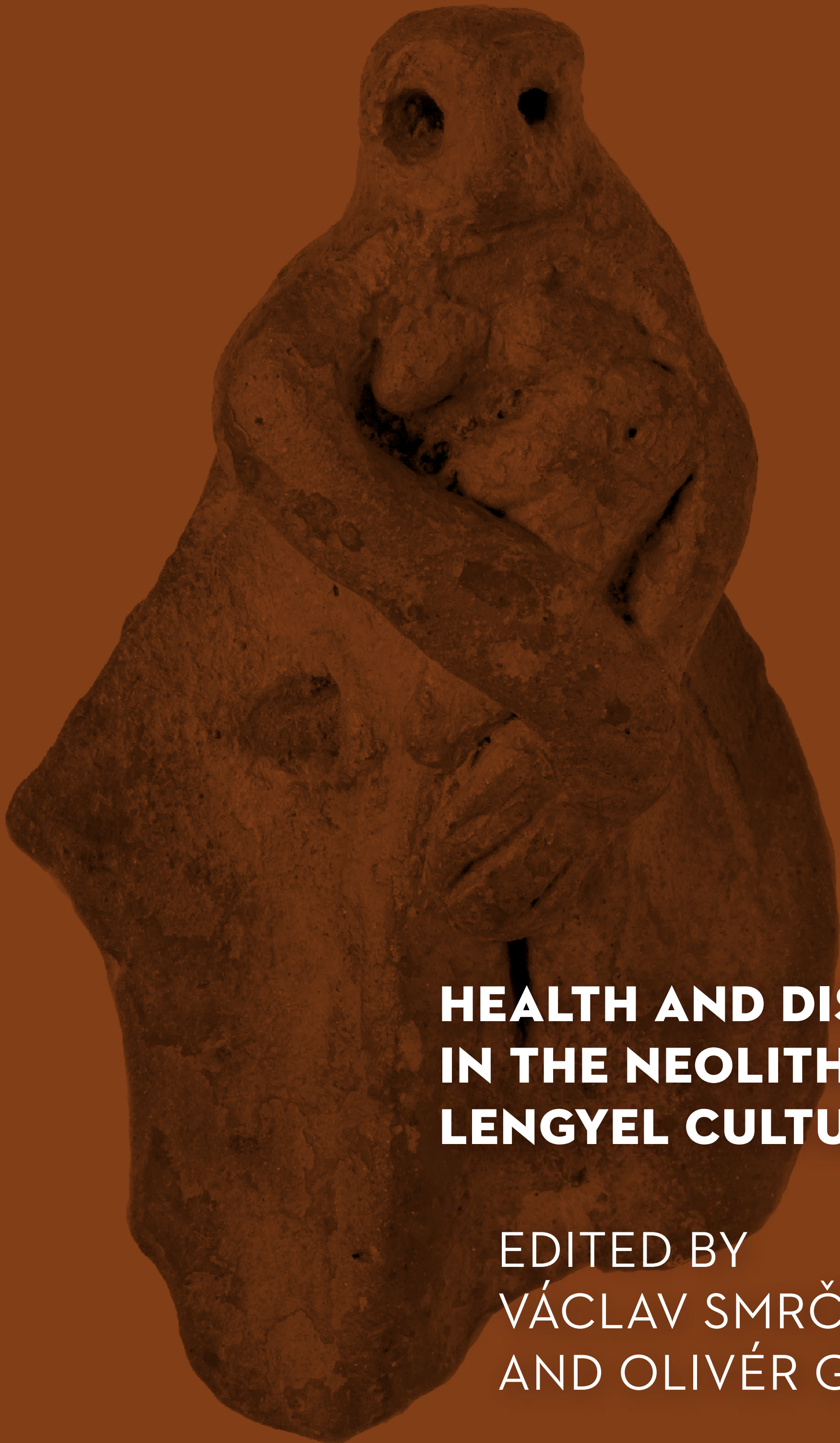

HEALTH AND DISEASE IN THE NEOLITHIC LENGYEL CULTURE

EDITED BY
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Health and Disease
in the Neolithic Lengyel Culture

