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Neolithic studies



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Cervi cave, Porto Badisco. From: Graziosi 1996. The prehistoric paintings of the Porto Badiso cave. Origines. Firenze: Pl. 12.

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The Late Glacial ancestry of Europeans: Combining genetic and archaeological evidence

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ABSTRACT – *Chronometric attention in the Late Glacial of Western Europe is turning from the dating of archaeological cultures to studying how the continent was re-populated at the end of the last ice age. We present results from a survey of all available radiocarbon determinations (the S2AGES database) which show that when calibrated, and compared to the GRIP stratotype of climatic events, the data can be interpreted as five population events in the 15ka prior to the onset of the Holocene. The fine-grained climate record provides an opportunity to study the impact of environmental factors on a human dispersal process that not only shaped subsequent European prehistory, but also the genetic makeup of modern Europeans. The population events have implications for archaeologists and molecular geneticists concerning the timing, direction, speed and scale of processes in Western European demographic history. The results also bear on the role of climatic forcing on the expansion and contraction of human populations and in particular the correlation of ice core and terrestrial records for the onset of warming in the North Atlantic.*

IZVLEČEK – *Kronometrična pozornost se v poznem glacialu zahodne Evrope odmika od datiranja arheoloških kultur k proučevanju ponovne poselitve kontinenta ob koncu zadnje ledene dobe. Predstavljamo rezultate pregleda vseh dosegljivih radiokarbonskih sekvenc (podatkovna baza S2AGES), ki kažejo, da lahko datume, potem ko jih kalibriramo in primerjamo z GRIP stratotipom klimatskih dogodkov, interpretiramo kot zaporedje petih populacijskih dogodkov v času 15ka pred pojavom holocena. Podrobno strukturiran klimatski zapis nam omogoča proučevanje vpliva okoljskih faktorjev na proces človekove razselitve, ki je sooblikoval evropsko prazgodovino in genetski zapis modernih Evropejcev. Populacijski dogodki so pomembni za arheologe in molekularne genetike, ki se ukvarjajo s časovnim usklajevanjem, smerjo, hitrostjo in obsegom procesov v zahodnoevropski demografski zgodovini. Rezultati kažejo na pomen klimatskih pritiskov pri širjenju in krčenju človeških populacij in še posebej na korelacijo med lednimi in kopenskimi zapisi ob začetku segrevanja v severnem Atlantiku.*

KEY WORDS – *Radiocarbon; Calibration; Late Glacial; Settlement patterns; mitochondrial DNA; GRIP; Archaeological Taxonomic Unit*

Introduction

A major population expansion occurred in Western Europe during the Late Glacial (15–11.5ka CAL BP) as the OIS2 ice sheets retreated and unglaciated areas in the north became available for re-settlement. Phylogeographic analysis using molecular evidence assigns 60% of the European mitochondrial DNA lineages (*Richards et al. 2000*), and an even higher proportion of West European Y-chromosome lineages (*Semino et al. 2000*), to a population bottleneck prior to an expansion from southwest to northern Europe (*Torroni et al. 1998; Torroni et al. 2001; Achilli et al. 2004; Rootsi et al. 2004; Pe-*

reira et al. 2005). A potential signal of the bottleneck has also been detected in patterns of linkage disequilibrium in the autosomes (*Reich et al. 2001*).

Population estimates (*Bocquet-Apel and Demars 2000*) based on the changing distribution of archaeological sites indicate an increase in the Western European metapopulation, excluding Iberia, from 9000 to 40 000 persons with the corresponding occupied areas augmented from 0.55Mkm^2 to 1.12Mkm^2. The demic expansion is associated with the Magdalenian, a time-space archaeological taxonomic unit (ATU), which is found in Western Europe from c.22 to 13ka CAL BP and is known for its abundant cave and mobiliary art. However, the temporal sub-divisions of this ATU, based on artefact type fossils and stratigraphic sequences, remain problematic (*Laville et al. 1980; Thévenin 1995*) such that the timing, direction and pattern of the Late Glacial demic expansion are imprecise. Moreover, estimates of the age of the timing of this expansion derived from a molecular clock model for mitochondrial DNA to be c.16ka BP (*Torroni et al. 2001*) rely upon a number of assumptions and need to be substantiated by independent radiometric means.

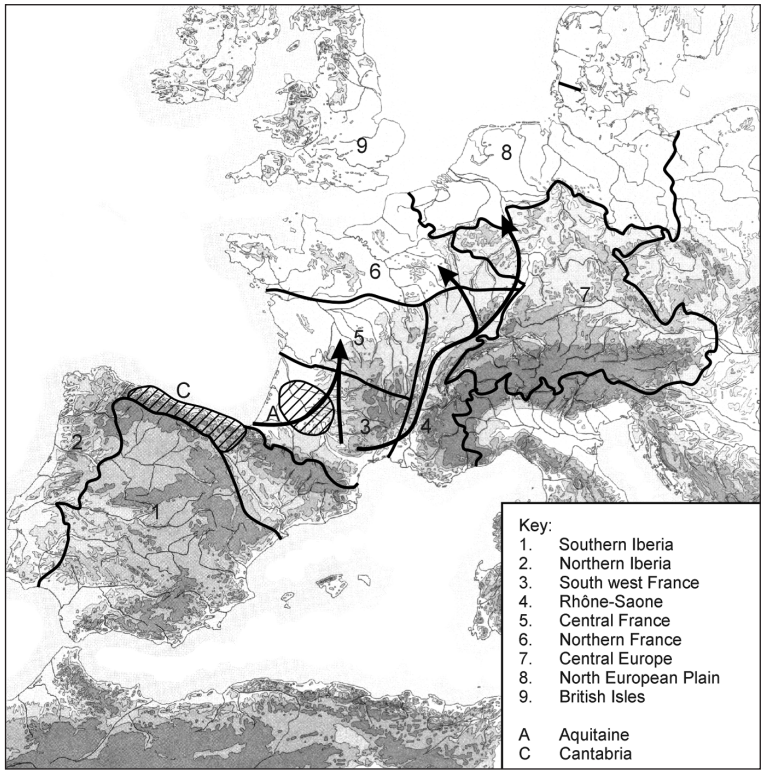


Fig. 1. Late Glacial Western Europe showing sampling regions, the two geographical refugia and probable expansion routes.

To address this imprecision, and to examine the correspondence between archaeological and genetic evidence for a population expansion, we present here results from S2AGES, an OIS2 database of radiocarbon determinations from Europe, the Near East and North Africa. The sub-sample described here comprises 2255 determinations from 1200 archaeological assemblages in Western Europe (Fig. 1) (*Pettitt et al. 2003*). Figure 2 presents, using CALPAL (*Weninger and Jöris 2004*), the calibrated radiocarbon determinations against the GRIP δ^{18} curve for Iberia, France and North Central Europe.

We interpret the changing frequencies of calibrated determinations as a proxy for the timing and direction of demic expansion as well as relative levels of human activity between regions. This method, using dates-as-data, is an established technique to investigate a process such as population dispersal into un-occupied habitats (*Holdaway and Porch 1995; Ross 2001*). We recognise five major population events for Late Glacial Western Europe (Tab. 1).

Population event	Settlement pattern	Dominant settlement type	Phylogeography	GRIP Stratotype	GRIP Ice core years BP
1. Refugium	Dispersed	Sheltered	Low population size	LGM – GS–2c	25ka – 19.5ka
2. Initial demic expansion	Pioneer	Sheltered and Open		GS–2b – GS–2a	19.5ka – 16ka
3.1 Main demic expansion	Residential	Sheltered	Founder effect and expansion	GS–2a	16ka – 14.7ka
3.2 Main demic expansion	Residential	Open		GI–1e	14.7ka – 14ka
4. Population stasis	Nucleation	Open		GI–1d – GS1a	14ka – 12.9ka
5. Population contraction		Open		GS1	12.9ka – 11.5ka

Tab. 1. Late Glacial population history of Western Europe as reconstructed from archaeological, radiocarbon and genetic evidence.

Population event 1: Refugium, 25ka–19.5ka BP

Existing refugium models for Western Europe predict that the lowest metapopulation and the smallest inhabited area co-incided with the last glacial maximum (= LGM 25–21.8ka) (*Soffer and Gamble 1990; Strauss 2000a*). By contrast, refugium is used here to describe the geographical distribution of population (G refugium), and the contraction, irrespective of geographic extent, of the size of the metapopulation (M refugium) within Western Europe.

Iberia, with radiocarbon determinations predominantly from Cantabria and Portugal (*Strauss 2000c*), was the major G refugium into which population contracted throughout the LGM and continued there until GS–2b (Fig. 2). By contrast, human presence was markedly less in France during this long period even though the Southwest, Aquitaine, has often been proposed as a major G refugium (*Jochim 1987; Soffer and Gamble 1990; Demars 1996*). North Central Europe was never entirely abandoned as shown for example by the site of Wiesbaden-Igstadt dated to GI–2 in the Rhineland (*Terberger and Street 2002*) but the calibrated curve indicates a low, probably intermittent, human presence in this region.

When the M refugium is examined using the S2AGES data, we find it lasted much longer than the LGM, sensu stricto and into GS–2b. Moreover, a radiocarbon database compiled for the Stage 3 project (*van Andel et al. 2003*) shows very low human presence in North Central Europe for at least the 10ka preceding the LGM in spite of a further six Dansgaard–Oeschger oscillations in this time interval (*Walker et al. 1999*).

The Solutrean has been proposed as the ATU of the LGM refugium (*Strauss 2000b*) (Fig. 3). The typological differences between the Solutrean and Badegoulian ATUs are regarded by archaeologists as too great to derive the latter from the former (*Djindjian et al. 1999*). As recently demonstrated by Terberger and Street (*2002*) the Badegoulian is most closely related to ATUs in Central and Eastern rather than Western Europe. This suggests the spatially extensive use of the French reindeer steppes by hunting parties with predominantly dispersed settlement patterns and whose population focus lay to the east, rather than the south. The eastern origins of the Badegou-

