúk in 2000.

The sketch of the contacts of the Lengyel culture is in fact a recapitulation of research history. In consequence of the actual state of research and the scarcity of data owing to the lack of source material, the part on the Late Neolithic cultures of the neighbouring territories do not contain significant new elements. It is also true, however, that this aspect is not among the objectives of the thesis.

The summary of the conclusions drawn from the analysis of the source material offered an occasion to sketch the social archaeological conditions of the Neolithic population although social archaeology is a field of research in the present and not a condition in the past. In the description of the social conditions results reach by other scientists dominate like explanations on the kinship relationships, lineage’s, endogamy and exogamy, the role of biological ages and organisation, which were borrowed from the literature. One of the conclusions in this topic is the supposition that matrilineal lineage and marriage dominated in the communities of the Lengyel culture. The ultimate conclusion is, however, which we can perfectly accept, that no prehistoric analysis can reveal the prehistoric kinship ties.

The general statements on the tribes and clans did not get us closer to the recognition of the organisation of the communities of the Lengyel culture. The graves of men buried with especially rich grave furniture do not indicate more than the initial phase of social differentiation. The supposition that the tools really reflect the job the deceased did in life, that
is that the tools reflect the division of labour within the community, is another question that needs further examination.

According to the results of the cemetery analyses, the society of the Lengyel culture was hierarchical and not only persons but also families could have a higher status. The evolution of the social differentiation was the result of the development of technology, the new methods of cultivation and the growing importance of commerce. Besides, the impact from the Tisza and the Vinča cultures could encourage the changes.

The data of the cemetery analyses convincingly proved the cited conclusions concerning the social structure. The archaeological literature has already revealed the character of the general changes that happened in the Late Neolithic. So the detailed description of the specific local factors that dominated in Southern Transdanubia and the deep analysis of the way the contacts with the Hungarian Plain and the influences arriving from the Balkans became manifest would certainly have been justified.

In contrast to the analysis of the social structure, the evaluation of the morphological and motive assortments characteristic of the handicraft products of the Lengyel culture in Southern Transdanubia has enriched the research with new information. Owing to the detailed analysis, we can follow the process of the modifications of certain object types in the subsequent phases of the culture. The comparison with the various periods of the Late Neolithic cultures around the discussed territory resulted a reliable chronology. The deep analysis of the causes of the evolution and the cessation of the discussed culture and the effects that influenced these processes could be the central topic of a historical study. The many citations, which were not linked with the topic, were not organic constituents of the work just like the descriptions of old research results, the explanations of the concepts and the numerous foreign terms.

The thesis excels in the Hungarian prehistoric research especially with the computerised analysis of the ceramic finds and the burial rites. The meticulousness of the analysis, the fact that it includes all the significant and less significant details demanded an enormous effort. Yet it did not bring results that would surpass the level of an evaluation reached with the traditional comparative method. Nor could we learn the actual history of the Southern Transdanubian communities of the Lengyel culture from the data of the detailed analyses, or their complex social history. It is true that the source material we have at present does not afford it as yet. Nevertheless, the huge database that supports the detailed results could only be obtained with a computer. Thus the applied methods indicated a way for research that can lead more laboriously but safer to the ultimate goal.

István Gaál’s work meets the demands set to an academic doctorate thesis both in its form and its content, thus I definitely propose it to be subjected to an open discussion. As the method of the analysis of the source material is modern and it certainly corresponds to the goal of the work, the social historical results are supported by objective data obtained from the analyses, I propose that the Committee grant the degree to the candidate.

Pál Raczy

The opponent, whose task was to evaluate the archaeological activity of the candidate, is in an easy situation since he is personally acquainted with István Gaál’s academic career. He is a person of whom one can say that his work has developed in systematically developed scholarly arc, in which the next logical step would be the title of Doctor of the Hungarian Academy of Sciences.

The rigorous treatment of the factual information, in a positive sense, of his working practice was fully developed during the time he spent at the University of Saarbrücken within the framework of a Humboldt grant as well as under the influence of Jan Lichardus, his professor, who played a major role in shaping the candidate’s career. István Gaál actually started his long-term archaeological analyses and the foundation of the method applied during this period. He became interested in the complex problem of cemetery analyses at the end of the 1980’s. His own archaeological investigations in Southern Transdanubia offered, among other things, a first rate material basis, especially the Late Neolithic burial units uncovered at Mórágy-Tűzködomb. In the 1980’s, he succeeded in widening his investigations based
on quantitative analyses with his studies of correlations between a number of unearthed cemeteries of the European Neolithic. His treatment of the topic was deeply permeated by the “Saarbrücken school” and the statistical method that Jan Lichardus used in his cemetery analyses of the Rössen culture. The candidate’s dissertation entitled “Social Archaeological Analyses of the Central-European Neolithic cemeteries” crowned this work and it appeared in the form of a book in 1988. All these studies focused on the complex general archaeological-historical problem of describing the relationships between the settlements and cemeteries, the possibilities for which differ from period to period.

István Gaál’s academic doctoral dissertation carries on the examination of the same methodological problem, on the mind of nearly all Neolithic archaeologists, with respect to the relationships between the settlements and the graves of the Lengyel culture in Southern Transdanubia. At the same time, this new “case study” offers a basic source for better understanding the Late Neolithic history of this major geographical unit and so the choice of the subject can certainly be approved. Prehistoric studies need, from time to time, syntheses that also try to integrate the ever growing quantity of new data into a qualitatively up-to-date model. This process naturally generates new questions and inspires new approaches in archaeological research.

István Gaál’s review involved the analysis of archaeological features related to 658 persons buried in 628 graves in 12 sites in Southern Transdanubia. We are faced with the initial axiom, which raises certain doubts, in his description of the theoretical background to the study right at the beginning. The candidate writes “...both the small and large grave groups and the individual graves found in a number of places are discussed as separate cemeteries based on methodological considerations. Thus, we have counted 35 cemeteries in the analyses.” This is how 21 cemeteries are described at the Zengővárkony settlement and 3 cemeteries at Mórágy. This “a priori” methodological statement would require a more detailed explanation. The statement is all the more astonishing since there is only a single grave in the so-called cemetery no. 7 at Zengővárkony (pp. 61–62). Thus, whether we respect Ch. Peschel’s or O. Höckmann’s cited criteria on the number of the graves required to define a cemetery (12 or 10 graves, p. 60), the independent existence of cemeteries no. 7 as well as of cemetery no. 8 at Zengővárkony, which have only 1 and 2 graves apiece, is very questionable. All these questions naturally raise further cognitive-philosophical problems. Namely, if the accepted rate of an archaeological examination approaches the groups of graves pre-determined within a system of such tiny “elementary units”, how can the coherence of the macro structures, units of larger numbers of graves representing a higher level of integration be determined? To make this dilemma more apparent let us take an example: The Aszód site of the Lengyel culture is well known from preliminary reports. Here, 3 large groups of graves can be distinguished, all definitely separated in space (Kalicz 1985, 30–33). Our question is whether this would represent 3 groups of graves from a single cemetery, as Nándor Kalicz, the excavator of the site himself interpreted them, or three independent cemeteries?

In our view, an archaeological analysis should proceed in the reverse direction. It would be more appropriate to start from a given random set of burials and let the inner quantitative analysis of this set lead to a stage where certain subsets (groups of graves) can be identified and determined within the set followed by the archaeological explanation comprised of the definition and an explanation of the chronological and spatial correlation of the graves. Only then can we speak of independent graves, grave groups, cemeteries, perhaps a regional system of cemeteries and the relationship of these units with diverse levels of the settlement units. In this approach, a “cemetry” is not a predetermined fact but a structure representing a certain hierarchical level, which appears as the result of a comparative analysis. This discussion strategy should follow the accepted method for the analyses of various settlement phenomena and units of increasing scales, since in itself the clarification of the correlations between the settlements and the cemeteries seems to demand this logical process.

In connection with any discussion of the aforementioned broader, systems theory approach, another similarly important problem should be raised, apparently neglected by István Gaál in his dissertation. We refer to the very important basic factual data used in the
general demographic and representative sampling methods. These contribute to the essential foundations of a social reconstruction. It is not an accident that this subject has also been discussed by N. Nieszery in his reconstruction of the actual population size in the synthesis of burials of the Bavarian Linear Pottery culture (Nieszery 1995, 13–18). The question is, how the 658 dead individuals discussed by István Gaál can be compared with the total population of contemporary settlements of the Lengyel culture in Southern Transdanubia, and what proportion of the prehistoric population they represent. The representative value of the 658 burials also needs to be determined. Nieszery, for example, arrived at the conclusion, which has larger regional implications, that the cemeteries of the Central European Linear Pottery culture represent the remains of only 20% of the population. His final question paints a rather pessimistic picture: “Was also ist mit knapp 80% der verstorbenen Bandkeramiker geschehen?” The situation is perhaps even worse owing to the fact that the dead found in the cemeteries were not chosen by random sampling which might have been more representative of proportions within the original population in a given smaller sample. Accordingly, the statistical analysis of cemeteries cannot provide an authentic picture of the entire Neolithic population. As P. van de Velde wrote in his study on the burial rites of the Linear Pottery culture: “And here lies a problem, for I do not believe that the selection of the people to be buried in the Bandkeramik cemetery was random in any statistical sense. When sociological, ethnographical or demographic research questions are to be answered from a graveyard, it should first be established that the relevant funerals have occurred randomly, as regards precisely these dimensions” (Van de Velde 1997, 85–86). Thus, we are left with a feeling that something is missing with regard to the estimated entire population of the Lengyel culture in Southern Transdanubia, the chosen scene for the analysis. Nor can we tell to what degree the relevance of the statistical data from these 628 graves can be extended to a larger territory. It should also be discussed in greater detail the chronological interval the graves used in this analysis represent in an absolute sense, since chapter 2 on the chronological problems attempts only a relative chronological sequence. Perhaps the 14C data cited in connection with Lower Austria on page 53 can be accepted as a directive regarding the Lengyel culture (4900–4300 BC). This identifies the complex chronological span of the phases of the culture, characterized by painted ceramics, as lasting 600 years. It seems likely that the Lengyel graves studied in Southern Transdanubia fall approximately within these boundaries.