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1. INTRODUCTION

VÁCLAV SMRČKA

1.1 DEFINITION OF THE NEOLITHIC DEMOGRAPHIC TRANSITION

The discovery of a ceramic gradient from the Middle East to Europe was referred to as the "Neolithic Revolution" by Childe (1925). A significant change from the former lifestyle of foragers led to a substantial increase in human numbers. This was termed "transition" by demographers (Lazaridis et al. 2016; Price 2000a, b, c; Price and Feinman 2001; Bocquet-Appel and Bar-Yosef 2008; Ames 2010 ; Kristiansen et al. 2017; Furholt 2021) and was the basis of this phenomenon.

1.2 ADOPTION OF FARMING: INSECT PATTERNS, THE ORIGIN OF COMPLEX SOCIETY

In both insect and human populations, societies can only start to form after the incorporation of plants into their way of life i.e. after the emergence of agricultural practices (Smrčka and Žďárek 2002; Smrčka et al. 2019; Hayden 2014). The most complex societies cannot develop until their network of social relations becomes sufficiently "dense" as a result of population growth. The development of agriculture and this incorporation of plants caused the growth of the human population and facilitated advances in communication between members of groups. This stage began when man started cultivating grasses for their seeds as nourishment. Similarly, the evolution of insect species that were able to form vast colonies with highly sophisticated, division of labour based on complex communication, was enabled by the development of special "agricultural" practices. This includes and is not limited to the employment of symbiotic bacteria, fungi and protozoa for the processing of cellulose as food (termites), and the cultivation of fungi (leaf-cutting ants) on plant material and faeces. The co-evolution with angiosperm plants and exploitation of flower products (nectar and pollen) facilitated the evolution of a complex societies in bees. An adoption of agricultural practices supposes a non-nomadic way of life. Members of social groups construct special dwellings: country-type common houses near fields in man, complex nests in bees, ants and termites. Dwellings have the biological function of protection, but also as an exchange places for obtaining other sources of food. The model of dwelling organisation can change from culture to culture, tribe to tribe, but it seems to remain fixed within a group. The location of a dwelling within the settlement reflects social relations among the families; those more closely related have closer contact between their dwellings while families of different clans are more separated. This organisation within settlement was such that higher-ranking groups were those that had inhabited the area first (Flannery and Marcus 2012). The distance between the dwellings of each culture seems to be standard (Gron 1997). After this amplification of agriculture, and establishment of a dependence on a vegetal diet, biological changes occurred in man, as well as in ants and termites. There is a significant decline in stature in Upper Palaeolithic populations through the Neolithic, and is best demonstrated in females (Meiklejohn et al. 1984). The shift from meat to vegetal food was demonstrated using analysis of trace elements (Zn, Fe) in human bones from the Neolithic to the early Middle Ages (Smrčka and Jambor 2000). This Neolithic gracilisation is directly linked with the concentration of Zn and other elements essential for growth (Cu, Fe) (Smrčka et al. 1989, 1998). Similarily, this difference in stature between the hunter and the farmer in the human population is seen in the hymenopteric world; the largest ant individuals can be found among the primitive predatory Ponerids, whose colonies are generally small, while ants that are primarily dependent on a vegetal diet (e.g. seed-eaters, leaf-cutters) form huge colonies of relatively small individuals with a strongly morphologically distinct worker casts. In humans, at least in the early stages, hierarchy was also based on aggression (Watts et al. 2016). Since the Neolithic Age, this societal stratification (Bentley et al. 2012) has meant those with the greatest individual power were also those that controlled the wealth (Gronenborn 2016; Heath 2017; Feinman 2016).