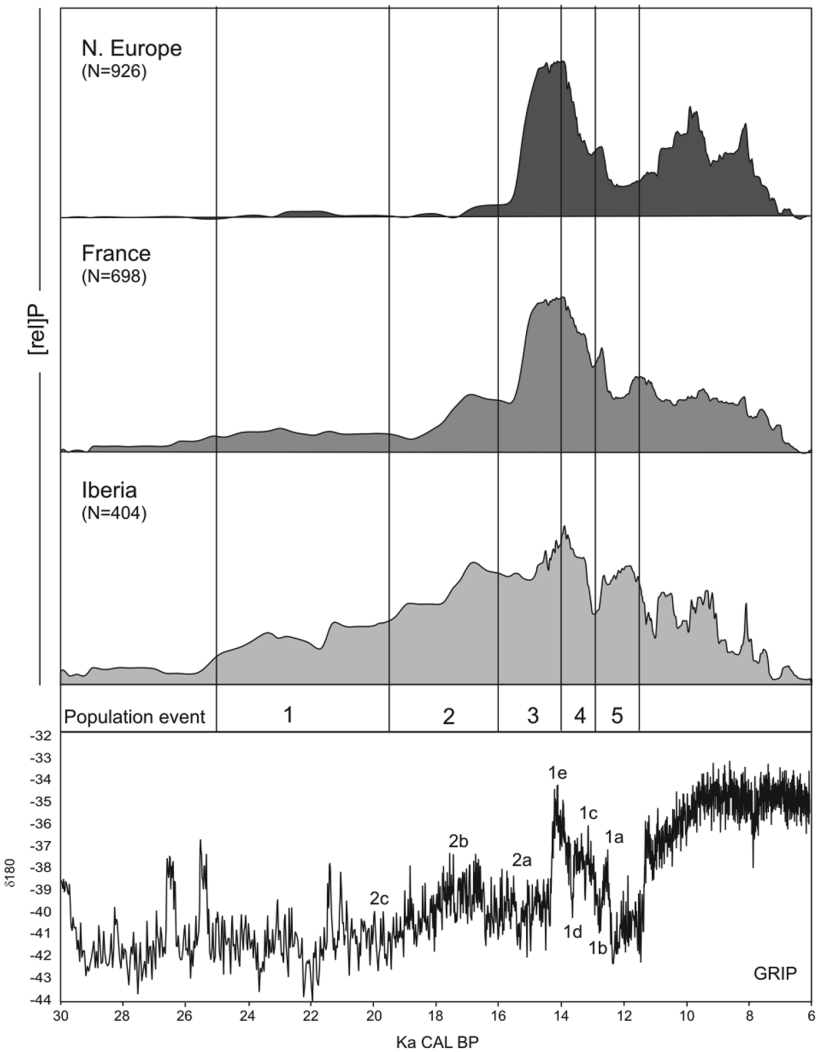


Fig. 2. Overview of Late Glacial radiocarbon dating probabilities for archaeological sites and assemblages, calibrated using CALPAL. The GRIP data form the stratotype for the Late Glacial–Last Termination event based stratigraphy. This recognises, post the Last Glacial maximum (LGM), two warm events (Greenland Interstadials 1 and 2 and two cold events (Greenland stadials 1 and 2). Currently GS–2 is subdivided into three sub-stages and GI–1 into five. In conventional terms GS–1 broadly corresponds to the Younger Dryas, GI–1e to the Bølling and GI–1c–1a to the Allerød interstadials. Other authors follow GISP2 for the period 25–16ka CAL BP. N = number of calibrated radiocarbon determinations in the frequency curve.

lian may be reflected in the distribution of mtDNA haplogroups H and pre-V. These are inferred to have an origin around 20–30ka BP either in eastern Europe or the Near East, and to have re-expanded from southwest Europe circa 16ka BP (*Richards et al. 2000; Torroni et al. 2001; Pereira et al. 2005*). The Y-chromosome cluster R1 shows a similar pattern (*Semino et al. 2000; Kivisild et al. 2003*).

Settlement type in both Cantabria and Southwest France during Population event 1 is dominated by rockshelters as opposed to open sites. Within Population event 1 we include the relatively short lived population expansions from Cantabria (Solutrean) and Central Europe (Badegoulian) into southern France (Fig. 3). We expect that similar demographic pulses were a regular feature of long-term human refugia.

Population event 2: Initial demic expansion 19.5ka–16ka BP

The radiocarbon determinations in Figure 4 form the proxy data to infer significant demographic change during GS–2b and the first half of GS–2a. In all areas this is associated with Magdalenian ATUs (Fig. 4). The change takes the form of an initial step and plateau (Fig. 2) in all regions outside the Cantabrian G refugium before the major rise in the frequency of calibrated determinations during the second half of GS–2a. This occurs during Heinrich Level 1 (17.6–14.9ka BP) when very low summer sea surface temperatures (SST) have been recorded in core MD95–2040 125km off the Portuguese coast (*de Abreu et al. 2003*).

In both France and Iberia Population event 2 corresponds (Fig. 4), to a pronounced peak in directly dated cave art. The number of sites is small (N = 14) but it is noteworthy that an earlier peak in France corresponds to the Solutrean population expansion we have identified (Fig. 3) and which also corresponds to low summer SST in the Iberian Atlantic during HL2 (24.3–23.1ka BP) (*de Abreu et al. 2003*). Therefore, cave art may be associated in some regions with small-scale demic diffusion out of the G refugium. This contrasts with earlier interpretations that linked the appearance of cave art to increased population density as people moved into refugia during the LGM and used art as a means to establish territorial rights to key resources such as salmon runs (*Jochim 1983*).

We favour an alternative, first proposed by Housley et. al. (*1997*), that this small demographic step inferred from the increased number of radiocarbon determinations represents a stage of pioneer settlement in the process of demic expansion as regions

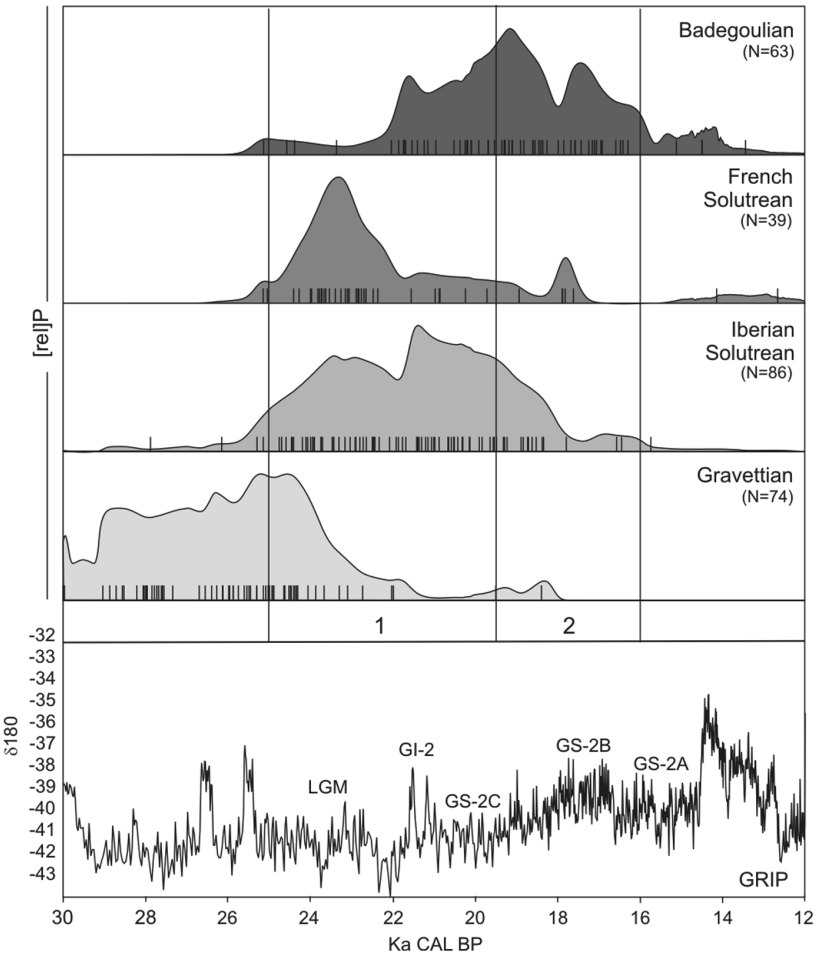


Fig. 3. Population events 1 and 2 (LGM to GS–2b) in Iberia and France. Calibrated curves are shown by ATUs. In Iberia the Solutrean is well represented from the LGM through GS–2c. In France the relative presence of the Solutrean, as indicated by the number of radiocarbon determinations, is substantially less suggesting a small demic diffusion north followed by population contraction back to the Cantabrian refugium. The wider context for the development of the Badegoulian (= Early Magdalenian) is therefore the contraction of population back into Iberia after GI–2.

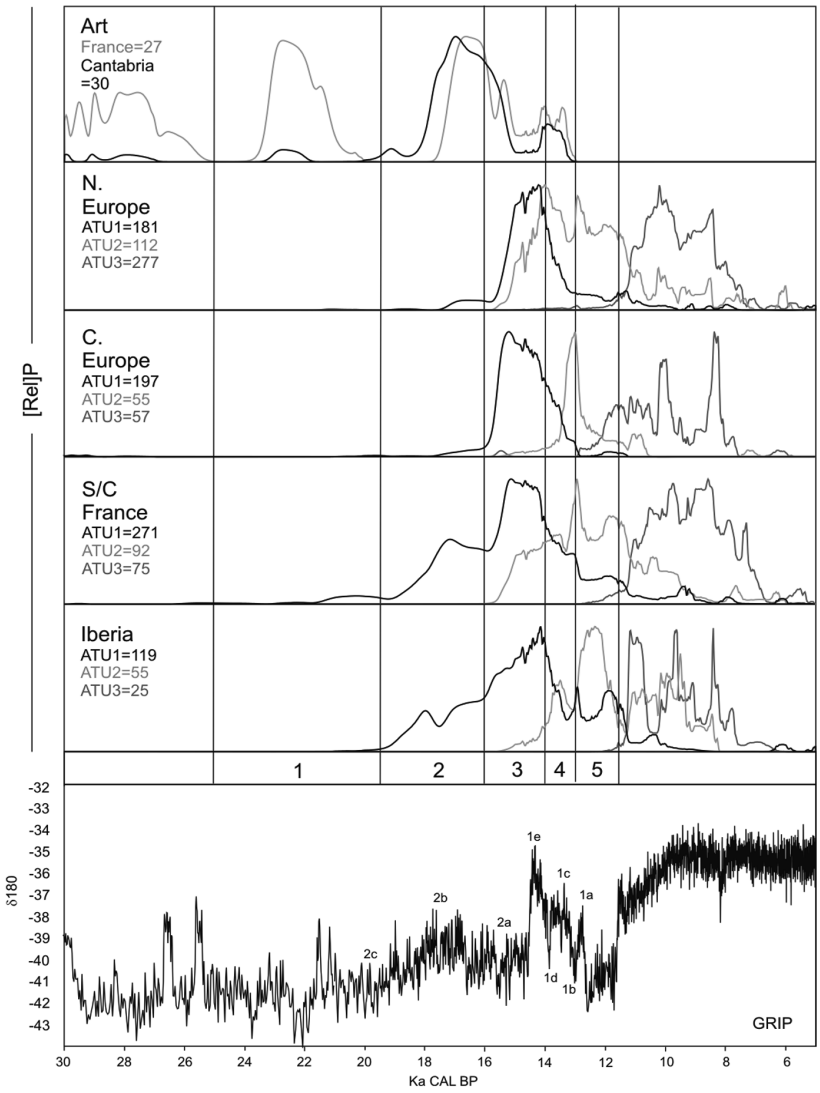


Fig. 4. Population events 3–5 (GS–2b to GS–1) radiocarbon dating probabilities by ATU. Later Magdalenian = ATU1; Epipalaeolithic = ATU2; Mesolithic = ATU3. It is expected that an audit of the dates by precision, accuracy and their archaeological integrity will reduce the outliers in earlier population events (*Pettitt et al. 2003*).

beyond the G refugium were explored, assessed and utilised in a more systematic fashion and on a more regular basis. This settlement pattern occurred over much of Western Europe where the main population focus now included southwest France as well as regions in Iberia outside Cantabria/Portugal. Settlement type now comprises both open and naturally sheltered sites.

Population event 3: Main demic expansion 16ka–14ka BP

The principal Late Glacial demic expansion occurred in two phases in Western Europe (Fig. 5) over a 2000 year period in GS–2a and GI–1e. In phase 3.1 (Tab. 1) there is a significant increase in the number of calibrated determinations in all regions between 16ka and 14.7ka CAL BP. During this 1300 year period the dominant ATU is the Late Magdalenian. Furthermore, the sequence in the radiocarbon curves (Fig. 5) confirm earlier archaeological studies and the interpretation of genetic evidence that within Western Europe demic expansion was from the south to the north and associated with a rapid increase in the metapopulation (*Demars 1996; Housley et al. 1997; Bocquet-Apel and Demars 2000; Strauss 2000a*).