János Makkay made estimations of this type in relation to the Tisza culture on the Great Hungarian Plain in 1982, regarding the calculated number of the population based on the sizes of the settlements and the houses and the capacity of the arable lands (Makkay 1982, 124–163). Lately, Nándor Kalicz has summed up the settlement data of the Late Neolithic in Hungary and their connection with the size of pertinent populations (Kalicz 2001). Among other things, he estimated a population of 45 000–50 000 individuals and a population density of 0.5 persons/km² in any given period of the Late Neolithic for the Lengyel–Tisza–Herpály–Csőszhalom culture complex. These data constitute basic values that allow evaluating the number of unearthed graves in a settlement in a relative sense as well. An absolute factual example is offered by Zengővárkony, where in the case of the estimated total number of graves from the entire duration of the cemetery (cemeteries in István Gaál’s opinion; about 400 years) containing 4000–6000 objects (Kalicz 2001, 160), the unearthed 658 burials would have represented from 6 to 9% of the population. Given a population estimate of 20 000–25 000 individuals in a generation as proposed for the Lengyel culture based on the settlement historical data, a population of 6000–8000 individuals can be supposed in Southern Transdanubia. Extrapolating this value to 24 generations in 600 years, we get a complex population number of 144 000–192 000 individuals. Examining the 658 burials discussed in the dissertation from this point of view, we get a representative value of 0.4–0.3%, which does not do credit to the relevance of statistical analyses.

To continue in this line of thinking, we should call attention to another important point. The social, demographic and other specifics of the Lengyel culture in Southern Transdanubia and, in general in the eastern region, derived from grave analyses cannot automatically be
applied to the western regions of Transdanubia. There is hardly any information on burials from this region, or more exactly, none of the known cemeteries are linked with settlements, meaning that a basically different set of regulations determined the burials as a whole. Thus, we cannot set up “universal laws” even within the Lengyel complex regarding the cult of the dead.

Starting from the same methodological concept, we can question another conceptual unit of the dissertation, which deals with the early Copper Age cemeteries of north-eastern Bulgaria (pp. 18–22). What connection in reality can this “case study” have with regard to the given region of the late Lengyel culture apart from the fact that both are burials? The majority of the cited cemeteries, especially the Varna cemetery, are chronologically linked with the early Copper age of the Carpathian Basin. Colin Renfrew already suggested in 1978, that the Varna cemetery contained the burials of the elite stratum from a number of communities over a large region. This can explain the unusually high number of extremely rich graves. So it cannot be accepted as a typical demographic and social representant for a single settlement. It also means that the Varna cemetery was exceptional not only in Bulgaria but in the entire territory of south-eastern Europe and any comparison with this cemetery needs a contextual explanation. István Gaál is at fault for not providing an explanation of this archaeological correlation, although it is clear that he suspects the existence of similar social stratification processes in north-eastern Bulgaria and in Transdanubia in the 5th millennium BC. All these problems result, however, in a mechanical conflation of an available research result and a working hypothesis before the analysis of the Lengyel graves at the beginning of the dissertation. It is true that the author shortly returns to the problem of the social conditions of the Varna cemetery in the final summary of his work, and tries to underpin justification of this conflation by finding a correspondence within the find associations of the examined Lengyel cemeteries (pp. 485–487). We think that the combined discussion of all aspects of such a distant cultural review should have been better grounded in this final evaluative part. In addition, the remarks cited from Jan Lichardus in note 135 and the ones regarding A. Häusler are relevant as well to this thematic unit, that is, the north-eastern Bulgarian Copper Age cemeteries.

A substantial part of István Gaál’s dissertation is grounded in the theory that the personal jewellery and articles of wear and use by the buried persons can be differentiated from the objects, the grave furniture, that the members of the community placed in the graves. From this starting point, he reviews the graves of the Lengyel culture in Southern Transdanubia in thematic units of three basic find categories. As every specialist must know all too well, the attribution of such finds into these categories can sometimes prove very difficult although such a simplification of the situation seems necessary from the viewpoint of an analysis. Further targets of the analyses are the grave as a unit in and of itself (grave constructions and the shafts) and the specifics of the positioning of the dead (e.g. the orientation, the position, the body posture). As a summary of the aforementioned criteria, the thesis defines 16 bodily posture groups, 14 groups of grave furniture offerings, 19 groups of tool offerings and finally 14 types of jewellery wearing customs. These variables can be interpreted with respect to the burials as the co-ordinates of a multivariate function. Comparison of the graves, therefore, actually requires a multidimensional functional comparison.

István Gaál uses statistical methods to analyse all the elements in the previously described variables, which he calls “groups of burial customs”. In essence, the preparation of the combined tables of the grave furniture, the tools and the articles of wear constitute the basis of the cemetery analysis. In this work, only those graves could be included that contained more than one find type and only when the same combination of finds occurred more than once. Altogether 101 custom groups are identified and statistically analysed, including the evaluation of their correlations. Table 5/1 sums up the distribution of the 8 find group categories according to the occurrence of the categorised objects of the graves in cemeteries in Southern Transdanubia. By analyzing the custom groups of grave furniture, offerings, tools and jewellery wearing, István Gaál is able to group the burials in 13 combination units, which, according to him, each defined a group in the prehistoric society in question. The
seriation analysis of the grave furniture, the tool and jewellery finds by graves resulted in 85 “find group combinations”, of which the limits of 11 “find ranges” are outlined by the demonstrated similarities. In the next step, the analysis of the position of these find ranges within the individual cemeteries is described. This is best illustrated in the distribution shown in table 5/2. The Mórágy-BI cemetery is especially interesting, since here the relationships between kinship groups from I to XII determined and 8 find group ranges could be examined by seriation analyses. The outcome seems to be somewhat negative, since the biologically determined groups cannot be unambiguously identified with certain of the find range groups. At the same time, larger find group ranges match the horizontally clearly differentiated grave groups in the cemetery. To us, this suggests that, in the case of the Mórágy BI cemetery different associations of objects were used within the kinship groups of the coeval population to express social differences. If this can be established in the case of a single cemetery, it is even more true for the more dispersed cemetery system in a broader geographical region.

An immense practical work and the computerised treatment of a huge mass of data lies behind the logical train of thought and hierarchical analytical method of the dissertation. At the same time, the so-called attribute analysis, the system of burial custom groups, find groups, find group combinations and find ranges provide frameworks for a systematically worked-out method.

The bulk of the archaeological “small work”, which demands a lot of energy, is best illustrated by the chapters on ceramics. It is a pity that the analysis of this thematic entity is divided into two distant chapters (“Classification of the grave finds – Ceramics” pp. 207–280, and “Combination analysis of the ceramics” pp. 348–414). Nevertheless, it is obvious that from the point of view of Late Neolithic cemetery analyses, vessels contain the most information about relative chronology despite the fact that even they follow the dynamics of the contemporary social processes with a considerable delay. The deep analysis of the ceramic shapes and the groups of ornamental motives and their interrelations revealed chronologically meaningful correlations (Table 5/11). Table 5/12 offers an impressive representation of the results of seriation analyses carried out on 64 vessel types from 94 burials with the introduction of the most probable relative chronological series. The typo-chronological evolution of the vessel types outlines those ceramic groups, that represent theoretical development phases within the complex unit of the cemeteries of the Lengyel culture in Southern Transdanubia. Thus, with regard to the vessel combinations that characterize relative chronology, the probable sequence of cemeteries in Southern Transdanubia could also be set up (Table 5/14).

Following this step, it seemed logical to match the theoretically implied “ceramic horizons” with the general chronological system developed for the whole of the Lengyel culture (5/15). We feel that in this chronological table, which integrates the development in the territories of Slovakia, Austria as well as Hungary, the phase system of the former also includes settlement historical data, while István Gaál’s chronological system is based on the results of cemetery analyses in Southern Transdanubia. It should be sufficient to mention that only the vessels that occur in the graves more than once can be used for chronological analyses, while the settlement materials contain a much more modest “vessel type range”. This way, certain immanent asymmetries are integrated into this morphological i.e. typo-chronological comparison although it clearly reflects a particular working hypothesis. An ideal working program for the future would be one that could identify the find correlations of the settlements that belong to the Southern Transdanubian cemeteries of the Lengyel culture and especially ones that could determine their ceramic horizons and how they can be compared to the chronology of cemeteries. To date, accordingly, the analysis of cemetery finds, a local group of sources, provides the basis for the scheme set up to describe the development of the Lengyel culture. It certainly seems provocative to further remark that even so an evolutionary model would be reliable only in Southern Transdanubia, and could not be extended to the whole of Hungary. Finding a solution to this complex problem is definitely not István Gaál’s sole task, yet perhaps it outlines the dimensions of the overall program that Hungarian prehistoric research must develop.
Chapter 6 paints a meticulous and very convincing picture of the surrounding cultures linked with the Lengyel culture and their general relative chronology. I mention here, as a small detail, that I miss a more emphatic use of S. Dimitrijević’s system concerning the chronology of the Vinča culture, since he differentiated phases D1-D2-D3 and he dealt with this problem in a much more detailed manner than B. Bruckner. We would find it equally important to integrate W. Schier’s recent publications, since he was the last author who reviewed all the former detailed debates on Vinča chronology and who set up the most comprehensive relative chronological table. He deserves more than a footnote (p. 419, note 11).

The relative chronology of the Late Neolithic of the Hungarian Plain clearly shows the main points of debate, especially the role of the correlation between finds from Bicske and Őszöd in the comparison between Eastern and Western Hungary. The chronological evaluation of the Tisza-Herapy-Csőszhalom complex in relation to the Neolithic cultures of Transylvania and the Banat region, especially the Vinča culture, would perhaps be better if Gh. Lazarović’s and even more importantly F. Drasovean’s arguments would be presented since these contradict ideas shared by Hungarian archaeologists. The essence of those theories is that the beginning of the Late Neolithic in the Carpathian Basin can only be linked with the Vinča C period, so a correspondence with the B2 phase, as has been suggested, is out of the question.