The history of the human species exhibits cyclical changes in its social network. Empires rise and fall. Therefore, it seems that history is repeated in the course of the development of states (Carmack 2015). Control over a certain territory by a group of aggressive individuals is the driving force behind the rise of the majority of founding states (Hrnčíř and Květina 2016). Aggression was the means by which order and social hierarchy, and subsequently the distribution of food, were maintained, before being replaced by rules, and finally formal laws (Smrčka and Žďárek 2002). Distribution of food in advanced eusocial insects is such that all sterile members of the society (the worker cast) receive an equal share of the colony wealth (social stomach) through mutual exchange of liquid food (trophalaxis). Only the reproductive females are preferentially fed, often with more nutritious food, in order to maximise the outcome of their reproductive potential. However, that is not the case in the human society; while the privileged social classes are also preferentially supplied, but their effect on overall reproduction within the population is negligible. Whitehouse et al. (2019) confirmed the association between moralizing gods and social complexity. Duration of eusocial insect communities may have seasonal or perennial character. Parallels between human and insect populations in factors surrounding population nutrition, which aided societal expansion, were observed. Such populations could form only after the process of the adoption of farming practices. This insect pattern shows that the Neolithic revolution was not a revolution, but a social phase of human evolution: the origin of complex society.

1.3 ARCHAEOLOGICAL EVIDENCE OF THE NEOLITHIC DIET

The earliest LBK agricultural crops included einkorn and emmer wheat, barley, millet, peas, lentil, and linseed (Kreuz 1990 in Jochim 2000). The wild ancestors of these plants are not native to Central Europe; therefore, their domesticated forms must have been introduced from elsewhere. Along with these, at least twelve different non-native weed species have been identified in the earliest LBK sites. Furthermore, domesticated animals at these sites include sheep, goats, cattle and pigs, with only the latter two have wild ancestors native to Central Europe. This impressive array of non-native foods suggests to many that they were imported as part of a functioning economy of immigrants, rather than as items of exchange (Jochim 2000). Settlements were located on gently sloping hillsides. These were often exposed to the east, and thus houses, mostly oriented NNW–SSE, were built parallel to the slope. Villages were built close to water courses (Gronenborn 1999). The focus on grain production gave rise to the manufacture of pottery (Schier 2015; Salisbury 2016), in which cereal meals and beverages could be prepared and stored. Close contact with animals is evidenced in small ceramic sculptures of animals.

1.4 BIOLOGICAL EVIDENCE OF THE NEOLITHIC DIET

Neolithic diets are remarkably uniform and based on terrestrial food sources. Neolithic burials from caves in Portugal generally show that Mesolithic diets had a strong marine component, and by the middle Neolithic there was a significant shift to mainly terrestrial foods. In the United Kingdom, the scarcity of Mesolithic human remains problematic, but a few studies do show the importance of marine foods in the diets of Late Mesolithic coastal peoples from the site of Oronsay (Richards and Mellars 1998). There is, however, a substantial amount of isotope data on Early and Middle Neolithic humans indicating a completely terrestrial diet (Richards et al. 2003). Samples from the Central European Neolithic period from the Vedrovice settlement (Buchvaldek et al. 2007), show collagen $\delta^{15}N$ values ranging from +8.8 to +12 per mil and $\delta^{13}C$, values of bone collagen fall between –20.5 and –21.9 per mil (Smrčka et al. 2008). In south-eastern and eastern European inland, there is stable isotope evidence of an aquatic-based diet (likely fresh-water fish) along the Danube (Bonsall et al. 1997) and the Dneiper (Lillie and Richards 2000) that continued to be important in Neolithic times.

1.4.1 TRACE ELEMENT ANALYSES

Concentrations of Zn in the skeletons of the first farmers of Central Europe (Linear Pottery Culture at Těšetice) are the lowest of all researched places (Smrčka and Jambor 2000). Meiklejohn et al. (1984) found that there is a significant stature decline from the Upper Palaeolithic through the Neolithic. The trend appears to manifest more strongly in the female sample than in the male. However, none of the subsamples show significant decrease from the Upper Palaeolithic to the Mesolithic. There is a significant decrease from the Mesolithic to the Neolithic in the female samples, and overall.