Phase 3.2 of the main demic expansion is represented in two of the three regional radiocarbon curves (Fig. 4) as a plateau that lasts throughout GI–1e (= Bølling interstadial). These 700 years partly coincide with a small plateau in the calibration curve (*Weninger and Jöris 2004*). This is not considered significant because at this time in southern Iberia the frequency of determinations continues to rise (Fig. 5).

Following Housley et al. (*1997*), we describe the archaeological settlement pattern in Population Event 3 as residential. Large-size, open-air campsites are known (*Strauss et al. 1996*) from Lake Neuchâtel and the Neuwied and Paris basins and these are matched by substantial rock shelter occupations in the Rhine-Danube watershed, the uplands of Southern Germany, Thuringia and Belgium. Smaller-scale rock shelter occupations are known from the periphery in the British Isles (*Barton 1999*) and are comparable in site scale to the pioneer settlement of earlier Population event 2. No doubt small open settlements extended into other northern areas, such as Doggerland (*Coles 1998*), now inundated by the North Sea.

Archaeological evidence suggests two dispersal corridors for Population event 3 to the west and east of the Massif Central (*Thévenin 1995*). The eastern cor-

ridor following the Rhône-Saône-Rhine rivers is supported by evidence for the long-distance transfer of raw materials including Mediterranean shells and Baltic amber (*Floss 2000*) and is studded with residential settlement sites (*Street et al. 2001*).

Population event 4: Population stasis, 14ka–12.9ka BP

The interpretation of this population event as stasis rather than contraction illustrates the importance of combining radiocarbon determinations, when used as proxy data for past demography, with archaeological information on settlement patterns. The face-value interpretation from the calibrated curves (Fig. 5) is that after 14ka CAL BP population declined in most regions of Western Europe.

However, Figure 6 shows that when the radiocarbon determinations from Northern Europe (Fig.1) are compared for two classes of sites, open and rock shelter/cave, then the reason for the decline in the proxy population curve becomes apparent. Naturally sheltered locations were dominant in both population events 2 and 3. However, this settlement type did not form a significant part of the continuing occupation of the region. On the contrary, open-air campsites continued in importance throughout GI–1 and remained largely unaffected by climate change until the last sub stage GI–1a. We interpret these frequency data as changes in regional settlement patterns, for example from dispersed to nucleated, rather than a decline in the size of the metapopulation.

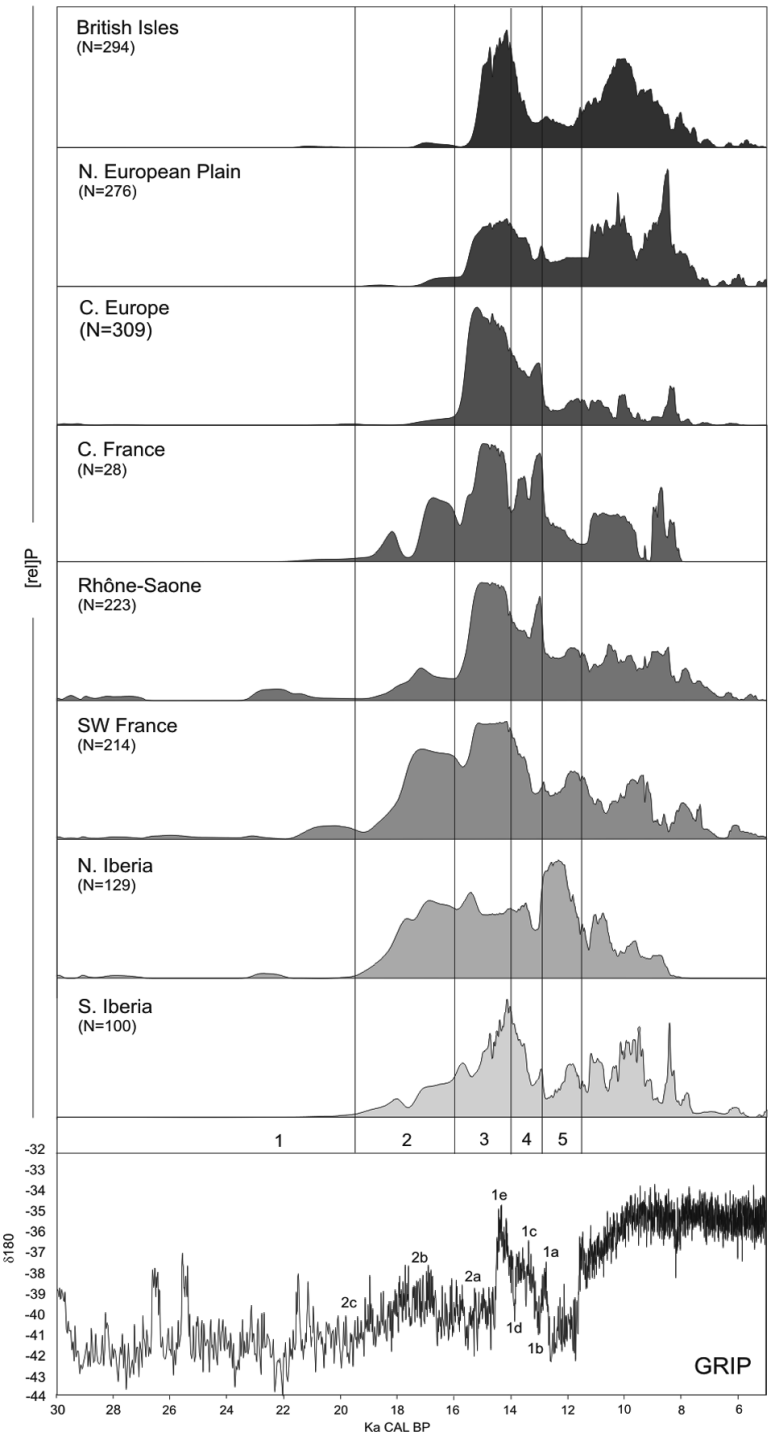


Fig. 5. Population events 3–5 (GS–2b to GS–1) radiocarbon frequencies by region. ATUs represented are Later Magdalenian, Epipalaeolithic and Mesolithic. As in Figure 4 the dates are unaudited.

Population event 5: Population contraction, 12.9ka–11.5 BP

The impact of GS–1 (= Younger Dryas) on population size in northern Europe was considerable (Fig. 6) and is confirmed by archaeological surveys (*Strauss et al. 1996*). However, this northern area was neither abandoned nor used as infrequently as in Population events 1 and 2 (Fig. 2). This suggests a higher metapopulation for Western Europe than the refugium minimum (*Bocquet-Apel and Demars 2000*) and from this deme came the Holocene/Mesolithic recovery and population growth.

Comparison with genetic data and the environmental framework

Phylogeographic analysis of modern Europeans indicates a major founder effect in the Late Glacial (*Richards et al. 2000*), with an age estimated from using the mitochondrial DNA molecular clock to circa 16 000 years ago (*Torroni et al. 2001; Pereira et al. 2005*). The radiocarbon chronology presented here provides the first independent assessment of this estimate with calibrated determinations (Tab. 1, Fig. 2). However, it is not yet possible to be precise about the duration of the constriction itself, except to suggest from the proxy radiocarbon data for regional demography that the neck of the bottle was particularly elongated. Estimates (*Bocquet-Apel and Demars 2000*) that the metapopulation increased from 9000 to 40 000 in the Late Glacial of Western Europe, excluding Iberia, now have to be considered as demographic growth, independent of in-migration, which occurred in Population event 3.1 over an estimated 1.3ka.

The S2AGES proxy data for demic expansion can be considered in the light of two current interpretations of the Greenland ice-core record and its significance for the North Atlantic (*Walker et al. 1999; Lowe et al. 2001*). At issue is the role of climate forcing in the expansion of human populations. Ameliorating climate at the end of the European ice ages is believed to drive the process of northward expansion of many species from southern refuges (*Hewitt 1996; Hewitt 1999; Willis and Whitaker 2000*). For this model to stand for human expansion it is necessary to interpret the radiocarbon and GRIP data as time-transgressive. Multi-proxy environmental evidence from terrestrial locations in northern Europe (*Walker et al. 2003*) suggest this may be the case. These data indicate warming was underway by 15.5ka CAL BP and that a time-transgressive interpretation between palaeoclimate archives at different latitudes is appropriate. If correct, the GRIP δ^{18} signal lags behind climatic warming and human, plant and animal migration in the oceanically controlled climates of Western Europe. Using Population event 3.1 as indicative of the effect of this warming on the distribution of human populations we can estimate the lag between climate change in Western Europe and its register in GRIP. Cross correlation Corr (τ) of the climate and radiocarbon curves identifies a positive peak only in the Northern Europe and French data. This indicates a significant response in the frequency of radiocarbon determinations some 700 years before climatic warming took place as indicated by GRIP. The width of the peak makes it difficult to ascertain precisely its statistical significance but its simultaneous occurrence in the two regions strongly suggests that it represents the same population event, probably related to biomass changes under climatic amelioration. Furthermore, the Iberian data show a negative correlation with climate change which is consistent with the continued refugium status for this region.

However, an alternative model that expansion is not directly linked to ameliorating climate and that the two records are time-locked is supported by marine evidence. High resolution records from an Iberian ocean core (*de Abreu et al. 2003*) shows in-phase oscillations with GRIP and GISP2 during the last glacial cycle. Significantly Heinrich Level 1 dated 17.6–14.9ka BP represents the coldest sea surface temperatures off Iberia in the last 70ka and coincides with the major human expansion during population events 2 and 3 (Tab. 1). Therefore, environmen-

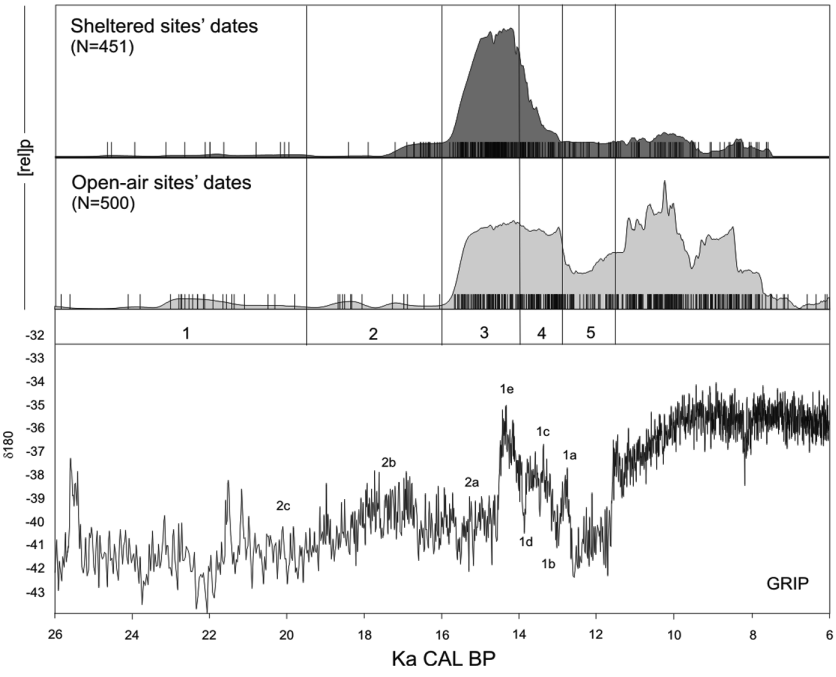


Fig. 6. Open and sheltered sites from northern France and North Central Europe (regions 6–9, Fig. 1) in population events 3–5.

tal forcing on population expansion was linked instead to colder climatic conditions in Western Europe and the earlier Solutrean pulse (Fig. 3) during HL2 confirms this.