The chapter entitled “The social archaeological conditions of the Southern Transdanubian Late Neolithic population” was intended to sum up the conclusions drawn from the immense analytical work carried out by István Gaál. In effect, we feel this thematic unit to be fairly modest after the impressive extent of previous analyses. Only 13 pages close the very intensive studies described over 400 pages, and even this historical social synthesis remains on the level of generalisations. The reference list should also be updated with the integration of the theoretical results from the most recent volumes (e.g.: M. P. Pearson: The Archaeology of Death and Burial. Phoenix Mill 1999; F. McHugh: Theoretical and Quantitative Approaches to the Study of Mortuary Practice. BAR IntSer 785, Oxford 1999; P. K. Wason: The Archaeology of Rank. Cambridge 1994; U. D. Price – G. M. Feinman (eds): Foundations of Social Inequality. New York-London 1995; J. E. Arnold (ed.): Emergent Complexity. Ann Arbor 1996). An increasing number of theoretical debates have lately concerned tribal and clan type organisation, which really reach beyond the framework of the present work. Thus, the problems of tribes and political unity could only superficially be mentioned in relation to Late Neolithic communities.

The dissertation is complemented with sections including the “Catalogue”, “Illustrations”, “Plates”, “Typological tables” and “Cemetery maps” organised within an independent volume. These help in understanding the results of the statistical analyses and to follow the logical line of the thematic units. This work in itself is enough to illustrate the extent of István Gaál’s work, which has created a quantitative basis for a discussion of the social questions surrounding the Late Neolithic in Hungary and, at the same time, presents us with an example of the genre of such complex synopses.

Nothing can better illustrate the significance of István Gaál’s scientific work than the archaeological literature that the author used in the dissertation under discussion here. It is certainly the result of a long collection, something evident from the candidate’s curriculum vitae as well.

In addition to the merits of the dissertation, one must also stress the role the candidate plays in Hungarian and international scientific life. This role was defined by the opportunities offered by the Humboldt grant and the system of European contacts he developed from this base. The working conditions provided in the Archaeological Institute of the Hungarian Academy of Sciences, and the outstanding scholarly weight of this research centre, secured a potent scientific background.

Summing up all these points, that is, recognising the merits of the dissertation and putting stress on the role the candidate plays in international scientific life we state securely that István Gaál is qualified to receive the title of Doctor of the Hungarian Academy of Sciences. Accordingly, we suggest that the Examination Committee appointed by the Doctoral Council of the Hungarian Academy of Sciences supported the candidate in the appropriate administrative process.
POSSIBILITIES OF THE SOCIAL-ARCHAEOLOGICAL STUDIES OF THE NEOLITHIC

I handed in my dissertation for the academic doctoral degree titled "The history of the Late Neolithic in Southern Transdanubia. Typological-chronological-social archaeology" to the Hungarian Academy of Sciences in 1991, and defended it in 2003. I analysed the cemeteries of the Lengyel culture with the so-called feature analysis (Merkmalanalyse), discussing the relationship of the living and the dead in the Neolithic, the bases of the analyses of Neolithic cemeteries, their possibilities and limitations. The case study was the result of the analysis of an early Copper Age cemetery in NE Bulgaria. I sketched the purpose and methods of the work, summed up the earlier and recent research history, the chronological problems and settlement patterns of the Lengyel culture in Hungary, Slovakia, Moravia and Austria.

I started the analysis of the cemeteries of the Lengyel culture in Southern Transdanubia with the determination of the burial rites (metric features, special grave features, grave shafts and grave constructions, depth of the graves, anthropological and biochemical analytical results, burial customs), the practice of providing grave furniture and the grouping of these practices, and groups of tools, jewellery and costumes. The next step was the classification of the grave finds, which included the analysis of the ceramics and the typological grouping of the polished stone tools. In the course of the feature analysis of the cemeteries I could determine the combinations of the groups of burial customs, the problems of group evolution and "ranking", the combinations of find groups and the ranges of finds.

The combinatory analysis of the grave ceramics with the determination of the correlation between the vessel shapes and ornaments played an especially great role in the relative chronological analyses. The results produced by my analytical method helped to determine the relationship of the Lengyel culture with the surrounding cultures, especially the Vinča culture, the Sopot culture and the Protolengyel horizon, just like the Late Neolithic cultures of the Hungarian Plain. At the same time, it afforded to prepare a summary of the information we have gathered about the burial rites of these cultures.

In the recapitulation, we could follow the development of the Lengyel culture as it is reflected in the archaeological feature groups, looking for answers concerning the social archaeological conditions and organisation of this Late Neolithic population.

Nándor Kalicz, Tibor Kemenczei and Pál Raczky evaluated my dissertation, and in the followings I will try to answer the questions and problems they raised in their examiner's reports.

Tibor Kemenczei stated that my study contained partly more and partly less than it could be expected after the title. We can agree that the history of a prehistoric period or culture cannot be described only from the data of cemetery analyses. We also mentioned that a really authentic picture can be drawn only from the combined analysis of the find materials of cemeteries and settlements, but we do not have settlements or settlement fragments unearthed to a considerable extent from the Southern Transdanubian sites of the Lengyel culture. We know contemporary Neolithic cemeteries and settlements only from the large tell excavations in the Great Hungarian Plain (Alföld) and from Asződ and Svodin (Szőgyén), which have not yet been published. From the occupation territory of the Lengyel culture, the Brześć-Kujawski site should be mentioned, where an entire system of trapezoid houses and grave groups was unearthed and analysed on a high standard. The results were taken into consideration at the discussion of the social archaeological issues.
P. van de Velde analysed the social structure of the western Linear Pottery culture preceding the Lengyel culture on the highest standard so far, although the settlement features from Elsloo and Heinheim investigated by P. J. R. Modderman were given only a secondary role beside the analysis of the Elsloo cemetery. Yet, in the western Linear Pottery culture, the Elsloo site is the only one where the relationship between the settlement and the associated cemetery can be examined even though the period of the use of the cemetery does not entirely overlap that of the settlement.

658 burials unearthed in 628 graves at 12 sites in Southern Transdanubia is really not a large sum, it is, however, sufficient to analyse the problems on an appropriate level from a historical aspect as well. A really modern excavation, where all the details of the excavation were recorded was conducted only at Mórágy-Tőzködomb. A new feature of the analysis of the Mórágy site was that beside the anthropological examination of the skeletons executed by Zsuzsanna K. Zoffmann, Imre Lengyel made biological (sero-genetic) analyses as well, so the sex of the infant skeletons of diverse age categories could also be determined.

The analysis of the grave groups unearthed by Mór Wosinsky on the Lengyel rampart caused the greatest problems, since neither the drawings of the graves nor a cemetery map, not even the skeletons were preserved, and the majority of the preserved finds could not be identified by graves. János Dombay prepared a relatively exact documentation of his excavation observations, but already Zsuzsanna K. Zoffmann called attention to the contradictions between the published descriptions of the graves and the data of the cemetery maps. It should also be mentioned that only about fifty skeletons were preserved from the 368 graves of the Zengővárkony cemetery. Most of them can be affiliated to certain grave groups, so the data of the anthropological and biological analyses offer a good opportunity to deduce significant conclusions.

The quantitative and qualitative components of phenomena and objects linked with the burial customs can furnish information on the position of the buried persons within the community yet it is just a vague reflection of the one-time reality. We also hinted at it and we have to mention, from this respect, the obvious difference that appears, for example, between the glacier mummy from Tirol and the Neolithic-Copper Age skeletons uncovered during the excavations. Tibor Kemenezei agrees that the grave finds of the Lengyel culture offered favourable conditions for the application of any kind of cemetery analysis. Yet he has doubts concerning the opinions cited from authors who thought that the prehistoric grave furniture...
marks ethnicity or who identify certain prehistoric cultures with ethnic groups and try to find the evidences in the ceramics. He is of the opinion that not even the prehistoric burial rites can be used as evident data for an ethnic affiliation, pointing out that a population having a specific culture could use diverse burial customs, and the rites could change by time.

The science of prehistory has supposed behind the individual prehistoric cultures an ethnicity of a mutual origin and the community of related population groups. G. Kossina's statement that the "cultural provinces" are identical with certain peoples or tribes of peoples triggered a debate that lasted for decades, which has not been closed even to date. Initially, the anthropological and the ethnological arguments had a great role in the debate on the concept of culture. The find-centred notion of culture was born in the 50's, and a decisive role was lent to the features of the archaeological objects as well. The most important results of this activity can be found in U. Fischer's works. He supposed that the characteristic features of the burial customs are conform with certain "ceramic types" and identical ethnic units can be supposed behind identical archaeological feature groups.

In this respect, I would like to mention the followings. The use of the term "culture" is ambiguous in prehistoric science, it means nothing but the classification of the finds in a systematic scheme, which is usually associated with the ethnic, economic, ideological or political groups of the people who produced and used them. Nevertheless, the material culture is often different even at groups living in the same geographical environment within identical economic conditions. A "culture" can show a uniform picture even independent of the ethnic barriers. Prehistoric peoples and tribes cannot be determined the same way as e.g. minerals. The evolution of a people or a tribe does not always follow the same pattern. Nevertheless, the "culture" construed from the statistics of finds, already indicates, even with its limitations, the defeat of the forced social economic trend of the past decades in Eastern Europe. The concept of culture, however, should encompass all the living conditions available. The greatest problem for and archaeologist of prehistoric periods is that he cannot see everything. The group formation derived from the finds, at the same time, is not based singly on the subjective opinion of the archaeologist, it has objective bases as well. The meaning of culture determined from the archaeological find material, especially the ceramics, often changed depending on the comprehension of the individual researchers and the given research conditions. We can find good illustrations among others in the study of the Furchenstich culture, or the Walternienburg–Bernburg culture. In these cases, the barriers of the cultures depended solely on the current opinions of the individual researchers. This is why a critical approach to the sources is so important. It is basically the social economic conditions we examine in their complex interrelationships. In the reasonable use of the prehistoric archaeological material, model building can be regarded as an important method. The use of models, however, can lead to overoptimistic conclusions. First of all the experiences of other fields of science, mainly the natural sciences, are borrowed in an unchanged form at the

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11 Fischer 1956.

12 Angeli 2002, 156.


use of prehistoric archaeological models. One of the most important system models based on archaeological data evolved from the trends of the relationship between the agrarian economy and the number of the population. It says that the innovations introduced in food production resulted in the increase of production, in consequence of which the number of the population grew. Specialisation appeared in production and it increased the significance of exchange. Finally, all these led to the evolution of a layer of a higher status. The change of the social structure had a positive effect on the productive sphere, which, once again, led to an increase in the population. The results of the analysis of the Lengyel cemeteries supported the likelihood of this model.