1.4.2 ISOTOPIC ANALYSES—DISTINGUISHING NEOLITHIC MIGRATORY POPULATIONS

Linear Pottery Culture (Linearbandkeramik—LBK) is traditionally used to describe the first farmers of Central Europe, named after the pottery they introduced approximately 7,500 years ago. Radiocarbon dating for LBK suggests it rapidly spread into Central Europe from its place of origin in the Hungarian Plain (Gronenborn 1999; Price et al. 2002). Bentley et al. (2002) identified Neolithic migrants who moved between geologic regions, the area uplands ($^{87}Sr / ^{86}Sr > 0{,}715$) and regional lowlands ($^{87}Sr / ^{86}Sr < 0{,}710$) near the Dillingen site. Strontium isotopic signatures make their way faithfully from local geologic materials and ultimately into the human skeleton. Comparing the isotope signature in adult teeth, which is incorporated into the teeth between four and twelve years of age, with that in bones, with characteristic turnover times varying between 6 and 20 years for different bones of the body. Ericson (1985) and Grupe et al. (1997) identified 11 out of 17 (65%) of the remains from Dillingen as nonclocal. Nonlocals in this LBK cemetery (and also in others—Flomborn and Schwetzingen) had social identities different from the locals. Nonlocal females were common. At Dillingen, all 5 (100%) females were above the local range compared with the 6/12 of the males being nonlocal (5 above the local range, 1 below). $^{87}Sr / ^{86}Sr$ may correlate with burial orientation. 80% of west-facing burials were immigrants at Floborn. At Schwetzingen, 30% (7/23 burials) with head directions ranging from north to east are nonlocals. Many nonlocals are buried without a shoe-last adze. At Dillingen, burials with shoe-last adzes are significantly more likely than those without. Among the 11 burials without a shoe-last adze at Dillingen, 9 (82%) are nonlocals, with tooth values above the local range. Of the 6 Dillingen burials with a shoe last adze, 2 (33%) are nonlocals and only 1 of whom was above the local range. The presence of nonlocal males without adzes confirms that the correlation is not merely between shoe-last adzes and males who happen to be locals. Nonlocal ^{87}Sr / ^{86} Sr values are mostly above the local range for their place of burial. Of the 27 immigrants from the three sites, 23 tooth values are above the local range for the site and only 4 below it. The last pattern is suggestive of the source of the nonlocal's diet in the younger part of their lives. The ^{87}Sr / ^{86}Sr values for the nonlocals are not high enough, however, to be "from" the granitic uplands, where water samples are generally above 0,720 The best interpretation at this point may be that the higher ^{87}Sr / ^{86}Sr values reflect a significant proportion of the diet from the regional uplands (Bentley et al. 2002).