One solution to the conflicting evidence over the role of climate in human expansion might rest in the model of southern refuges. Climate modelling using sea surface temperatures (*van Andel et al. 2003*) and evidence from the palaeobotanical (*Willis et al. 2000*) and faunal (*Stewart 2003*) archives points to the existence of cryptic refuges during cold phases north of Europe's continental divide. These refuges may have been small in extent and limited in duration but would have acted as an attractor to human populations with an extensive settlement network.

By comparison to human expansion, the contraction we document in Population event 5 appears in phase with the GRIP stratotype but is not related to any Heinrich Level. This association supports Foley's (*1994*) larger analysis of environmental change and evolutionary events among hominins, where the primary influence of climate is on extinction rather than speciation. We conclude that the expansion and contraction of mobile Late Glacial populations in Western Europe may be responding to fine-scale climate change in similar ways and where, at these smaller temporal and spatial scales, population dispersal and decline are analogous to speciation and extinction (*Gamble et al. 2004*).

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The role of Southeastern Europe in origins and diffusion of major paternal lineages

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ABSTRACT – *The aim of this study is to explore the existing data based on high-resolution phylogenetic studies of Y chromosome variation in populations from Southeastern Europe and elsewhere in Eurasia in order to evaluate the role of the region in the process of the prehistoric colonization of the European continent and the structuring of the modern paternal genetic pool. Even though the distribution and estimated range expansions of major paternal lineages in Southeastern Europe are consistent with the typical European Y chromosome gene pool, the specific role of this region in the process of structuring the European paternal genetic landscape is evident in prehistoric episodes of significant gene flow that diffused from or into the region.*

IZVLEČEK – Cilj te študije je preučiti obstoječe podatke, ki so osnovani na visoko resolucijskih filogenetskih študijah variacije kromosoma Y v populacijah jugovzhodne Evrope in v drugih delih Evrazije, z namenom, da ocenimo vlogo regije v procesu prazgodovinske kolonizacije evropskega kontinenta ter pri strukturiranju modernega moškega genskega sklada. Čeprav sta distribucija in predviden obseg širitve glavnih moških dednih linij v jugovzhodni Evropi skladna s tipičnim Evropskim genskim skladom kromosoma Y, se posebna vloga te regije kaže v procesu strukturiranja evropskega moškega dednega genetskega zemljevida, povezanega z dogodki v prazgodovini in genskim pretokom v regijo in iz regije.

KEY WORDS – *Human Y chromosome; phylogenetic analysis; Southeastern Europe*

Introduction

The human Y chromosome defines male sex through the action of the sex determining region (SRY). It is an atypical segment of the human genome, since it is haploid in most of its length, escapes recombination with the X chromosome, and undergoes uniparental transmission. These properties make the Y chromosome sequence a valuable tool for the purposes of human history reconstruction and studies focused on the dispersal of anatomically modern humans. The non-recombining region of the Y (NRY) is inherited as a single locus that changes exclusively via mutations accumulating over time, thus allowing the preservation of a relatively simple record of genetic history in comparison to nuclear DNA (autosomes).

There has been an interest in studying paternal genetic history since the mid-80s (*e.g. Casanova et al. 1985; Hammer 1994; Underhill et al. 2000*). A constantly growing number of evolutionary informative polymorphisms provide a deeper resolution of human paternal history and evolution. Currently, there are more than 300 known SNPs (single nucleotide polymorphisms) and small indels (*YCC 2002; Jobling and Tyler-Smith 2003*). In evolutionary genetics terminology, the set of alleles at different biallelic loci along the chromosome is called a haplogroup.

Assuming a 1:1 sex ratio, the effective population size of the Y chromosome in a population would be

about one-quarter of that of any autosome. Consequently, a genetic difference depicted by Y chromosomes, in comparison to autosomes, is more susceptible to the effects of random genetic drift that accelerates geographic clustering and differentiation between different (especially small) populations. The general structure of paternal genealogies is compatible and indicative of the common origin of all non-African contemporary populations from a small subset of Africans. Despite disagreement about the time to the most recent common ancestor (TMRCA) of the Y chromosome, its phylogeny roots in Africa around 100 KYA (*e.g. Hammer et al. 1998; Underhill et al. 2001; Underhill 2003*).

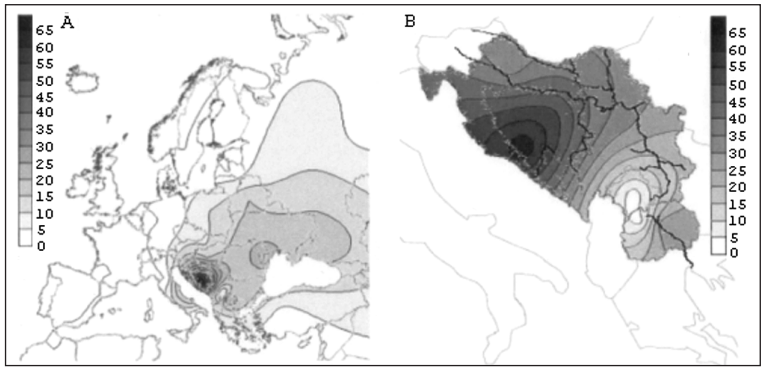


Fig. 1. I1b* frequency distribution in Europe, Northern Africa and Asia Minor (panel a) as well as in Southeastern Europe (panel b). Frequency distributions surfaces are taken from Peričić et al. (2005). I1b* frequency data for different Eurasian populations were generated from literature, as listed in Table 1 in Peričić et al. (2005).

The first extensive studies of European Y chromosome dispersal by Semino et al. (*2000*) and Rosser et al. (*2000*) showed clinal patterns for the most frequent European haplogroups. Moreover, Semino et al. (*2000*) grouped more than 95% of European Y chromosomes into 10 phylogenetically distinct haplogroups, of which 70–80% of the Y chromosome gene pool was represented by R1a, R1b, I and N3, and the remaining 20% by J2, E3b, and G.

Palaeolithic haplogroups

Haplogroup I is the only autochthonous European haplogroup assumed to have arisen in an Epi-Gravettian group among the descendants of people who arrived in Europe from the Near East around 25 KYA (*Semino et al. 2000*). This haplogroup is almost entirely restricted to the European continent, where it shows frequency peaks in two areas – Scandinavia and Southeastern Europe (*Semino et al. 2000*). Further phylogenetic subdivision revealed subclades I1a, I1b*, I1b2, and I1c (*Rootsi et al. 2004*). The geographical distribution of I1a (the highest frequencies in Northern Europe among Norwegians, Swedes and Saami) is considered to be a result of the recolonization of Europe after the LGM from the Francocantabrain refugial area (*Rootsi et al. 2004*). The origin of the less frequent I1c, that covers a wide range of Europe and peaks in northwest coastal Europe, is in concordance with I1a (*Rootsi et al. 2004*). A completely different distribution pattern is observed in I1b* Y chromosomes, the most frequent haplogroup I clade in Eastern Europe and on the Balkan Peninsula. I1b* reaches maximum frequencies in Southeastern Europe in Bosnia and Herzegovina (Fig. 1). Our results indicate that the homogenous distribution of elevated I1b* frequency among different populations in Southeastern Europe could support the hypothesis of their having a common paternal history shared over a long period of time (*Peričić et al. 2005*). Rootsi et al. (*2004*) estimated that I1b* diverged from I* at 10.7+4.8 KYA, possibly in relation to the post Younger Dryas (YD) climate amelioration in Europe, and that I1b* expansion occurred around the early Holocene at 7.6+2.7 KYA. Our coalescent estimate of I1b* (*Peričić et al. 2005*) is substantially older (11.1+4.8 KYA). This finding suggests that the I1b* lineages might

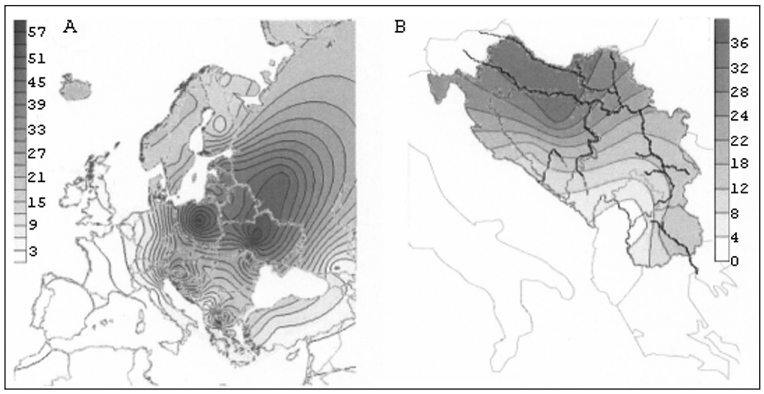


Fig. 2. R1a frequency distribution in Europe, Northern Africa and Asia Minor (panel a) as well as in Southeastern Europe (panel b). Frequency distributions surfaces are taken from Peričić et al. (2005). R1a frequency data for different Eurasian populations were generated from literature, as listed in Table 1 in Peričić et al. (2005).

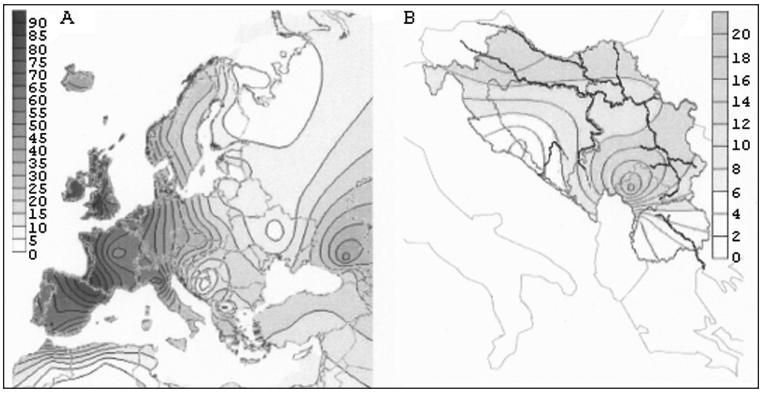


Fig. 3. R1b frequency distribution in Europe, Northern Africa and Asia Minor (panel a) as well as in Southeastern Europe (panel b). Frequency distributions surfaces are taken from Peričić et al. (2005). R1b frequency data for different Eurasian populations were generated from literature, as listed in Table 1 in Peričić et al. (2005).

have expanded from Southeastern to Central, Eastern and Southern Europe in a period not earlier than the YD to Holocene transition and not later than the early Neolithic (*Peričić et al. 2005*). Although not yet supported by archaeological evidence, the I1b* spread in Europe suggests that Southeastern Europe could have served as an LGM refugium, as previously suggested by Semino et al. (*2000*) and Barać et al. (*2003*). This scenario could be indirectly supported by the recolonization of Northern Europe from the direction of Southeastern Europe by at least two species – the brown bear *Ursus arctos* (*Taberlet and Bouvent 1994*) and the European hedgehog *Erinaceus europeus* (*Hewitt 2000*).