J. Lüning differentiates the concepts of deductive and inductive culture. The first one is deduced not from the prehistoric source material but from other branches of science, as e.g. U. Fischer associated the Corded Ware people with the Indo-Germans both linguistically and culturally. The inductive concept of culture is based on the prehistoric find material itself. It is a selective method, since the find material represents only a segment of the “one-time reality”, the culture of the people who lived in the prehistoric times. Another selection is also made when the scientific question is raised and the data are classified and grouped, so the inductive concept of culture constantly changes as the investigations develop. In the Neolithic, the concept of culture serves first of all the classification of the archaeological phenomena and marks a higher level of the classification system, which is suitable, at the same time, for the accomplishment of certain tasks and reaching aims.

I myself always use the concept of “social structure” in a sociological or ethnological sense, in agreement with P. van de Velde. This means the division of the communities within a culture according to groups, family relations and kinship relations.

Various burial customs can be observed within the large occupation territory of the Lengyel culture. It is enough to think of the cremation and inhumation burials occurring in the Aszód and Győre cemeteries. The same can be observed at the chronologically earlier western Linear Pottery culture as well, where there are cemeteries with only inhumation or only cremation burials and ones with mixed rites. In the Tiszapolgár-Basatanya cemetery of the Copper Age, research supposed different ethnic groups from the burial rites and especially from the body positions. In the case of the Linear Pottery culture, research dedicated special attention to this problem in the recent years supposing the existence of alien groups that settled over or conquered the autochthonous populations, although the differences are also explained by diverse social layers. The question can be decided in the future with the help of anthropological, or even more probably DNA analyses. It can be observed in the Lengyel culture that the grave group of cremation burials, composing a closed territorial unit in the Győre cemetery, represents the early, initial phase of the culture. Cremation burials are also mentioned from the Lužianky (Sarlókajsza) cemetery of the preceding Protolengyel horizon. The presumption that the communities of the same ethnic group buried their dead in the southern Transdanubian cemeteries of the Lengyel culture, in addition to the fact that the burial rite and the material culture, including the character of the ceramics and the cultic objects, are uniform within the eastern occupation zone of the culture, can be supported first of all by the results of natural scientific analyses. Imre Lengyel’s serogenetic analyses underlined the possibility that a certain kinship relation existed between the inhabitants of the Zengővárkony and Mórágy settlements.
from Penrose identities that the population of the Mórágy group could be autochthonous, and this group could not be effected by alien influences (migration or infiltration) in Transdanubia during the Neolithic, at least it could not be demonstrated by the Penrose analysis.26

Nándor Kalicz mentions that my work embraces a more limited area as it returns to the Lengyeli culture. In the 70’s, I analysed the cemeteries of the Central and Western European Linear Pottery culture as well,27 but without the application of computerised and modern analytical methods and database. In the present study I elaborated a cemetery analysis method which does not only afford the examination of the burial customs and the find material of the Lengyel culture but it also helps the evaluation of the burial customs of the Tiszá and Herpály cultures after a recapitulative elaboration. It can be based on the publications of the burials unearthed at the Gorzsa, Csőszhalom and Herpály sites completed with the addition of the burial features of a similar age found in the eastern and southern parts of the Carpathian Basin in a database and their statistic and seriation evaluations. The Late Neolithic sites unearthed recently in the Hungarian Plain with the most up-to-date methods offer an advantage we lacked in the case of the Lengyel culture in Transdanubia: the system of settlements and burials can be examined in their complexity, mostly within the frames of the chronological relationships determined from the stratigraphical positions.

Regarding the finds, we first focused on the customs concerning the grave furniture, the classification and analysis of the grave furniture, the tools and the jewellery finds, and the determination of the combinations of the relationships. Nándor Kalicz writes: “whatever has been elaborated from this method, based on natural science and mathematics, first of all in Germany, the candidate uses and sometimes even modifies it to comply with the Hungarian conditions...” In this regard I would only like to mention that this analytical method is varied according to various schools in Germany and in Austria, and it constantly changes, as I could experience it during my study trips to Germany. I myself did not go beyond the method of ceramics analysis that I had started to learn in 1987, and which I used for the analysis of the grave vessels of the Mórágy cemetery.28 The typological system of Mórágy has significantly been changed since then as the entire bulk of the southern Transdanubian grave pottery material has been analysed, masses of new typological units has come to existence and the typological-chronological course of the development of the ceramics could be delineated from the earliest Lengyel period of Southern Transdanubia to the latest known period. The analysis of the B1 grave group at Mórágy did not afford such determinations since the cemetery was not used at the early phase of the development. It was opened only in the transitional (Lengyel Ib) horizon, and the majority of the burials dated from the late and the latest development phases.

Another question that arose is that perhaps I separated the type groups of the examined finds into too many elements. When I recorded the ceramics into the database and analysed them, I mainly relied on the results published by M. Dohrn-Ihmig,29 J. E. Doran and F. R. Hodson,30 P. Stehli and A. Zimmermann,31 M. Lichardus-Itten,32 R. Vossen,33 R. Gläser,34 G. Schneider,35 R. Heiner,36 M. Meisenheimer,37 J. Ruf38 and M. Strobel.39 The first aspect I had

28 Zalai-Gaál 2002
29 Dohrn-Ihmig 1983.
30 Doran – Hodson 1975.
32 Lichardus-Itten 1980.
37 Meisenheimer 1989.
to consider was that the Neolithic pottery was hand thrown, so naturally there are no two vessels that are identical in every feature, only ones where a number of features are similar. It depends on the find material itself and the information we have how we divide the ceramic material into its elements. As we could see, the stylistic features have a much greater importance in the ceramic analysis with a typological and chronological purpose than the technical features. It should be added that the chosen features and the archaeological interpretation dimensions (technology, function, spatial and chronological distribution) are linked, yet the majority of the researchers carry out the typological and chronological analyses from the vessel shapes. The measurement and grouping of the technological features is a complicated task, which often cannot be executed in its complexity in the case of grave ceramics. The technological features often do not depend on the culture in a relative chronological sense, they are rather determined by the raw material people could find around the settlement. The technological features do not afford the setting up of a similarly fine chronological system as the other features do.

The vessel shapes can be analysed from various aspects. Only those chosen features can be taken into account that are relevant from the respect of the question we raise and that can serve the elaboration of the so-called artificial and natural classes. In the case of artificial classes, the morphological features of the ceramics were analysed according to a uniform scale of values (functional units).

According to Nándor Kalicz, the features manifested in the individual grades of the typological system can be recognised yet they are so minimal in the final stage of the classification that the necessary information can be attained already in the previous phases of the analysis and it is not certain that the determination of the relative chronological order needs such a detailed classification. The grading comes from the hierarchical classification system of a polygenetic structure used in natural science. At the same time, a code system is necessary to be able to enter the large number of finds, first of all the ceramic material, into the database, and seriation analyses also need this solution. The grading is a simple process. The two classes of ceramics are composed of “high” and “broad” vessels (“Klasse I and II”). Within these two classes we can find the vessel genres (“Gattungen”), which contain the series (“Serien”), which are also metrically determined from the relationship between the individual vessel parts. The morphological groups (“Formengruppen”) were determined within the series metrically and from the profiles. Within these groups, the variants (“Varianten”) and sub-variants (“Untervarianten”) are differentiated only by the similarities and the diversities of the profiles. This classification system has mathematical and also “atavistic” elements in that the typological units of former investigations, that is hollow-pedestalled bowls, tumblers, the so-called Butmir-vessels were the determinant elements in the differentiation of the vessel types. The primary aim of the classification, the perhaps too detailed division of the finds was to get typological units that can be checked by simple measurements. They can be examined in seriation context and the typological features of the finds can be compared not only with the finds of the Lengyel culture recovered from other territories but with the objects of the late Neolithic cultures of the region as well. The hierarchical typological method I used can be further developed on a higher mathematical level. My intention was to reach a level where the relative chronological connections and the typological units that are indispensable for the examination of the development can be separated. It should also be mentioned from the respect of the German method that classification has recently been entirely placed on mathematical bases, e.g. each vessel can be placed within a circle and the analysis is carried out in relation to the circle and the individual vessel regions.

42 In the development of my ceramics typological method I got significant help from Prof. Jan Lichardus when I pursued studies in the Saarbrücken University by the grant of the Alexander von Humbolt Foundation.
I also agree with Nándor Kalicz in that the necessary information (on the relative chronology) can often be attained already in the previous analytical phase. It is true that the relative chronological order can successfully be determined in a previous analytical phase as well. The method I use is necessary first of all because of the exact description and definition of the typological units, which is the prerequisite of an analytical publication in the German and also the Anglo-Saxon research beside a detailed descriptive catalogue. During the years spent with the analyses, the greatest difficulty we had to face was the determination within the hierarchy of the typological system of the level the units of which would be used for the seriation evaluation and of the level the units of which could represent the traditional “type”. However, seriation was made on the level of the morphological groups, versions and also sub-versions. I established that the evaluation on the level of morphological groups (136 graves/47 morphological groups) illustrated the connections between the graves and the ceramic typological units in a too wide plane, while on the level of subversions (76 graves/63 subversion) in a too narrow plane. Seriation in itself cannot solve the chronological problems of prehistoric archaeology. The order of the graves and typological units appearing in the seriation tables has to be compared with the plates illustrating the pottery found in the closed archaeological complexes, that is in the individual graves. It means that the seriation results have to be completed with the results of the traditional-archaeological comparative method, and the result has to be analysed in relation to the cemetery maps. This complex analysis revealed that, in our case, the seriation made on the level of versions provided the most reliable results in the correlation of 122 graves and 75 typological units. Naturally, the results of the analyses made on the other above-mentioned levels can also be evaluated. As it has been mentioned, the chronological system is composed of two grades (I, II), three phases (Ia, Ib and Ila) and five periods (Ia1, Ia2, Ib, Ila1, Ila2). With the help of seriation made from the versions, these chronological units can clearly be distinguished, while the results reached on the levels of series and morphological groups do not answer the question in what proportion the individual vessel types are represented in the larger stages (grades and phases) of the development of the Lengyel culture.