1.5 AGRICULTURE, THE PROBABLE REASON FOR BONE PATHOLOGY

Throughout the entirety of the Neolithic period in Europe, gathering continued to be a supplementary part of the economy. Gathering and agriculture were not mutually exclusive, but they supplemented each other according to local natural conditions (Bickle and Whittle 2013). The change in diet, based on grains, triggered a population explosion which resulted in the formation of new socials contacts. However, from a biological point of view, humans were unable to adapt completely to these new conditions even though there are hints of partial genetic adaptation e.g. lactose tolerance in adults (Allentoft et al. 2015). In the period of agricultural development, the proportion of vegetal foods in the diet increased and meat consumption decreased. However, at the same time, the population became more slender and shorter. Angel (1984) and Schoeninger (1981) compared the average size of individuals in populations of Palaeolithic hunters and Neolithic agriculturalists. They concluded that the European *Homo sapiens sapiens*, who consumed animal albumin to the maximum extent in the Late Palaeolithic 30,000 years ago was 30 cm taller than his successor in the period of agricultural development. A meat diet contains zinc, which is necessary for both the development of the foetus and for the pregnant female. This element, as well as many other essential elements, can get caught up in the intestine on the fibrous material of grain husks, and can cause premature osteoporosis. This was identified in the populations which intensified their agriculture and consumed unleavened bread (Smrčka et al. 1998). Gluten from wheat flour or, more exactly, prolamin gliadin, can have a toxic effect and give rise to coeliac disease as demonstrated by Dicke and his colleagues (1953) in the Netherlands. The Greek doctor Aretaeus described this disease in the 2nd century A.D. (Adams 1856 in Simoons 1981). However, it was Gee (1888 in Simoons 1981) who presented the first clinical description: "A kind of chronic ingestion that can appear at any age, but more commonly in children 1–5 years old. Diarrhoea, vomiting, loss of appetite and weight loss, or failure to gain weight, are the symptoms." Gee concluded that the condition is brought about by errors in diet and that "if the patient can be cured at all it must be by means of diet." Gee noted that "death is common" and the disease, which had a 15% overall mortality rate in the 544 celiac patients included in articles published in Europe and the United States from 1909 to 1939. Moreover, those early patients who recovered tended to have stunted growth (Hardwick 1939). Falchuk et al. (1972) found a highly significant correlation between the disease and the HLA-B8 antigen: 88% of adult celiac patients in the United States and the United Kingdom had the HLA-B8 antigen, compared with 22–30% of the controls. Concentrations of Zn in the skeletons of the first farmers at Těšetice (Smrčka and Jambor 2000), in the Central-European territory (Linear Ceramics), are the lowest of any researched location. It was not until the arrival of Corded Ware and Bell Beaker cultures, with different diet types, that gracilization of the skeleton "stopped" in Europe. We suppose that "the Neolithic gracilization, which is the background of the wealth of agricultural populations and the increase of population," is directly linked with the concentration of Zn and various other elements of growth (Smrčka et al. 1998). In developing countries, where the chief nutrients are cereal grains and where the diet lacks animal protein, there is a prevalent nutritional Zn deficiency. Zinc deficiency interferes with the mechanisms necessary for mediating long-term memory (Wauben and Wainwright 1999). Those most vulnerable to zinc deficiency include (1) infants, (2) adolescents during rapid growth phases, and (3) women during pregnancy and lactation. A study of food samples from Iranian villages and from Nubia (Smrčka et al. 1998) indicated that zinc concentrations in the diet were suboptimal.

1.5.1 MANIFESTATION OF SHORTAGE AND DISEASE

In the Neolithic, periods of famine were probably repeated in cycles. This, including associated diseases with vitamin C deficiency (*scurvy*) and mineral deficiencies were indicated by interrupted enamel growth, *enamel hypoplasy*, or discontinued bone growth, *Harris lines* and *porotic hyperostosis* (Arnott 2005). In this context, parasitic infestations should not be omitted as it was one of the causes of *anaemias*.

1.6 AGRICULTURE AND ZOONOSES

Bone pathology was not only affected by the transition to a cereal grain-based diet, but also by the domestication and breeding of animals. Close contact with animals and milk utilization since the 7th millennium B.C. (Evershed et al. 2008) lead to a rise in diseases transmissible to humans—zoonoses. Due to transmission from cattle, *tuberculosis* occurred in various regions of the Neolithic world (Kohler 2012, 2013, 2014), and at the same time, due to the goat population exchange, sporadic *brucellosis* infections would occur.

1.7 THE AIM OF THIS PUBLICATION

The aim of this publication is to clarify the hitherto unknown or little explained facts regarding the daily life of individuals of the Lengyel Culture (LgC), Neolithic farmers who emerged from the Balkans to replaced the original early agricultural population of Central Europe of Linear Pottery Culture (LBK or LPC) and the successive Stroked Pottery Culture (SPC). This Neolithic culture lived in village communities with grain cultivation and in close contact with domesticated animal. The settlement organization, with its hierarchy and emerging individual specialisation (Řídký et al. 2018), was exposed to plant and animal lives in the agricultural cycle. The Lengyel culture differed from early Neolithic cultures by the introduction of metal, copper, its regional distribution, the distribution of volcanic glass and an increase in hunting proven by archaeozoologic research (Dufek et al. 2016).

This culture was presented to the world by the pastor of Szecvárd, Mór Wosinsky and the notary in the Moravian town of Znojmo, Jaroslav Palliardi, at the turn of the 20th century.

The eponymous type site was at Lengyel in Tolna County, Hungary, even though later settlements of this culture were also discovered in Vojvodina, Serbia, and in Croatia. This Neolithic culture migrated beyond Moravia, further west to parts of today's Austria and Poland.