Another widespread haplogroup in Europe, R1a, is characteristic of Eastern European populations (Fig. 2a). The age of this haplogroup has been approximated to 15 KYA (*Semino et al. 2000; Wells et al. 2001*). Kivisild et al. (*2003*) suggested that Southern and Western Asia might be the source of R1 and R1a differentiation. Present R1a distribution in Europe shows an increasing west-east frequency gradient, with the highest frequencies among Finno-Ugric and Slavic speakers (Fig. 2a). R1a frequency shows a decrease in the north-south direction in Southeastern Europe (Fig. 2b), where its age is estimated at 15.8 ± 2.1 KYA (*Peričić et al. 2005*). This estimate is consistent with the R1a deep Palaeolithic time depth previously suggested by Semino et al. (*2000*) and Wells et al. (*2001*). At the current level of resolution it is not possible to determine which of three potential episodes of gene flow might have influenced the estimated age in Southeastern Europe: early post-LGM recolonizations from the direction of the Ukrainian refugium, migrations from the northern Pontic steppe in the period between 3000 to 1000 BC, or Slavic migrations between the 5th and 7th centuries AD.

Its sister clade, haplogroup R1b, was introduced by or arose in an Aurignacian group who entered Europe and diffused from east to west about 40 to 35 KYA (*Semino et al. 2000*). R1b shows a frequency peak in Western Europe and a decrease in Eastern and Southern Europe (Fig. 3a). Even though R1b frequency decline continues from Western to Southeastern and Southern Europe, two intermediate local peaks are evident in Southeastern Europe (Fig. 3b). According to our data, in Southeastern Europe the coalescent estimate of R1b (11.6 ± 1.4 KYA) closely matches the estimate for the I1b* lineages, pointing to the Younger Dryas to Holocene transition as a possible expansion period of these two major Y chromosome lineages (*Peričić et al. 2005*).

Neolithic haplogroups

Approximately 20% of European Y chromosomes belong to haplogroups E3b, J2 and G that, due to their decreasing frequency gradients from the Near East to Europe, have been traditionally considered to re-

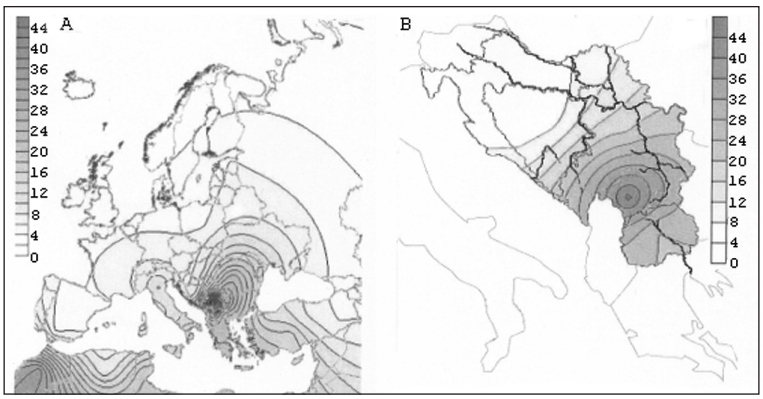


Fig. 4. E3b1 frequency distribution in Europe, Northern Africa and Asia Minor (panel a) as well as in Southeastern Europe (panel b). Frequency distributions surfaces are taken from Peričić et al. (2005). E3b1 frequency data for different Eurasian populations were generated from literature, as listed in Table 1 in Peričić et al. (2005).

present the male contribution of a demic diffusion of farmers (*e.g. Semino et al. 2000; Semino et al. 2004; Cruciani et al. 2004*). E3b1 shows a frequency peak in Southern and Southeastern Europe (Fig. 4a). In fact, E3b1 shows a rather continuous frequency decline in Southeastern Europe (Fig. 4a). Populations of the Adriatic-Dinaric complex are distinguished from neighboring populations of the Vardar-Morava-Danube river system by a lower frequency of E3b1 (Fig. 4b), possibly due to its different dispersal modes in two proximate geographic regions. Moreover, the Vardar-Morava-Danube river system could have been one of major routes for E3b1 expansion from South and Southeastern to continental Europe, as evidenced in the archeological record (*e.g. Tringham 2000*). The estimated age of this haplogroup of 7.3 ± 2.8 KYA in Southeastern Europe accords with the time of expansion of the Neolithic in Europe (*Cruciani et al. 2004; Semino et al. 2004*).

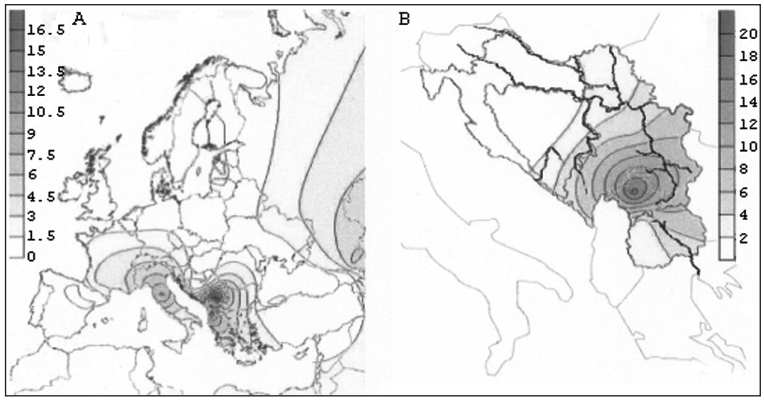


Fig. 5. J2e frequency distribution in Europe, Northern Africa and Asia Minor (panel a) as well as in Southeastern Europe (panel b). Frequency distributions surfaces are taken from Peričić et al. (2005). J2e frequency data for different Eurasian populations were generated from literature, as listed in Table 1 in Peričić et al. (2005).

Haplogroup J is subdivided into two major clades, J1–M267 and J2–M172 (*Cinnioğlu et al. 2004*). J2–M172 is more frequent in Europe (*Semino et al. 2004*). In Southeastern Europe the most frequent is haplogroup J2e, which comprises 5% of all chromosomes (*Peričić et al. 2005*), while haplogroup J2, the main J2 cluster among Greeks and Italians (*Di Giacomo et al. 2004*), is present at a frequency of less than 1%. The estimated age of the haplogroup J2e in Southeastern Europe (2.8+1.6 KYA), together with its spatial distribution (two frequency peaks positioned in the Balkans and central Italy, Figs. 5a and 5b), may be explained by the maritime spread of J2e lineages from the southern Balkans towards the Apennines later than is traditionally suggested by the demic expansion model (*Peričić et al. 2005*).

Concluding remarks

Even though the distribution and estimated range expansions of major paternal lineages in Southeastern Europe are consistent with the typical European Y chromosome gene pool, the specific role of this region in the process of structuring the European paternal genetic landscape is evident in the following prehistoric episodes of significant gene flow: the post-LGM R1a expansion from Eastern to Western Europe, the YD-Holocene I1b* diffusion out of the Balkans, with subsequent R1a and I1b* gene flows between Eastern and Southeastern Europe, and the weaker extent of E3b1 dispersal out of Southern and Southeastern Europe towards Eastern Europe than towards Western (especially Mediterranean) Europe.

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Y-chromosome haplogroup I prehistoric gene flow in Europe

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ABSTRACT – *To investigate which aspects of contemporary human Y-chromosome variation in Europe are characteristic of primary colonization, late-glacial expansions from refuge areas, Neolithic dispersals or more recent events in gene flow haplogroup I was analyzed. The analysis of Hg I Y chromosomes revealed several sub-clades with distinct geographic distributions. Sub-clade I1a accounts for most of Hg I in Scandinavia, with a rapidly decreasing frequency towards the East European Plain and the Atlantic fringe; but microsatellite diversity reveals that the Iberian Peninsula/Southern France refugial area could be the source region of the early spread of both I1a and the less common I1c. I1b* extends from the eastern Adriatic to Eastern Europe, and declines noticeably towards the southern Balkans, and abruptly towards North Italy. This clade probably diffused after the Last Glacial Maximum from a homeland in the Balkans or Eastern Europe. In contrast, I1b2 most probably arose in southern France/Iberia, underwent a post-glacial expansion, and marked the human colonization of Sardinia about 9000 years ago.*

IZVLEČEK – *Da bi raziskali, kateri aspekti sodobne človeške variacije kromosoma Y v Evropi so značilni za primarno kolonizacijo, pozno glacialno širitev iz refugijev, neolitske širitve in bolj recentne dogodke v genskem zapisu, smo analizirali haploskupine I. Analize kromosoma Y haploskupine I, so pokazale sub-klade z jasnimi geografskimi porazdelitvami. Sub-klad I1a označuje Hg I v Skandinaviji, s hitrim pojemanjem v smeri proti Vzhodnoevropski ravnici in obrobju Atlantika. Mikrosatelitska raznolikost je pokazala, da je bil Iberijski polotok/južna Francija verjetni refugij in izvorno področje, iz katerega sta se razširila oba sub-klada I1a in manj pogosti I1c. I1b* se razteza od vzhodnega Jadrana do vzhodne Evrope in opazno pojema v smeri proti južnemu Balkanu ter strmo upade v smeri proti severni Italiji. Ta klad se je verjetno razširil po zadnjem glacialnem maksimumu iz domovine na Balkanu ali v vzhodni Evropi. I1b2 najverjetneje izhaja iz južne Francije/Iberije in kaže post-glacialno širitev in človekovo kolonizacijo Sardinije pred okoli 9000 leti.*

KEY WORDS – phylogeny of Y-chromosomal markers; haplogroup I sub-clades; late-glacial expansions; Neolithic dispersals

Introduction

Although there is sound evidence that the majority of present-day European genes descend from indigenous Palaeolithic ancestors, it is to be expected that the pre-LGM landscape of the spread of genetic variation was profoundly re-shaped during and after the LGM – Late Glacial Maximum (*Richards et al. 2000; Semino et al. 2000*). The aim of this investigation was to apply the phylogeographic approach to Y-chromosomal haplogroup I, the only known Y-chromosomal haplogroup that probably arose in Europe in Palaeolithic times, and which is still common and widespread there, whilst being virtually absent elsewhere.

The distribution of haplogroup I was intriguing, with its two high frequency peaks in distant parts of Europe (the Balkan region and Scandinavia); and the further large-scale I haplogroup study by Rootsi et al. (*2004*) concentrated on achieving a better phylo-

genetic and phylogeographic resolution of this haplogroup, informative for the reconstruction of long-distance gene flows in space and time.

Results and Discussion

It has been shown earlier that the high frequency of hg I is characteristic of two distant and distinct regions – around the Dinaric Alps (*Semino et al. 2000; Barać et al. 2003*) and in Nordic populations of Scandinavia (*Semino et al. 2000; Passarino et al. 2002; Tambets et al. 2004*).

In a study by Rootsi et al. (*2004*), concentrating on haplogroup I phylogeography and phylogeny, more than seven thousand individuals from Europe and the surrounding regions were assessed for the marker M170, which defines hg I.

1104 Y chromosomes from 48 European and 12 populations from surrounding regions which showed the derived M170 C- allele were further genotyped with a set of markers (M253, P37, M26 and M223) that define distinct sub-clades of I, respectively I1a, I1b, I1b2 and I1c.