So it can be seen that prehistoric typology is based on chosen features that help the differentiation of objects. The identity and similarity of these features suppose a connection. The starting point of the typological method was the organisation of the types of object groups into a series based on smaller or larger similarities. These series are usually interpreted as development series, which are evaluated according to chronological aspects. Two things, however, need to be emphasised from this respect. 1. The setting up of the typological series is not chronologically relevant in itself; it can gain a chronological significance only in consequence of the interpretation. 2. It should not be forgotten that we deal with the products of human activities, the evaluation of which can define the direction of typological analyses. One of the greatest difficulties of former ceramics analyses was that the typological systems were treated as static formations. Yet they constantly change, so instead of being static, they are dynamic formations, which is corroborated by the results of our analyses. This holds true for the complexity of social archaeological conditions just as well as for the vessel shapes and ornaments.

Nándor Kalicz examines my typological-chronological system in details and mentions the sites in Upper-Northern Hungary that served as analogues to the individual periods of the system. In the systems made by Slovakian researchers, the finds uncovered at Pecenady, Moravany and Santovka had a great role. In these cases, however, find units of small item numbers, consisting of 20–60 sherds, are used, which do not have a representative value from

the respect of chronological analyses. One of the neuralgic points of the Lengyel periodisations has been J. Lichardus and J. Pavúk’s debates carried on for decades on the division of the stages of the Lengyel culture with painted vessels. Not even the analysis of the cemeteries of the Lengyel culture in Southern Transdanubia could decide this debate. A turning point can be expected from the analysis of the 161 graves V. Némejcsová-Pavuková unearthed recently at Svodín (Szögyén) and the 220 graves uncovered by Nándor Kalicz at Aszód, and the evaluation of the finds they contained.

According to Nándor Kalicz, it is questionable to what degree the hierarchy supposed mainly from the distribution of the graves in the cemetery and the finds can manifest itself in the entirety of the associated settlements, regarding the great differences in the size of the examined units. To prove the hierarchy supposed from the quantitative and qualitative features of the finds buried with the dead, he mentions one of the published grave groups from Aszód. The richest grave no. 2 furnished with prestige goods is located in the centre of the group surrounded by numerous graves of infants and women and a few men. It means that “the position (form) of the two grave groups and their finds reflect diverse community conditions within the same settlement” at the Aszód site as well.

Nándor Kalicz doubts that the number of the vessels in the individual graves within the burials can suggest rank order. We certainly agree with his opinion that the number and the combination of vessels have, in this case, only a secondary, complementary role. It can be observed, at the same time, that 19.6% of the burials furnished with vessels contained one vessel, 21.0% contained 2 vessels, and 14.5% had three vessels. Burials with four (10.7%), five (10.0%) and six vessels (5.6%) were less frequent, and only a very low proportion of the burials contained more than 6 vessels (6 vessels: 5.6%; 7 vessels: 2.9%; 8 vessels: 0.7%; 9 vessels: 1.4%). More vessels occur only sporadically in the Lengyel graves in the Southern Transdanubia: 10 vessels were given to an adult male in grave no. 108 at Zengővárkony and a boy in grave no. 109 at Mórágy. Eleven and twelve vessels were found, respectively, in the cremation graves nos. 12 and 13 at Győre, while the largest number of vessels, 21 items, were found in grave no. 114 of an adult at Zengővárkony. So it can be observed that the number of people buried with larger and larger numbers of vessels gradually decreases (diagram 1).

All the three opponents mention the problems raised by the cemetery of Varna, first of all that I compared the hierarchy supposed in the communities that used the Late Neolithic cemeteries in Southern Transdanubia with the conclusions of the Copper Age cemetery of Varna, which I used as a model. I agree with Tibor Kemenczei that the similar or diverse social conditions developed independently at communities living far from each other depending on the local economical, cultural and natural conditions. Consequently, the social differentiation that existed in the communities of the Lengyel culture in Southern Transdanubia developed without the impact of the Varna population. Both Nándor Kalicz and Pál Raczyk think that the Varna cemetery is unique because of its specific character (and geographical conditions) not only in Bulgaria but in Europe as well. Its extreme richness and specific rites differentiate it from
every other cemetery of the same period. It also represents a younger phase than the burials of the Lengyel culture. Besides the entire cemetery has not yet been published, which would be indispensable for the analysis. In the catalogue and the volume of the Saarbrücken conference of 1988, only the finds of the grave units, among them the central grave group, that were considered the most important from the respect of the analyses were completely published,\(^{47}\) which really does not compensate for the publication of the entire material. The elaboration of the social archaeological model of the Karanovo VI–Gumelnita–Kodzaderma culture was carried out not only from the Varna cemetery. The smaller, so-called “rural cemeteries” of the territory consisting of 30–60 graves (Goljamo Delcevo, Devnja, Vinica, Radingrad, Liljak, Targoviste, Kubrat, Ruse, Durankulak, Balbunar, Varaсти, Drídu) are completely published, and the results of the observations made in the Varna cemetery were evaluated in relation to these sites. These cemeteries are located within the same geographically enclosed region and represent stages A2–B1 of the mentioned cultural entity. J. Lichardus differentiated 5 groups within the communities buried in the cemeteries by the grave furniture (Ausstattungskategorien).\(^{48}\) The analysis of the structure of the Varna and the rural cemeteries has demonstrated social differences in regard of both sexes and the children and it could be recognised for the first time that social differentiation is linked not with the individuals but with the families.\(^{49}\) So it can be told that the social system of the Karanovo VI–Gumelnita–Kodzaderma cultural entity was differentiated. Certain layers can be demonstrated among men as well as women and children. Metal trading was concentrated in the hands of the leading personalities. The complexity of the new technique supposes not only a great skill but also the inheritance of the knowledge. It is probable that the development of metallurgy (copper and gold) contributed to the basic changes that happened in the social structure, beside exterior influences. Certain elements of the burial rites of the Karanovo VI–Gumelnita–Kodzaderma cultural entity survived from the preceding Neolithic Boian–Marica entity, continuity can be demonstrated in many features, while significant differences appear suggesting discontinuity. It is important to note that innovations could be demonstrated not only in burial rites but also in religion, economy and society (e.g. copper, cart, horse, plough, trade, temple-like buildings etc.). A hierarchically built social organisation evolved in consequence of the changes, which was headed by the families of a local and an “over-regional” upper layer, as it is proved by insignia and symbols of power. The group or layer of persons of special functions (handicrafts, miners, and traders) evolved. Certain elements of the burial rites differ in the case of men and women and cultic places appear separated from the dwellings.\(^{50}\) These changes can only be explained by exterior impacts, their origin can be found outside the territory of the cultural entity. This is the reorganisation that can be demonstrated in the Early Copper Age of Bulgaria especially in the burial rite. It proceeded on the cultural base of an agrarian population, so the traditions certainly did not disappear; yet a new and very specific social structure came to life. This process cannot be understood in the Balkan and the Central European region through only typological analytical methods. First of all the examination of the structures and the analysis of their interrelations is needed for the investigation of the phenomenon within the safest possible chronological frames.\(^{51}\) At the analysis of the Lengyel cemeteries, we placed the emphasis not especially on the individual phenomena but on the demonstration of the correlation of structures. We examined the analogues of the social archaeological phenomena that appeared during the investigation of the cemeteries in North-Eastern Bulgaria in an earlier phase, in the Late Neolithic of Southern Transdanubia. For me, these results and possibilities meant


\(^{49}\) Lichardus 1991, 186.

\(^{50}\) Lichardus 1984, 142; 1989, 18.

\(^{51}\) Lichardus 1989, 22.
the actuality of the “Varna model” in the analysis of the social archaeological problems of the Lengyel culture. At the same time, I did not suppose the existence of similar social stratification processes in North-Eastern Bulgaria and Transdanubia in the 5th millennium BC.

The burial rites of the Neolithic development, the Linear Pottery culture and the even earlier SE European Early Neolithic cultures were discussed in a number of recapitulative papers in the recent years.52 Ida Bognár-Kutzián evaluated the cemeteries and the graves of the Tiszapolgár culture, which followed the Lengyel culture, and published them still applying the comparative archaeological method.53 The most up-to-date analytical methods were used on Copper Age cemeteries in the case of the above-mentioned NE Bulgarian cemeteries, so it is only here that we had data and results that could give an answer to the above listed questions, the stratification and the hierarchy of the population group that lived in the period following the Lengyel culture. The Lengyel culture lived in its occupation zone between the two mentioned chronological horizons, so it was evident to analyse the social archaeological problems of the Lengyel population with regard to the well investigated earlier western Linear Pottery culture and the appropriately analysed later Copper Age cemeteries. The main emphasis was placed on the question what was new as compared to the earlier phenomena, what differences and divergences could be observed in relation to the social archaeological conditions of the later Copper Age population who lived already in developed tribal communities. I would like to add that the burial rite of the Tiszapolgár culture, which followed the Lengyel culture in the Hungarian Plain, was recently analysed in a number of papers,54 yet non of these studies included all the known Tiszapolgár burials. I have already started the recording of the data of these burials in a database, which will afford social archaeological analyses with the same method I used at the investigation of the cemeteries of the Lengyel culture.