The first amateur archaeologists, just like the succeeding professionals, were enthralled by the beautiful painted pottery, statuettes of animals and humans, as well as everyday objects.

An idea about the everyday life of the people in this population of the Middle and Late Neolithic started to form. Since the 1950s, following the discovery and analysis of rondels, the spiritual life and the religious ideas of these humans have started to emerge (Řídký et al. 2018).

In the first third of the 21st century, it might seem that all archaeological questions had been answered, yet more questions arise (Kristiansen and

Earle 2015; Řídký et al. 2015; Renfrew 2018). How was this population affected by the introduction of metal? Why was the need for hunting increased? What was the health and morbidity of the Lengyel Culture population before its migration from today's Hungary to the Moravian region of the Czech Republic, where it flourished unprecedentedly? Which diseases mostly troubled the inhabitants of Lengyel settlements? In what ways was the lifestyle during the expansion of this Neolithic culture different from those of the preceding Linear and Stroked Pottery Cultures? These questions will be addressed in the following chapters.

1.8 SUMMARY OF INDIVIDUAL CHAPTERS

CHAPTER 2
In this chapter, the rudimentary features of the Lengyel Culture in Hungary with special attention given to the Baranya and Tolna regions, where the eponymous site is located, are presented. It is conceived from the archaeological point of view with a brief overview of the analysed burials at the, now already classic, burial sites of Zenkövárkóny and Villánykővesd.

CHAPTER 3
In this chapter, the paleopathologic analyses of the sites Zenkövárkóny, Villánykővesd, Belvárgyula, Borjád and Alsónyék-Bátaszék are interpreted. An archaeological gender study of the Zenkövárkóny burial site introduced new findings about textile, hide, and metal processing at the site. These were also verified through bone material analysis. Pathological changes, exceptional from the medical aspect, were examined from the point of view of several scientific disciplines.

CHAPTER 4
In this chapter the dietary trends from the Zenkövárkóny and Villánykővesd burial sites are examined using stable nitrogen and carbon isotopes.

CHAPTER 5
Migration analysis using stable strontium isotopes conducted at the Zenkövárkóny, Villánykővesd, Belvárgyula and Borjád sites.

CHAPTER 6
In this chapter, the health of the Neolithic population members of the Zenkövárkóny, Villánykővesd and Belvárgyula sites is addressed through the use of multi-element analysis of trace elements in bones and tooth enamel.

CHAPTER 7
The archaeological characteristics of the Lengyel Culture (Moravian Painted Ware Culture) in Moravia are presented in this chapter, including the history of research.

CHAPTER 8
The population of the Moravian Painted Ware Culture (LgC) is compared with the preceding Linear Pottery Culture (LPC) and the Stroked Pottery Culture (SPC) from an anthropological viewpoint.

CHAPTER 9
In this chapter, the Neolithic cultures of Moravia (LPC, SPC, LgC and Moravian Painted Ware Culture) are compared from the perspective of paleopathological analysis of bone diseases.

CHAPTER 10
Dietary trends in Neolithic cultures of Moravia (LPC, SPC, LgC and Moravian Painted Ware Cultures) are compared based on stable nitrogen and carbon isotope analysis.

CHAPTER 11
The Neolithic cultures of Moravia (LPC, SPC, LgC and Moravian Painted Ware Cultures) are compared from the aspect of the population's mobility using stable strontium isotope analysis.

CHAPTER 12
Bone health in individual periods of the Neolithic cultures of Moravia (LPC, SPC, LgC and Moravian Painted Ware Cultures) is examined through multi-element analysis of trace elements.

CHAPTER 13
Conclusion on the health and morbidity of the Lengyel Culture populations including their paleopathological profile and reference to the importance of scientific examination of Neolithic bone material.