Thanks to the new informative markers used, the improved resolution of phylogeny of hg I enabled to reveal distinct phylogeographical patterns of sub-clades I1a, I1b and I1c, which jointly cover about 95% of hg I individuals. Sub-clade I1a is widely distributed in northern Europe, with its highest frequencies in Scandinavia: in Norwegians, Swedes and Saami, accounting for 88–100% of hg I individuals in these populations and showing rapidly decreasing frequency towards both the East European Plain and the northwestern coastal areas of Europe. Combined analysis of STR diversity and a relative portion of I1a sub-clade among all I lineages suggests that France or possibly more precisely – the Franco-cantabrian refugial area – could have been the source region of the spread of I1a during the post-LGM re-colonization of Europe. The same may apply to the spread of the less common sub-clade I1c. This scenario is also supported by a high positive correlation (0.75) between the geographic distributions of I1a and I1c. I1c covers a wide range in Europe, with the highest frequencies in north-west coastal Europe, and a lower frequency elsewhere (Fig. 1).

A totally different distribution pattern can be seen for I1b*, which is the most frequent haplogroup I clade in Eastern Europe and the Balkans. It reaches its highest frequencies in Croatian and Bosnian populations, encompassing almost 80–90% of hg I there. When comparing frequencies in different regions of Croatia (*Barać et al. 2003*), clear and significant differences between the three southern islands with higher frequency and the mainland and the northerly island of Krk with lower frequency, became apparent. More than half of Croatian hg I sampled individuals – 126 out of 221 (57%) – share an identical STR haplotype, which was named the Dinaric Modal Haplotype. This haplotype was not present in 102 hg 2 chromosomes (according to Jobling's nomenclature) as reported by Helgason et al. (*2000*); the most frequent among them was labeled as the Nordic Haplotype (*Barać et al. 2003*).

The phylogenetic network of hg I STR haplotypes points to characteristic haplotype patterns in different sub-clades, which allows us to identify possible founder haplotypes for the different sub-clades, and calculate their possible expansion times according to the method described in Zhivotovsky et al. (*2004*).

The estimates for possible expansion times suggest that the expansion phase of I1a and I1b occurred around the early Holocene and only the less frequent sub-clade I1c shows an earlier age for its STR variation, suggesting that the corresponding mutation arose earlier.

High frequency combined with the high diversity of sub-clade I1b in the Croatian population (both mainland and island populations) suggests that during the LGM there might have been a refugium nearby. According to our knowledge, placing of the western Balkans on the list of human refugia during the LGM has not been confirmed so far unambigously by archaeologists. However, the northern part of the Adriatic Sea, including the Dalmatian Islands, was at that time a part of dry land, being covered by water only much later, at the boundary of Holocene (references within *Barać et al. 2003*). Therefore, one may speculate that the wealth of the traces of human occupancy of the area lies submerged. Nevertheless, it is justified to suggest that the present-day western Adriatic was the reservoir of M170 (I1b) lineages, as well as a starting point for the spread of these lineages during the post-glacial re-colonization of Europe. Meanwhile, the star-like pattern of both, I1a and I1b* STR haplotypes, might be explained by simultaneous re-colonization of Europe from different refugia.

I1b* sub-clade dissipates very rapidly west of the Balkans, being virtually absent among Italian, French and Swiss populations, but extending eastwards at

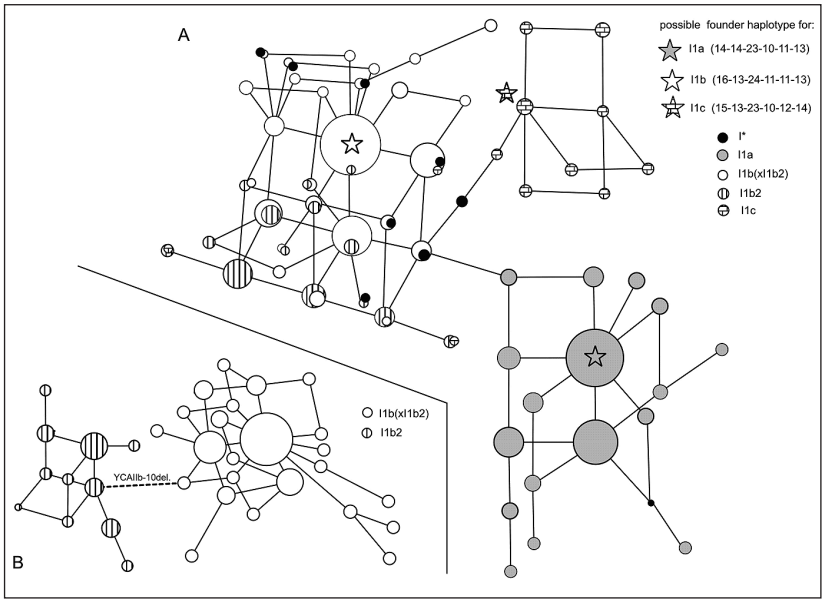


Fig. 1. A – Median-joining network of combined haplotypes of six STR loci (DYS19, 388, 390, 391, 392, 393) in 25 populations/584 individuals (Norwegians, Estonians, Saami, Swedes, Hungarians, Czechs and Slovaks, Poles, Ukrainians, Croats, Bosnians, Macedonians, Albanians, Greeks, Moldavians, Gagauz, Turks, Italians, Sardinians, French, Dutch, Andalusians, Bearnais, Basques and Swiss). Only haplotypes with frequency >1 were used. Nodes indicate haplotypes with sizes proportional to their frequency (smallest node corresponds to 1 individual – only in case of overlap between subclades, otherwise haplotypes with frequency >1 are presented). Haplotypes of different sub-clades are indicated with different patterns.
The most frequent haplotype of I1a sub-clade (14-14-23-10-11-13) corresponds to the earlier named Nordic Haplotype and the dominant in I1b* haplotype is the so-called Dinaric Modal Haplotype (16-13-24-11-11-13) according to Barać et al. (2003). The possible founder lineage for the third sub-clade, I1c (15-13-23-10-12-14), was revealed in Rootsi et al. (2004).
B - Median joining network of I1b(xI1b2) and I1b2 lineges based on seven STRs (DYS 19, 388, 390, 391, 392,393 and YCAIIa,b). I1b* (YCAIIa,b mostly 21,21 alleles) and I1b2 (YCAIIa,b; 21,10 alleles) lineages are clearly separated from each other by the difference inYCAII a,b haplotypes. They differ by 10 repeats in YCAIIb allele length that is probably a result of one single mutational event rather than step-by step deletions - in particular because no intermediate repeat variants have been detected.

notable frequencies, mostly in the north Balkans and among Slavic-speaking populations, including more eastern Ukrainians. This finding suggests that I1b* may have expanded from a glacial refuge area, which may have been located in the Balkans. As indicated above, there is only limited archaeological evidence for such a refugium in this region at present. Nevertheless, data on the re-occupation of northern Europe from the Balkan region by mammals such as the brown bear *Ursus arctos* (*Taberlet and Bouvet 1994*) and European hedgehog Erinaceus europeus (*Hewitt 2000*), birds such as the European great tit *Parus major* (*Kvist et al. 1999; Kvist 2000*) and insects such as the meadow grasshopper *Chortippus parallelus* (*Hewitt 2000*), supports its existence indirectly.

It seems somewhat less likely though not impossible that I1b* was preserved during the LGM in an area of much better documented Periglacial refugium in the present-day Ukraine. It appears less likely because (a) not only its frequency, but also diversity is higher in the Adriatic region; (b) a branch of I1b* – I1b2–M26 – has a clearly western pattern of distribution, being totally absent in Ukrainians.

On the other hand, a clearly visible difference that can be observed in the distribution patterns of I1b* and an outshoot of it – I1b2 – suggests that their separation may have occurred even before the LGM, whereas isolation, genetic drift during the LGM, recolonization and an unknown number of putative more recent demographic events created the pattern that one observes among extant populations.

Meanwhile, the extremely high incidence of I1b2 among Sardinians (about 40%) can be explained by the presence of carriers of I1b2 lineage among the first inhabitants of the island early in Holocene and by the influence of genetic drift thereafter.

Certain extent of similarity in distribution patterns of some mtDNA haplogroups, in particular V (*Torroni et al. 1998; Torroni et al. 2001*), with Y-chromosomal hg I sub-branches has been suggested by Rootsi et al. (*2004*). These findings show that distribution patterns characteristic to Y-chromosomal haplogroup I sub-clades are supported by parallel evidence from other genetic markers and probably indicate more general patterns in human past demographic movements.

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Most recent investigation of peopling of Bosnia and Herzegovina: DNA approach

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ABSTRACT – *Many historical episodes marked Bosnia and Herzegovina as a significant ethnic crossroads, which makes it a very interesting site for various population studies. The first stages of these complex investigations were based on observations of numerous phenotype markers. The following phase, which was relatively brief, was dominated by the use of different cytogenetic markers. Finally, at the beginning of this century, the molecular-genetic diversity of the BiH population became the focus of modern research. Autosomal and Y-STR markers, together with mitochondrial haplogroup (Hg) diversity were initially used in the examination of isolated groups, as well as the whole population of modern Bosnia and Herzegovina. The most recent study describes the distribution of Y-chromosome haplogroups in the three main ethnic groups in Bosnia and Herzegovina, and suggests a preliminary hypothesis for the process of peopling this area.*

IZVLEČEK – *Veliko zgodovinskih dogodkov je zaznamovalo Bosno in Hercegovino kot pomembno etnično stičišče, ki je zelo zanimivo za različne populacijske študije. Začetki kompleksnih raziskav so povezani z opazovanjem številnih fenotipskih označevalcev. V naslednji fazi je prevladala uporaba različnih citogenetskih označevalcev. Na začetku tega stoletja so raziskave usmerjene v molekularno-genetsko raznolikost BiH populacije. Pri raziskavah izoliranih populacij, kot tudi celotne človeške populacije moderne Bosne in Hercegovine, so na začetku uporabili avtosomalne in Y-STR označevalce skupaj z raznolikostjo mitohondrijske haploskupine (Hg). Najnovejša študija opisuje porazdelitev haploskupin Y-kromosoma pri treh glavnih etničnih skupinah v Bosni in Hercegovini in izdela preliminarni scenarij procesa poselitve tega področja.*

KEY WORDS – *molecular markers; Y-chromosome; Last Glacial Maximum; Paleolithic; Neolithic*

Bosnia and Herzegovina: from the most ancient times to the present

Because of its great number of small, more or less isolated, indigenous populations, Bosnia-Herzegovina represents a very interesting area for population-genetic surveys of different levels and approaches. The fascinating diversity of local human populations (obvious even in phenotype characteristics of individuals), as well as various levels of reproductive isolation can be attributed to the simultaneous and interactive effects of a vast number of factors (geographical, ethnic, religious etc.). Within those areas, each local population exhibits a different degree of openness and isolation and has unique relationships with

ancestral populations. The results of previous studies show that classic "islands in the land" exist in some regions (*Marjanović et al. 2004*).

Migration played a very important role in shaping recent conditions, such as, in particular, those relating to the peopling of central Balkan, as well as small regional movements, which were rather frequent because of the geographical position of this area (*Malcolm 1994*).

Archaeological finds indicate that the territory of modern Bosnia-Herzegovina was continuously settled since the Palaeolithic (*Imamović et al. 1998*). Stone tools found in north Bosnia date to more than 50 000 years ago (*Imamović et al. 1998*). However, the most interesting prehistoric traces of civilization date from the Neolithic.