Pál Racky was not convinced of the starting axiom that “the smaller and larger grave groups and the individual, scattered graves are discussed separately for methodological reasons, so we can count with 35 cemeteries during the analyses.” Nándor Kalicz also poses the question: when can we speak of independent cemeteries or only groups of graves? The question is if we can consider all the grave groups that can be distinguished within a larger unit as independent cemeteries or they are parts of a larger cemetery. Ch. Peschel discussed those cemeteries in his study on the burial rites of the western Linear Pottery culture in which at least 12 graves were unearthed and they offer sufficient information for the analysis.55 According to O. Höckmann’s definition we can speak of a cemetery when a burial group contains more than ten graves.56 Larger numbers of graves can be observed in a few grave groups at Zengővárkony, Lengyel and Mórágy. The exact number of the graves in a cemetery is often difficult to determine since the original extent of a cemetery can only approximately be determined and erosion and later disturbances have destroyed many graves. Another question is how many people could live on a certain territory or area at a time, since this aspect is very important in the study of every historical period. The majority of the data on prehistoric periods are not realistic, the data on the size of prehistoric populations are only approximate ones.57

Some researchers estimate the number of the population from the settlements and the settlement features (houses). The analyses based on the size and the structure of the houses can give realistic results only within an identical climatic zone and at populations that carry on identical economic activities, as it has been demonstrated by P. J. R. Modderman’s studies.\(^{58}\)

It was investigated at the settlements of the Linear Pottery culture if the house communities reflect the social units. Three different models were analysed. Accordingly, a small or an enlarged small family or one or more small families or a large family could live in a long house. J. Lüning thinks that not large families but autonomic, cultivating small families lived in the long houses since the palaeodemographic-data prove that at least 50% of the new-born infants died and a very low average age can be expected at persons who lived until their 18\(^{th}\) birthday. Apart from the parents, the small families included two-three “surviving” children and also the grandparents and unmarried girls. Thus a family of the Linear Pottery culture counted 5–7 persons according to Lüning’s calculations.\(^{59}\) U. Veit thinks, at the same time, that no realistic data can be deduced about the number of the people only from the size of the houses: The comparison with the data of other territories and periods also lead to larger numbers than the 5–7 persons per house supposed by Lüning.\(^{60}\)

In the case of the Lengyel group of Southern Transdanubia, this question cannot be discussed from settlement data, it were mainly Imre Lengyel’s serogenetic results from the Mórágy cemetery that we could use (Table 1):

\[
\begin{array}{ccc|ccc|ccc|ccc}
& \text{Kinship groups (family units)} & & & & & & & & & & & \\
& \alpha & \beta & \gamma & & & & & & & & & \\
\hline
A2 & (tools, ceramics, Canis familiaris) & - & 10. male & & & & & & & & & & & \\
D & (jewellery/articles of wear with ceramics) & - & 49. male & 63. Inf. II girl, 51. female, 52. Inf I boy & & & & & & & & & \\
\hline
12 individuals & 11 individuals & 11 individuals & & & & & & & & & & \\
\end{array}
\]

Table 1. Correlation of anthropological categories and find groups at Mórágy

Pál Racky also thinks that the biological (kinship) groups demonstrated in grave group B1 at Mórágy cannot on the whole be matched with certain find range groups. The picture will be different, however, if we examine the relationships in the wider, also kinship groups, in the family units illustrated in Table I. Pál Racky also states that the larger find range groups match the horizontally well-differentiated grave groups in the territory of the cemetery.

It is much more difficult to tell how large the extended families (“erweiterte Familie”) consisting of 2–3 nuclear families (“Kernfamilien”) could be. Similarly to Modderman and Velde, B. Soudsky and I. Pavlů also supposed the existence of these extended families after the analysis of the Middle Neolithic houses unearthed at Postoloprty in Bohemia.\(^{61}\)

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58 Modderman 1970


60 Veit 1996.

The size of the Neolithic populations can best be estimated from cemeteries using the early formula published by G. Smolla. These calculations can answer the question of the chronological interval raised by P. Racky. Accordingly, 328 persons could live at a time in the 12 Late Neolithic settlements in Southern Transdanubia, from where the burials of 628 individuals are known, who were buried in a period of about six hundred years. This can mean an average population of 27 individuals in a village. Thus the number of the family units (houses) could be 3–5 in a village depending on the estimated number of the living members of a family. Another question that can be raised is if there were just as many houses in the large, central settlements like Zengővárkony, Lengyel and Mórágy as in the smaller ones where the cemeteries contained fewer graves. The number of the known sites of the Lengyel culture has increased to about 130 since the recent field walkings. From these sites we can calculate that 3500 people could live at a time, in average, in the investigated region, which means 2 (2.3) individuals on the 8133 square kilometres of the region. Taking into consideration, however, that only about one third of the sites of the Lengyel culture are known, the size of the population living at the same time could be around 10 000 (10 530) individuals, which equals with 0.7 persons per square kilometres. This number is close to the 0.5/km² calculated by Nándor Kalicz for the entire Lengyel–Tisza–Herpály–Csőszhalom complex.

The scientific analyses also furnished data on the demographic conditions. According to Imre Lengyel’s calculations, the serogenetic balance reflected in the significance of the divergence between the uncovered and calculated samples of AB item number proves that the Zengővárkony population counted at least 550–620 individuals. This result was reached from the analysis of 58 bone samples from Zengővárkony (the number of the skeletons that were preserved after the excavations). Examining the 658 individuals registered in the database in relation to Imre Lengyel’s data, we can expect a population of about 7000 individuals only in Zengővárkony during the development of the Lengyel culture in Southern Transdanubia, and this number of the population should be projected to the above-mentioned period of six hundred years. Accordingly, about 1000 persons lived in average in 100 years, that is roughly in three generations. Nándor Kalicz calculated with at least ten thousand burials at the entire Aszób site after the comparison of the size of the unearthed area and the number of the graves found there with the entire extent of the site. Zsuzsanna K. Zoffmann supposed a total population number of 120 individuals and 4–5 small families of seven members, in total 32–36 individuals at a time during the analysis of the grave group B1 at Mórágy. She concluded that the rows or concentric circles of the graves imply that the population that used the cemetery consisted of 4 to 6 families, on the condition that the cemetery was used during at least four generations. The grave group B1 at Mórágy, however, was used only in the transitional and late horizons of the Lengyel culture and at least four or five larger grave groups can be expected at the site after the surface observations. So not even the scientific analyses can unambiguously determine the size of the populations and the number of the generations that used the cemeteries.

As we could see, the question how representative the graves are poses one of the gravest methodological problems in the prehistoric cemetery analyses since the number of the known graves is too low as compared to the estimated data. The results of the “large regional” and “small regional” analyses should also be mentioned in this respect. According to calculations

64 Imre Lengyel’s report on November 24 and 26, 1985.
POSSIBILITIES OF THE SOCIAL-ARCHAEOLOGICAL STUDIES OF THE NEOLITHIC

made from the settlement data in the territory of Aldenhovener Platte, 5000–10 000 people could live at the time of the Linear Pottery culture yet only a single cemetery of 112 graves (Niedermerz 3) is known there.67 A ten times larger population is supposed in the territory of Graetheide, Holland as well, while here, too, only a single cemetery of 113 graves (Elsloo) is known.68 One hundred graves of a population of 10 000 individuals have been unearthed, that is the proportion of the graves is only 1% (an intensive archaeological topographic activity was pursued in both territories so it seems possible that the population of the Linear Pottery culture used only a single cemetery). According to the principles of population statistics, a sample of one hundred items is sufficient for statistic analyses independent of the size of the basic population. It is not the relative proportion of the sample but the absolute size that is important. Analysing sociological, anthropological or demographic issues in a cemetery, we have to accept that the examined burials were randomly chosen. The situation, however, is different in the case of the Lengyel cemeteries. Here every recorded grave and relatively many cemeteries or grave groups are included in the analysis. Some colleagues suppose from the above discussed arguments that more than 1000 individuals could live in the Niedermerz region during more than six generations, from whom only 102 inhumation and 10 cremation burials have been preserved. The rest could be burnt, buried in a small depth, the graves could be destroyed by the plough or erosion.69 In the case of the inhumation burials, a minority is supposed, the role of which within the total population is not yet clarified.70

The problem of the representativeness of prehistoric graves appears in a new light when they are first examined within small regions. If the Elsloo cemetery belongs to a single nearby settlement where 8–10 houses accommodated 5–6 persons, the coexistence of 40–60 people can be supposed in the settlement. Thus the approximately three generations that used the cemetery could bury here 120–180 dead persons, only a little more than the unearthed 113 graves.71 Niedermerz is more complicated from this respect. The cemetery is about 500 m from the nearest three settlements, and some more hamlet-like settlement remains were found at a distance of 700–800 m. Relying on the Elsloo data, the population of a single settlement used this cemetery as well. If only the settlement Langweiler 8 is regarded, the 7–11 contemporary houses could bury 250–300 dead during six generations.72 In this case, however, the dead buried in Niedermerz represent not a minority but a significant proportion of the total population.73 Naturally the results of both analytical methods are uncertain, the boundaries cannot be definitely drawn between speculation, hypothesis and proof.74

As it has already been mentioned, all the known and sufficiently documented graves of the Lengyel culture from Southern Transdanubia are analysed in the study. Most of them were uncovered in larger cemeteries, grave groups and clusters, although many sites yielded only a single or a few burials. The recapitulative evaluation discusses the consequences that can be drawn from these latter occurrences. The smaller and larger grave groups unearthed at Zengővárkony, on the Lengyel rampart and on the Tűzkődomb at Mórágy and the single graves uncovered at various sites are discussed as cemeteries only because of methodological reasons. The expression “cemetry” was used as a technical term supposing that the graves composing the totality of the territorially linked burials at a site, distributed in groups and, within the groups, in clusters, contain the bodies of persons of the same kinship. The quantitative and qualitative analyses were carried out in typological, chronological and social archaeological
contexts not only in respect of the individual burials and grave clusters but also in relation to all the burial features unearthed at a site. Thus the occurrence of every phenomenon and manifestation is examined from the respect of the relationships, divergences and similarities between the Zengővárkony, Mórágy and Villánykövesd cemeteries. In the book I am preparing from my study, however, respecting the extremely useful pieces of advice from my opponents, I write about the Mórágy, the Zengővárkony and the Lengyel cemeteries, discussing the grave groups and clusters in separate territorial units. Nándor Kalicz agrees with me that the grave groups composed an independent unit within the larger organisational units of the populations of the settlements, so their independent analysis is justified. The discussion strategy of the Lengyel cemeteries in Southern Transdanubia, however, did not afford the application of the known method of the increasingly intensive analysis of the various settlement phenomena and units, which Pál Racky misses from my study. He expected to see the sketch of the dimensions of the archaeological program to be accomplished by the prehistoric research of Southern Transdanubia. The analysis of the settlement features and finds will be the second stage of my study on the Late Neolithic of Southern Transdanubia. Up to now, the ceramics from Zengővárkony and Mórágy have been entered into the database and the associated photos have been made. The drawings of the profiles, which are indispensable for a typological-chronological analyses are continuously prepared. The evaluation of the drawings of the cuttings illustrating the position and place of the settlement features (pits) at Zengővárkony, published by János Dombay, and at Mórágy prepared by us will also be made. Only then can we determine the relationship between the graves and the settlement features under or above them, which seems to be especially difficult at Zengővárkony since the settlement material unearthed at the site was strongly selected and the layers were not respected at the excavations. DNA analyses should be included in the archaeological project, which can be made in the Archaeological Institute of the MTA in the future and the settlements should also be excavated.