2. THE LENGYEL CULTURE IN HUNGARY

OLIVÉR GÁBOR

2.1 TIME AND TERRITORIAL BOUNDARIES

In Europe, the change from the hunter gathering lifestyle to the settled lifestyle took place during the 7–6 Millenium B.C. (Childe 1925; Lüning 1988; Andel and Runnels 1995; Fernández-Domínguez and Reynolds 2017). The most important innovations were settling in one place for a long time, deliberate food production, making polished stone tools, and the birth of pottery craft. A permanent settlement established near the cultivated area, and the larger area unit was covered by a settlement network. At that time was evolved the well known Dumbar's number (a measurement of the cognitive limit to the number of individuals with whom any one person can maintain stable relationships—Dunbar 2010). Neolith revolution: producing farming (agriculture, animal housbandry), an active attitude towards the environment (both creative and devastating) (Childe 1936; Bíró 2003a, 99; Barker 2009). At the beginning the stone tools used as chock and axe spread while the areas under newly cultivated land were cleansed (Bíró 2003a, 99). Constant shaped containers made of clay (inorganic material). The larger clay pots were used to store the crop more safely, the smaller ones mimicked the shape of bowls made of pumkins. The first artifical material in the history was the burnished clay. The farming population grew due to the food production, and caused the spread of the new population and its lifestyle to the detriment of the mesolithic people. The enrichment caused by the food production, created social differenties, which are reflected in the excavated graves.

The Lengyel culture was born in the late Neolithic age (around B.C. 4800) in Hungary (Bíró 2003b, 103), as a genetic offspring of the earlier Linear Pottery Culture (Zalai 2003, 110), but not directly. The last time limit of this culture was the early copper age (till B.C. 4000), because it saw the appearence of the first copper beads. This period was the beginning of the Secondary Products Revolution during the copper age (Greenfield 2010; Szeverényi 2013, 58): milk, dairy products, wool use, inventing alcoholic products beverages (Gábor 2008, 77; Gábor 2009, 188).

In the Neolithic era was the late Neolithic the flower. This is also the richest period in archaeological finds: sophisticated craft products, long distance obsidian trade and large central sites. According to the highest density of contemporary settlements, the center of the late Neolithic Lengyel culture was in Southwest-Hungary.

2.1.1 AREA

The Lengyel culture was a part of a greater late Neolithic Central-European cultural-unity, which includes territories of West-Hungary, Austria, West-Slovakia, South-Moravia and South-Poland (Bíró 2003b, 102). But this unity was determined only in modern age (20^{th} century), based on the similarity of archaeological finds—mainly the painted ceramics. That is why we do not know if this material similarity in that era also meant real ethnical and cultural unity or not. However we can figure an inner boundary, by help of Neolithic balkanian traditions, which reached to Hungary but not further north.

2.1.2 ORIGIN, SPREAD, DATING AND PERIODS OF THE CULTURE

In the territory of Slovenia and Croatia a new late Neolithic culture was born, which is called Sopot culture (Dimitrijević 1968; Kramberger 2014). The settlements of the 2nd phase of this culture appeared in South West Hungary, and later in North West Hungary (Regenye 2002). The material culture also changed, and cultural unification began. The base of the new Lengyel culture came from the remains of the middle Neolithic population. This late Neolithic culture was probably built on local foundations with the help of powerful South East European influence (Simon 2003, 102; Bíró 2003b, 102–103).

The time periods and phases of Lengyel culture were calculated using synchronology (e.g. ceramic typology and absolute chronology (Lichardus and Vladár 2003; Barna 2011, 243–246). The Lengyel culture was born about 4800 B.C. (Barna 2011). The tradition of ceramic painting was inherited from the previous Sopot culture (Kalicz and Makkay 1972) and not directly from the Linear Pottery Culture. The dishes were the finest in the most colourful (red, white, black and yellow) in the first period. Later fewer colours were used. In the latest period the colours were replaced by plastic ornaments (cams). The extent of the Lengyel culture was the South West Hungarian group (Baranya county and Tolna county), the North Hungarian, and the South Slowakian Aszód-Csabdi-Svodín group from the late period.

- 1st phase: lots of painted ceramics (mainly red), scrached ornaments, small knobs with horizontal opening, pedestaled bowls, mushroom vessels.
- 2nd phase: continousity of the earlier vessel-forms, red-white painted ceramics, schrached meander.
- 3rd phase: the surveillance of the culture reached to copper age, but only in West-Hungary (copper beads). The life of the settlements and usage of