At the beginning of the second millennium BC, the discovery of considerable sources of various kinds of metals attracted new settlers to the Balkan region, including Bosnia-Herzegovina as its central part. In this period the area was inhabited by Illyrian tribes. At the same time, Gals' invasions caused the Illyrians to migrate and settle in the eastern parts of modern Bosnia (*Wilkes 1992*).

By the end of the first century BC, after a hundred-year war, the Romans had defeated all the Illyrian tribes. The Illyrian province was under Roman rule for over 500 years. This was of great importance for this region that, after the construction of military roads and opening of numerous mines (silver, gold, copper, iron etc.), became once again the destination for many adventurers from all parts of the Roman Empire (*Klaić 1990*). The final division of the Roman Empire made the Balkans an unstable borderland and the crossroads of civilizations, peoples and religions.

Two crucial, relatively recent events, along with a number of more minor historic episodes, laid the foundations for the current population structure of region.

The first event was the great migration in the sixth and seventh centuries AD that caused the final fall of, first, Western then the Eastern Roman Empire. Documentary evidences suggest that the Goths were the first immigrants to this region (*Malcolm 1994*); shortly thereafter the Avars and Slavs arrived. In spite of the numerous invaders, there are reasons to believe that the first invasions were blunted by the resistance of well-armed resident Illyrians and the specific landscape, and that the local inhabitants probably completely assimilated most of the first immigrants (*Imamović et al. 1998*). According to some authors, this situation persisted for the next couple of decades, when the total 'slavization' of this area began with the arrival of two new Slavic tribes and the foundation of their powerful neighboring countries (*Imamović et al. 1998*). The present territory of Bosnia-Herzegovina is located between the areas inhabited by Croats (to the west) and Serbs (to the east). The first document mentioning this region was written by Constantine Porphyrogenitus in 958 (*1967*). It mentions that Bosnia, being a political and geographical subject, is located in a narrow area along the river. This part of history, in the absence of detailed written documents, is something of a 'twilight zone' for the interpretation of the political situation of that time. Principally, different understandings and presentations of historical facts have been dictated by ideology and politics. However, great mysteries such as the Bosnian heretical church, the term 'Bogomils' (*Rački 1931*) and the origin of isolated Bosnian populations remain issues for the future. A key fact is that the territory of Bosnia-Herzegovina at that time was the border, or the crossroads of two religious philosophies, Orthodox and Catholic.

The second important historical moment for this region was the expansion of the Ottoman Empire in the fifteen century. The conversion to Islam of a large part of the population was a fundamental process in the creation of modern Bosnian history. It was a long-term process, which took 150 years before Muslims were the majority in the former Bosnian sandzak (*Malcolm 1994*). This process is somewhat controversial, and the only thing that can be refuted with certainty is the hypothesis of forced mass conversion of the indigenous population. Unfortunately, historical dilemmas about some stages of establishing modern Bosnia-Herzegovina society have provided opportunities for various ideological, political, national, even nationalistic manipulations and distortions of the facts.

Modern Bosnia-Herzegovina is a multi-ethnic and multi-religious country, with a very stormy recent history. In various public and scientific media, many recent conflicts were sought through different interpretations of some parts of its history. Therefore, every population-genetic study based on the analysis of molecular markers suitable for detecting migration and micro-evolutionary phenomena, with

utterly reliable and exclusively scientific result presentation, can create new perspectives, but also raise questions about the structuring demographic characteristics of this area.

The development of population genetic studies

Fundamental genetic studies of different human, animal or plant populations are based on a preliminary understanding of the nature of molecular marker variations in observed populations. This universal rule, applicable to a wide range of organisms as potential research subjects, is especially important when *Homo sapiens* is the focus of study.

Modern population-genetic studies have changed significantly, especially in the last two decades. Previous studies were based on the observation of classical phenotypic markers. Population-genetic studies that simultaneously analyze the diversity of numerous, carefully selected, phenotypic characteristics can result in interesting information about micro-changes in the genetic structure of observed populations over a certain period. However, many of the informative phenotypic markers are limited by a lack of clarity in defining the heritable and non-heritable components that form most of the phenotypic attributes of an organism, especially those which are easiest to detect.

Human population genetics often uses intra- and inter-population distributions of genetic molecular markers in and between analyzed parts of population in order to elucidate their demographic and migration history (*Wells et al. 2001*). The development of new molecular-biological techniques has improved the molecular markers system. Among these markers, of primary importance are the STR (short tandem repeats) sequences, located on autosomal chromosomes (*Bowcock et al. 1994*), and SNP (single nucleotide polymorphisms) haplotypes (*Jin et al. 1999*). Even nowadays, these two kinds of markers can significantly contribute to a better understanding of the demographic and migration processes that affected the gene pool of now living populations.

Polymorphic markers, such as biallelic and STR, located in the non-recombining part of Y-chromosomes (NRY), are also known as holiandric markers, because of their transmission from father to son. The absence of recombination, as well as patrilocal marriage in approximately 70% of modern societies, makes this unique item of human chromosomal sets exceedingly useful in the study of large-scale evolutionary events in human history and population genetics phenomena in large and small, relatively isolated communities.

In the past few years a substantial amount of population data regarding the non-recombining part of Y-chromosomes has appeared (*YCC 2002 and references therein*). The spate of surveys in this field began with papers in the mid-1980's (*Casanova et al. 1985*) Markers located in this part of the human genome have an important role in evolutionary studies (*Hammer et al. 1996; Poloni et al. 1997; Rosser et al. 2000*), as well as in forensic (*Jobling et al. 1997*) and medical genetics (*Jobling and Tyler-Smith 2000*). The most frequently used markers at that time were RFLP (restriction fragment length polymorphism) or STR loci (*YCC 2002*). A historic breakthrough was made by the utilization of the DHPLC (denaturing high-performance liquid chromatography) method in the investigation of binary markers from the non-recombining portion of Y-chromosomes (NRY) (*Underhill et al. 1997*). As reported in some papers (*Underhill et al. 2000; Shen et al. 2000; Hammer et al. 2001*), over a short period of time, this method allowed the identification of over 200 SNPs and short insertion/deletion (indel) positions (*YCC 2002*). A very low mutation rate characterizes these polymorphisms' (named for this reason Unique Event Polymorphisms – UEP), making them suitable for the identification and detection of parental lineages stretching back thousands of years (*YCC 2002*). In order to set up a more flexible nomenclature system and to provide a complex NRY binary haplogroup tree, Y Chromosome Consortium (YCC), established by leading experts in Y-chromosome analysis, suggested a universal system in 2002 that is widely accepted today (*YCC 2002*). According to this system, Y-specific binary haplogroups (often denoted simply as haplogroups) refer to chromosome clusters characterized by the deepest UEPs. These clusters are more stable, but at the micro-evolutionary level, less informative than haplotypes defined by the more variable STR markers (*Jobling and Tyler-Smith 2003*). On the whole, a total of 16 major haplogroups (denoted by letters: A–R) were identified and the study of their distribution (phylogeography) provided important information about the peopling of different geographical areas, post-glacial and Neolithic expansions (*Underhill et al. 2001*). As to Europe, more than 90% of the Y-chromosomes belong to a few (E–SRY4064, I–M170, G–M201, J–12f2, R–M17and R–269) principal haplogroups (*Semino et al. 2000; 2004; Cruciani et al. 2004; Rootsi et al. 2004*).

Overview of population-genetic studies in Bosnia and Herzegovina during the last three centuries

Anthropo-genetic studies in Bosnia-Herzegovina were begun by the Austro-Hungarian government (*Hadziselimović 1984*). The first known bio-anthropological analyses of the population conducted by Austro-Hungarian army doctors can be considered an initial phase in determining its genetic structure (*Himmel 1887*).

It is important to stress that all of the studies were based primarily on the observation of phenotypic traits such as blood groups (*Kalić, Kostić 1934; Berberović et al. 1973*), color blindness (*Berberović 1969*), the shape of lobules (*Hadziselimović 1970*), PTC sensibility (*Berberović et al. 1973*), thumb flexibility (*Hadziselimović & Brdar 1979*), or analysis of the effect of some factors that disturb genetic equilibrium (*Hadziselimović 1983*).

The first steps were taken in investigating the variety of the fundamental, molecular-nuclear and mitochondrial DNA markers for diversity analyses of isolated Bosnia-Herzegovina populations at the beginning of this century (*Marjanović et al. 2004; Kapur et al. 2004; Marjanović et al. 2005*). Following analysis of STR marker variation, autosomal (*Marjanović et al. 2006*), and Y-chromosome markers (*Marjanović et al. 2005a*) were studied in order to establish a reference sample and to incorporate data about the molecular biodiversity found in BiH in a regional database (REBID-a).

Finally, the most interesting and controversial results were obtained trough the observation of 28 Y-chromosome biallelic markers within 256 males (90 Croats, 81 Serbs and 85 Bosniacs) from Bosnia-Herzegovina (*Marjanović et al. 2005b; 2005c*).

The Y-chromosome approach (summary of published articles)

The people of Bosnia-Herzegovina display European specific haplogroups that probably appeared in different glacial refuge areas of Europe (I–M170, R–M17 and RM269 from Balkan, Ukrainian and Franco-Cantabrian refuges, respectively), and haplogroups considered to have originated in Africa (E–SRY4064) and the Middle East (J–12f2) and to have arrived in Europe through a prolonged gene flow.

However, the presence of the HgI sub-haplogroup I–P37 in more than 50% of the examined Y chromosomes sets the population of Bosnia-Herzegovina apart from the majority of other European regions. Taking into account that a Palaeolithic origin for the P37 mutation in this Balkan district has been suggested (*Rootsi et al. 2004*), it is possible that the post-glacial expansion of a population with a high frequency of I–P37 from one of the refuges in the Balkans played a major role in the creation of the gene pool of modern Bosnia-Herzegovina.

HgE is the second most frequent haplogroup in Bosnia-Herzegovina; its presence in Europe has been attributed to multiple migrations from the Middle East and North Africa during and after the Neolithic (*Cruciani et al. 2004; Semino et al. 2004*). HgE is almost exclusively represented by the sub-clade E–M78. It is worth mentioning that the clinal distribution in Europe of E–M78 and its internal micro-satellite variance have been attributed to dispersals in Neolithic and post-Neolithic times from the Balkans to all directions, as far as Iberia to the west and, probably also to Turkey in the southeast (*Cinnioğlu et al. 2004; Cruciani et al. 2004; Semino et al. 2004*). In this framework, our data suggest that this expansion would have significantly affected the gene pool of Bosnia-Herzegovina.

Haplogroup J is another haplogroup that arrived in Europe from the Middle East, and its sub-clades probably marked complex migration processes during and after the Neolithic period (*Cinnioğlu et al. 2004; Di Giacomo et al. 2004; Semino et al. 2004*). In the Bosnia-Herzegovina population this haplogroup, with almost all of its known sub-clades, is found mainly in the Bosniacs. The detected J sub-clades are J–M267, which has been associated with Arab expansion; J–M92, which suggests genetic links between Anatolia and southern Italy; J–M67, which is frequent in the Caucasus; and finally J–M102, which shows frequency peaks in the southern Balkans and central-southern Italy.