Nándor Kalicz also raises the question of the evaluation of settlement burials. The population of the western Linear Pottery culture established uniform, huge cemeteries as well in its occupation zone, which were not at all or only sporadically known in the territory of the later Lengyel culture at the time of the Linear Pottery culture. Taking into consideration the 96 graves from Vedrovice, Moravia,75 the 24 graves from Rutzing, Austria,76 and the more than 60 graves unearthed at Kleinhdersdorf,77 “the Nitra cemetery with the 76 unearthing graves does not really seem unique. So we can probably expect the existence of grave groups and cemeteries of the Linear Pottery culture in Transdanubia as well beside the known settlement burials.” The recently unearthed Linear Pottery graves from Balatonszárszó do not compose a closed, uniform cemetery, according to the publications, like the ones known e.g. from Nitra78 or the Rhine region.79 István Torma could not find any trace indicating such a cemetery during his systematic field walkings in Tolna county.80 The reasons of the diverse burial forms and customs in the western and eastern geographical groups of the Lengyel cultures are not simply due to the actual state of investigations. A noteworthy phenomenon can reinforce it. During the

intensive field walkings conducted in the northern part of Zala county in the recent years, 124 new sites of the Lengyel culture were discovered yet no trace of cemeteries or grave groups could be demonstrated.\textsuperscript{81} This cannot be ascribed simply to the soil conditions, which are unfavourable for the preservation of bones, especially if we take into account that the burials could be documented at Elsloo and also in Niedermeyr only from the imprints of the skeletons ("Leichenschatten"). The state of investigations is, however, really responsible to a certain degree for the lack of the cemeteries of the Linear Pottery culture.

H.-P. Storch was the first to call attention to the evident disproportion of the Neolithic settlements and cemeteries during the analysis of the Linear Pottery sites of the southern Upper Rhine region.\textsuperscript{82} In the case of extensively studied settlement areas of the Linear Pottery culture, N. Nieszery compared the population number estimated from the houses with the number of the graves that could be associated with them or were unearthed in their vicinity. He arrived to the conclusion that the few burials of the Linear Pottery culture made only 20\% of all the buried people.\textsuperscript{83} This is explained, among others, by the fact that the main burial rite was cremation and the depth of the graves with scattered ashes is modest and they were furnished with less grave furniture than the inhumation burials. This raised the question what had happened to the 80\% of the deceased population. The same problem holds true for the Late Neolithic, Early Copper Age period as well even though similar demographic analyses cannot yet be made in the case of the Lengyel culture at the present state of investigations. First it should be clarified if only a certain part of the population was buried in the cemeteries of the Linear Pottery culture and the Lengyel culture. Some researches think it evident that all the members of a community are buried in the same cemetery. This is nothing but the mechanic adaptation of ethnographic analogues to prehistoric situations. According to G. Kurth, a prehistoric anthropological series is representative only when the proportion of not adults (infans 1 and 2 and juvenile individuals) is higher than 60\%.\textsuperscript{84} K. Randsborg thinks that it cannot be expected that both sexes can be found in a cemetery in equal proportions from every social group.\textsuperscript{85} A number of cultures and cemeteries are known from the Neolithic where probably not the entire population is present. For example, the dominance of males or females, the lack of children can be due to defective anthropological identifications, or that the researchers concentrated first of all on the more robust male skeletons, as it could be observed in the case of the Zengővárkony excavations. These problems were raised with regard to the development of the Central European Lengyel culture as well.

Nándor Kalicz finds the extension of the role of white painting to the Sopot culture questionable since vessel painting is missing from this culture in the territory of Croatia except for the younger, that is Brezovljani phase and the imported Lengyel vessels. We agree that this period is not only the period of disintegration into groups but also the time when a second significant expansion took place, which can be observed first of all in Carinthia and Slovenia. The Drava-Sava Interfluve, however, does not belong to the border zone. Ceramics of pastose painting occurs in numerous, geographically strongly connected cultures in the territory from the Aegean to Moravia. Its chronological importance is that it appears not as an isolated phenomenon but within a large, closed region, and the Vinča-Pločnik culture played an important role in its distribution. The "prestige goods" of pastose painting, however, did not have a practical function, since the very thick chalk-like matter, applied on the surface after baking, readily peels off from the vessel. The real pastose white painting applied after baking first appeared at the beginning of the Neolithic. It is true for the Tisza, Herpály and the Lengyel culture alike, although it cannot be decided as yet where this characteristic ornamental technique came from. It more likely arrived from the south than from the north.


\textsuperscript{82} Storch 1984–1985.

\textsuperscript{83} Nieszery 1995. 16 and 19.


The finds unearthed in the Győré cemetery, which are unique in the Central European Neolithic, especially the typological characteristic of the vessel with a band-handle unearthed in the cremation grave no. 12, yielded further data to the study of the southern, south-eastern contacts of the Lengyel culture. The "Knopfhenkel" vessels appeared in the SE European region together with the black burnished ceramics. The first black burnished ware appeared in the Struma valley (Kovácevo) in the Balkan at the end of the Early Neolithic (Karanovo II) and it became a characteristic element of the Middle Neolithic development characterised by the ceramic material of Sitagroi I and II and Dikili Tash. They are such super-cultural processes that led to the evolution of the Vinča culture and the Dimini-Tsangli, Karanovo III, Dudešti, Usoe, Sopot, Kakanj and Danilo cultures in Southeastern and Central Europe. The transition from the early to the middle Neolithic in the Balkan ran in parallel to the transition from the middle to the late Neolithic cultures in the Aegean.

At the same time, basic changes took place in the Central European Neolithic as well, which are usually associated with influences and impacts arriving from the region of the Vinča culture. Recently, research reduced these impacts to the Sopot culture, the evolution of which could be determined by changes in the Vinča culture, and which only mediated the impacts. The south-eastern European influences manifested themselves the strongest in the western part of the Carpathian Basin at the time of the development of the Sopot II culture (Proto-Lengyel horizon).

It should be mentioned with regard to the chronological position of the above mentioned grave no. 12 from Győré that horn-shaped applications appeared already in stage IA of the Sopot culture beside the knob ornaments. The basic ornamental motives were the "Tiefstich" and the "Kerbschnitt", techniques that had been unknown in the area until then. S-profiles also appeared in the ceramics of the Sopot II culture on a few strongly Vinča-featured vessel types, and the earliest tumbler types of the Lengyel culture had similar profiles. This stage of the Sopot culture is the most "Vinčoid", and the various types of the "Knopf- and Ansatzhenkel" are characteristic first of all of the find material of the Vinča culture. As it is known, the effect of the Vinča culture in the evolution of the Sopot culture appeared mainly in the radical change of pottery technology. Thus the horizon of the black burnished ceramics in the Slavonian-Sirmium region and in Transdanubia started with the Sopot culture, in parallel to the Vinča B2 and C1 stages. It cannot be accidental that the direct antecedents of the band-handled vessel from grave no. 12 of Győré can be found in the ceramics of the Sopot II culture on a few strongly Vinča-featured vessel types, and the earliest tumbler types of the Lengyel culture had similar profiles. This stage of the Sopot culture is the most "Vinčoid", and the various types of the "Knopf- and Ansatzhenkel" are characteristic first of all of the find material of the Vinča culture. As it is known, the effect of the Vinča culture in the evolution of the Sopot culture appeared mainly in the radical change of pottery technology. Thus the horizon of the black burnished ceramics in the Slavonian-Sirmium region and in Transdanubia started with the Sopot culture, in parallel to the Vinča B2 and C1 stages. It cannot be accidental that the direct antecedents of the band-handled vessel from grave no. 12 of Győré can be found in the ceramics of the Sopot II culture unearthed at Bicske-Galagonyás. The vessel handle found at the Pepelane site ("Pepelane Typ der Sopot-Kultur") seems to be contemporary to the Győré find, and the item from Obre II also came from the Late Neolithic.
According to the actual results of investigations, the southern, south-eastern influences could arrive in Southern Transdanubia along the Sió and the Sárvíz, from which respect the region of Nagytétény could also be important.94 Recently research supposed a third route as well at the end of the evolution of the Vinča culture, the stages of which are marked by the Vinča, Obrež-Beletinci, Gomolava, Babská, Sopot, Sceče and Balatonmagyaród-Hidvégpuszta sites.95

At the examination of the Late Neolithic burials in the Hungarian Plain, I really did not go beyond the earlier known data, in this case I only intended to demonstrate similarities with the burials of the Lengyel culture. The burial customs of the two territories and cultural entities can be compared only when the Neolithic burials of the Hungarian Plain will be evaluated with the same method as the ones of the Lengyel culture. The contacts between the Lengyel and the Tisza culture can be studied at the present state of research at Aszód and Bicske, although Nándor Kalicz does not owe a special chronological importance to the Tisza finds uncovered here being too fragmentary and since the ornamental motives are not really characteristic. Only a few Tisza sherds are known from Mórágy-Tűzkődomb as well, a few of which were found above the graves of the Lengyel Ib phase, while the rest were stray finds.96 Nándor Kalicz agrees with me that the best analogues are known from Gorzsa. Based on these finds the Lengyel Ib-2a, that is the “copper horizon” seems to be contemporary to the oldest D-C phases of Gorzsa. He thinks to find proofs of a southern contact beside the northern, E-W oriented contact system, which can be demonstrated at Aszód.

Tibor Kemenczei also accepts the theory cited by many specialists that the individuals buried with unique or numerous grave goods had a prominent role in the community and that certain grave-goods had a symbolic role. He raises the question what spiritual background can lie behind placing querns in the graves. János Makkay,97 M. Lichardus-Itten,98 and M. Dohrn-Ihmig99 discussed the phenomenon in details. Entire querns are known only from three graves of the Lengyel culture in Southern Transdanubia. In many other graves we found fragments called rubbing or polishing stone. Idols, grave vessels of unusual types and animal grave-goods (first of all Canis familiaris), which can be linked with fertility cult, also raise problems, which I have already published and discussed a few studies.100 I also intend to prepare a book on the religious historical evaluation with a complex, European review. It should be mentioned concerning the archaeological interpretations of the fertility cults, which are treated as evidences ("fertility goddess", "Great Mother Goddess", "Mother Earth", etc.), that their religious historical background can be led back to studies by J. Mannhardt,101 G. Frazer102 and M. Malinowski,103 which were based on even older concepts from the 19th century. There are very few object that support the theory of a “fertility paradigm”. The archaeological finds we have only afford to find the place of the items of figural art in space and time and in the relevant social and economic systems.

From the discussed Southern Transdanubian Lengyel burials, 6.5% represents the group of uncommon grave furniture. Tibor Kemenczei mentions that this means the total period of the use

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98 Lichardus-Itten 1980.
99 Dohrn-Ihmig 1983.
of the cemetery so it cannot be told how the proportion changed in the individual periods of the Lengyel culture and thus we cannot follow the changes of the social structure. The small item number did not always afford us to trace the changes in the periods or horizons in the case of uncommon burials. Only 1.0% (6) of the graves with grave furniture contained anthropomorphic or zoomorphic objects in Southern Transdanubia. They usually occur in only a single grave in a cemetery except grave group B1 at Mórágy, where animal-shaped ceramics characterised the burials of two young women. In the Zengővárkony graves we do not know the sex of the buried persons, yet the finding circumstances of burial no. 214 imply that the zoomorphic (bear-shaped) vessel was placed beside a male. The remains of Canis familiaris were found in only 0.5% (3) of the graves with grave furniture in Southern Transdanubia. An entire dog was placed beside the dead in burial no. 10 at Mórágy and no. 128 at Zengővárkony, while grave no. 119 at Zengővárkony contained the skull of a dog. In all the three graves the skeletons were strongly crouched, and placed in a specific position, different from the rest of the skeletons. The grave furniture was unusually rich from the respect of both the quantity and the composition. Placing a pig jaw in the graves also appeared in the Carpathian Basin in the Late Neolithic. In Southern Transdanubia, however, only 1.0% (6) of the burials contained this type of grave furniture, and all of them were discovered on the southern side of grave group no. 9 at Zengővárkony. In five graves even the skull was missing. As it has already been mentioned, only 3 graves (0.5%) contained querns in the Southern Transdanubian cemeteries of the Lengyel culture. Only a single grave contained such a find at Zengővárkony, where the skull was missing. The quern was placed under the skull of a girl of inf. 2 age in grave no. 46 of the Mórágy cemetery. It showed the remains of red paint on the surface, which is an important contribution to the determination of the function of these objects. The symbolic meaning of the rubbing stones placed beside
the dead (in 4.1% of the graves, 24) is also proved by the fact that the skulls were missing in 11 graves of this character. The frequency of the occurrence of querns and rubbing stones in the individual cemeteries is connected not only with the contemporary social archaeological conditions but also with the relative chronological position of the burials.

The correlations and the structural changes were analysed in chapter 5 of my study. Here I only wish to hint at the results indicating the changes by cemetery horizons in the diagrams. At the analysis of the feature groups, 14 units of grave furniture, 19 tool and 12 jewellery/articles of wearunits were separated and they were determined as custom groups (diagrams 2–3):

From a methodologically point of view, the choice of the criteria after which the certain analytical units were distinguished was the crucial point. After the analysis of the correlation of custom groups, the find group categories were analysed by cemeteries, and finally the combinatory statistical analysis of the graves and the find groups was carried out with the definition of the combination groups and the examination of the group formation of the burials. The distribution of the find groups by horizons is illustrated in diagram 4 (A: burials without grave furniture, B: only grave furniture, C: only tool finds, D: only jewellery/articles of ware finds, E: grave furniture and tool finds, F: grave furniture and jewellery finds, G: tool and jewellery finds, H: grave furniture, tool and jewellery finds):

The sériation analysis of the correlation between grave furniture, tool and jewellery groups by graves yielded further data on the social archaeological conditions of the Lengyel population in Southern Transdanubia. Here we examined the custom groups that occurred in more than two graves, and we examined only those 285 graves where more than one custom group could be distinguished. In these burials, the custom groups of grave furniture, tool and jewellery form 85 find group combinations. To enable a more detailed analysis of group formation and order between burials, the burials that represent the above 85 grave find group combinations were separated into 11 find ranges after the differences ("richness") we could observe between them (with the find group combinations in brackets). Their distribution by horizons is illustrated in diagram 5.

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Diagram 6: Distribution of uncommon burials by horizons

Diagram 7: Distribution of burials with various stone axe types by periods

The proportional divergences, differences and changes between the individual horizons are conspicuous in the case of the above-mentioned uncommon burials as well (diagram 6):

The same method was used for the analysis of the number of the vessels (diagram 7), the stone axe types (diagram 8) and the silex tools (diagram 9) by graves and the distribution of the various tool types (diagram 9) and the imported wares (diagram 10) by horizons. Significant conclusions could be drawn regarding the development of the economic conditions and their changes in time. Tibor Kemenczei concluded that the burial custom groups including various object types, the differentiation of the finds groups of tools, jewellery and articles of ware and the tables of their combinations afforded the determination of grave groups within the individual cemeteries and established the ratio of graves with richer grave goods than the rest, from which we can draw conclusions concerning the social differentiation of the community that used the cemetery. Another question that could be answered was in what other elements of the culture this so-called development appeared beside the changes that could be demonstrated in ceramics.

The analysis of the custom groups uncovered not only that there were rich and poor people and people of a special, undetermined status in the Lengyel communities. Within the supposed community, I could also analyse the stratification on several levels.

Diagram 8: Number of silex tools in the individual graves by horizons
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According to Tibor Kemenczei, more space could have been dedicated to the economic, technical historical and natural geographic factors that contributed to the evolution of the identities and similar features of the social conditions, burial customs, cults and handicrafts in the Lengyel, Tisza, Vinča and Sopot cultures. The population groups of these cultures mostly lived at the same time in neighbouring territories within similar geographical and climatic conditions, and influenced one another. Judged from the tool finds, their way of life and activities must have been similar and a significant identity can be discovered in their burial customs, which can indicate similar social organisations. Most of the common traits appear in a cultic-religious field. Idols, anthropomorphic and zoomorphic vessels of identical shapes occur in the eastern group of the Lengyel culture from Svodín (Szögyén) through Aszódi to Mórágy, that is from the north to the south. Pál Racky published the fragments of the “Svodín type” anthropomorphic vessels of the Lengyel culture from Polgár-Csőszhalom,104 and we can find cultic objects of similar features although of different shapes in the Tisza and Herpály cultures. In these cases, research supposes common roots, impacts arriving from the south, southeast. The technical changes of tools and weapons can clearly be followed in the finds of the Lengyel culture.105 The same will be possible at the Late Neolithic cultures of the Hungarian Plain after the publication of the large excavation materials of the last decades.

In the description of the outlined social conditions, we included the explanations about the kinship systems, the lineage, the concept of endogamy and exogamy, the role of ages

104P. Raczky: Evidence of contacts between the Lengyel and Tisza-Herpály Cultures at the late neolithic of Polgár-Csőszhalom. BudReg 36 (2002) Fig. 1. 1 a-c, 2 a-c, 3.
and organisation collected from the technical literature. They are the results of ethnologic investigations made on living populations, which I tried to use as analogues to the communities of the Lengyel culture. One of the greatest hindrances of the analyses of the prehistoric community conditions is the hardly surmountable attitude that we use the concepts of our own age and society to interpret the phenomena. Another characteristic of the investigation of prehistoric conditions is the generalised approach to archaic societies, which is characteristic even to date. The anthropological models we can use are too general, and the varieties in the archaeological records are difficult to categorise for comparative studies. Regional differences and features appear in every site, so it cannot be expected that they perfectly fit into the typological systems set up in anthropological theories. As we could see, the archaeological data on burials offer an excellent opportunity for the analysis of the organisational forms since a cemetery is the result of the chronologically long-term activity of a certain closed human group, which is cohered by a network of kinship relationships, common ideological ideas and economic interests. Thus we found the study of kinship relationships indispensable on the condition that, beside historical peoples and ethnologic communities, the Neolithic populations also lived in kinship systems and took record of the lineage. As we could see the analysis of kinship is the most difficult part of social anthropology not only in the case of prehistoric societies but also in ethnologic communities. Taking into consideration, however, the table in which Murdock illustrates, in a sample of 250 societies, 193 unilateral organisations of the types of kinship groups and their attitude to exogamy, we can understand that no prehistoric analysis in itself can solve the issues related to kinship systems, and the only help we can expect in the future is DNA test. In connection to Imre Lengyel's serogenetic studies we have already discussed the problems of endogamy and exogamy since the examined population fragment can be regarded endogamous after its serological features. The degree of endogamy, however, is not known.

As I have already mentioned, I intend to publish the two main parts of the thesis, the results of the typological-chronological analyses of the ceramics and the social archaeological research in a significantly enlarged form in two separate volumes. In these studies I will use the pieces of advice of my opponents, the latest social archaeological materials published in the technical literature, which have not evaded my attention but I will need more time to study them in order to answer the emerged questions and problems.

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Zalai-Gaál 2002


K. Zoffmann 1999

CORRIGENDA

in: István Zalai-Gaál: Possibilities of the social-archaeological studies of the Neolithic, 468-469.

diagram 8: Number of silex tools in the individual graves by horizons

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□ bone tool
□ silex
I stone adze, wedge, chisel
□ stone axe

LK Ia1-2  LK Ib  LK IIa1-2
```

diagram 9: Distribution of burials with stone axes, stone adzes, silex and bone tools by horizons

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□ bone tool
□ silex
I stone adze, wedge, chisel
□ stone axe

LK Ia1-2  LK Ib  LK IIa1-2
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diagram 10: Distribution of burials with imported wares by horizons

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□ obsidian
■ copper
□ marine shell

LK Ia1-2  LK Ib  LK IIa1-2
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