R–M17 is the prevalent sub-haplogroup of Hg R, as previously observed in other eastern European populations (*Semino et al. 2000; Passarino et al. 2001; Wells et al. 2001*). Its frequency perfectly fits the expected distribution of R–M17, which is found almost exclusively in Eastern Europe, with a decreasing gradient from northeast to south-west. This gradient, initially attributed to expansion(s) from a Ukrainian glacial refuge (*Semino et al. 2000*), could also be due to infiltrations of Indo-European speaking peoples from southern Russia about 2000 years ago (*Jovanović 1979; Barać et al. 2003*), as well

as to the arrival of Slav clans during the 6th and 7th centuries. However, to evaluate this latter hypothesis, detailed analyses of R–M17 and internal STR diversity in the Bosnia-Herzegovina population are required.

The presence of the R–M269 sub-haplogroup in the sample is of interest. Despite the relatively low frequency of this marker, it indicates that the gene pool of the ancestral population(s) of the Franco-Cantabrian refuge area also contributed to some extent to this region of the Balkans, as additionally attested by analyses of the mtDNA (*Achilli et al. 2004*).

The first PC analysis (*Marjanović et al. 2005c*) suggests that the three ethnic groups are genetically extremely close to each other, and closely related to other populations of the Balkans. However, the second PC tends to separate the Croat group from other populations, probably as a result of the aforementioned effects of genetic drift and founding events on this ethnic group.

On the whole, our data suggest three main factors in the gene pool foundation of modern Bosnia-Herzegovina: (a) post-LGM expansion – possibly from a LGM refuge area in the Balkans, (b) complex migratory processes from Central Asia and Eastern Europe and (c) the numerous Neolithic and Post-Neolithic migration events that contributed haplogroups considered to be of African and Middle Eastern origin.

The main objectives of possible future studies of the peopling of Bosnia and Herzegovina

The outcome of this study is a possible account of the pattern of settlement in the area of modern Bosnia-Herzegovina. For the purpose of further elaboration it is necessary to insist on more of the basic parameters in future studies.

A multi-disciplinary approach is required in order to investigate fully all the pre-historic and historical events relative to the peopling of Bosnia-Herzegovina and the Balkans. All historical, archaeological and other findings relevant to determining migratory factors and modern micro-migratory processes should be analyzed. The results of this study should be compared to those of previous population-genetic studies based on observations of a wide range of both classic and molecular markers. Presented scenario, based on the results of holandric marker variation analysis, could benefit from such an approach.

The second parameter, which points to the dating of primary mutations in samples of the Bosnia-Herzegovina population, is highly notable. With the intention of estimating the possible time of mutation occurrence, analyses of Y-chromosome STR markers, and their frequencies and correlations within the detected haplogroups can be of great value. The results of these analyses would facilitate the precise reconstruction of regional migration patterns. Preliminary results based on the observation of 100 males from Bosnia and Herzegovina, have already yielded interesting results (*Marjanović et al. 2006*). Eighty-one different Y–STR haplotypes (from a total number of 100 samples obtained) were detected: 69 of them were unique, 7 appeared twice, 4 appeared three times, and 1 five times. Six of twelve not singleton haplotypes were shared by different population groups: two of them by Croats and Bosniacs, two by Bosniacs and Serbs, and the last two by Serbs and Croats, thus testifying almost certainly to recent gene flows between groups.

Most importantly, the results must be evaluated with an expanded sample. The sample of 256 individuals is larger (in European proportions and for such a relatively small population as Bosnia-Herzegovina) than many other samples investigated so far. Also, sample size for each of the three major ethnic groups completely meets the standards for this type of investigation, and is larger than those used in previous European studies of much larger populations than this one. The fact that the subjects are from more than 50 different locations in Bosnia-Herzegovina speaks in favor of a representative sample. However, regarding the high specificity and close relations of the ethnic groups, their common historical development, specific micro-migrational paths and the specific historical circumstances under which these groups developed, it is important to examine the intra-population diversity of regional subpopulations. For instance, the Croat population could be analyzed including sub-samples from Herzegovina, Middle Bosnia and Posavina; the Serbs through Herzegovina, Eastern Bosnia and Krajina groups; while the Bosniacs could be typed by comparing Herzegovina, East-Middle Bosnia and Western Bosnia groups. However, all the other demographic-genetic characteristics of the local groups of these populations can be taken into consideration. This approach can resolve the question of whether differences observed through this study are due to inter-populational (ethnical) or, more probably, intra-populational (regional) characteristics.

Until these complex studies are conducted, it is important to state that all findings, implications, hypotheses, reconstructions and models of this study are based on the results of the analyses of a screening-sample of the Bosnia-Herzegovina population and its relation to previously studied Eurasian populations.

Recent scientific studies from this field (*Semino et al. 2000; Barać et al. 2003*, and others) offer one truly interesting and completely new scenario. However, extreme caution is required in presenting these scientific results in the public media in order to avoid misinterpretation of the facts and unscientific speculation that could have unforeseeable consequences.

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Pushing it back. Dating the CCR5–Δ32 bp deletion to the Mesolithic in Sweden and its implications for the Meso/Neo transition

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ABSTRACT – *Genetic variation in the chemokine receptor gene CCR5 has received considerable scientific interest during the last few years. Protection against HIV-infection and AIDS, together with specific geographic distribution are the major reasons for the great interest in CCR5 32bp deletion. The event for the occurrence of this mutation has been postulated by coalescence dating to the 14th century, or 5000 BP. In our prehistoric Swedish samples we show that the frequency of 32pb deletion in CCR5 in the Neolithic population does not deviate from the frequency in a modern Swedish population, and that the deletion existed in Sweden already during the Mesolithic period.*

IZVLEČEK – *Med znanstveniki je bilo v zadnjih nekaj letih precej zanimanja za genetsko variacijo na kemokinskem receptornem genu CCR5. Glavna razloga velikega zanimanja za zdrs 32bp na CCR5 sta zaščita proti okužbi z virusoma HIV in AIDS ter specifična geografska porazdelitev. S pomočjo 'datiranja zlitja' je bilo predpostavljeno, da se je ta mutacija pojavila v 14. stoletju AD ali pa 5000 BP. Na švedskih prazgodovinskih vzorcih pokažemo, da ni bistvenega odklona v frekvenci zdrsa 32pb na CCR5 med neolitsko in moderno švedsko populacijo in da je mutacija na Švedskem obstajala že v mezolitiku.*

KEY WORDS – *CCR5-Δ32; Bubonic plague; Smallpox; Mesolithic; Neolithic*

Introduction

The product of the CCR5 gene is a member of a seven-transmembrane G-protein-coupled receptor family, and is important for the cell entry of the human immunodeficiency virus HIV-1 (*Alkhatib et al. 1996; Choe et al. 1996; Deng et al. 1996; Doranz et al. 1996; Trkola et al. 1996*). In 1996 a 32bp deletion in the CCR5 gene was reported which truncates the protein and appears to provide almost complete protection against infection by HIV-1 (*Liu et al. 1996; Samson et al. 1996; Dean et al. 1996; Ometto et al. 1999*). In homozygotes for 32bp deletion the protection is well documented, but there are different opinions about the protective effect of heterozygosity against HIV-1, although it seems to delay the outbreak of AIDS (*Samson et al. 1996; Dean et al. 1996; Huang et al. 1996; Michael et al. 1997*). The CCR5 32bp deletion seems to be restricted to Caucasian populations. However, the frequency of the mutation varies widely among European populations. Whereas the frequency is quite high in St. Petersburg, Russia (0.166), and in Sweden (0.143), it is considerably lower in the southern parts of Europe, e.g., in Spain (0.050) and Greece (0.041) (*Lucotte 2001*).

However heterozygosity for the deletion was found at a frequency of 0.23 in a Swedish HIV positive group (*Bratt et al. 1998*). Since that study was cross-

sectional and not prospective, this frequency may represent a population subjected to a different selection pressure than an ordinary Scandinavian population. In cases where the deletion has been found in non-Caucasian populations, there has usually been continuous contact and a likely admixture with Caucasians (*Liu et al. 1996; Samson et al. 1996; Dean et al. 1996*). The geographic distribution of 32bp deletion in Europe has been explained in several ways, as e.g., genetic drift (*Martinson et al. 1997*) or positive selection due to resistance to a major disease (*Dean et al. 1996*). Based on coalescence, 32bp deletion has been estimated to have appeared approximately 700 years ago (*Stephens et al. 1998*). Consequently, it has been speculated that the Black Death (*Yersinia pestis*) caused a positive selection (*Stephens et al. 1998; O'Brien 1998*). The basis for this hypothesis is that CCR5 may be involved in the mechanism of Yersinia-induced macrophage apoptosis (*Stephens et al. 1998*). If the Black Death, believed to be caused by *Yersenina pestis*, resulted in a positive selection, this has to be a fairly recent process, since the outbreak of this disease was in the mid 14th century. However, according to Galvani and Slatkin (*2003*), the bubonic plague, although severe, could never have driven the frequencies to over 10% in the short time span of 700 years. In another study, it was postulated that the mutation originated about 2000 years ago, somewhere in north-eastern Europe (*Libert et al. 1998*). In later publications, smallpox is thought to be a more likely candidate, where the selective pressure from this virus would have pushed the frequency of 32bp deletion across Europe into today's figures (*Klitz et al. 2001; Galvani and Slatkin 2003*). In a recent publication Sabeti et al. (*2005*), has pushed back the estimate of the occurrence of the CCR5–Δ32 allele to over 5000 years ago. There are also several articles suggesting that the deletion was dispersed by the Vikings along its present gradient across Europe (*Lucotte 2001 and Lucotte and Dieterlen 2003*). In 2005 the CCR5–Δ32 was detected in human Bronze Age skeletons from Germany by Hummel et al., and this is the first evidence that the mutation existed before the14th century plague outburst.

Although there are disagreements about the time for the first occurrence of 32bp deletion, the cause of the event, and the distribution of the deletion all seem to agree on the fact that the deletion originated from a single historical mutation event.

Here we want to address the question regarding the deletion's first occurrence and distribution by extracting DNA from well-known and well-dated prehistoric human and animal bones and teeth. Of specific interest is a date for the occurrence of the deletion that precedes 5000 BP, i.e. approximately the Mesolithic-Neolithic transition in Scandinavia.

In Scandinavia the Mesolithic stretches from around 8300 to 4000 BC. It is a period connected to the end of the last glaciation, and marks a shift in climate towards a warmer period. During this period people began to colonise southern Sweden, both along the coasts and inland. In this study we have included samples dating to the Mesolithic from Skateholm in the south, and Huseby Klev from the west coast.

The Neolithic period began in Sweden with the introduction of farming around 4000 BC, and it ended around 1800 BC with the introduction of the Bronze Age. During the middle Neolithic in Sweden, there were three main cultures: the Funnel Beaker (TRB), the Pitted Ware (GRK) and the Battle Axe (STY) cultures. We have analysed human and animal bones and teeth from two of these cultures, the Funnel Beaker culture complex that is believed to be connected with the introduction of farming and cereal cultivation, and the GRK-complex that consists mainly of a set of hunter/gatherer dwelling sites and cemeteries along the Scandinavian Baltic coast and the major Baltic Islands. The GRK are represented by samples from the islands of Gotland and Åland, and the TRB samples are represented by two passage graves in central Sweden (Fig. 1). The individuals from Dragby represent the last phase of the Neolithic in Sweden, thus this case study encompasses more than 5000 years.

Materials and methods

Bones and teeth from two Mesolithic and six Neolithic sites were chosen for this study.

The two Mesolithic sites used in this study are Huseby Klev, radiocarbon dated to 7000–6500 BC, and Skateholm, radiocarbon dated to 5250–4900 BC (Fig. 1). Four individuals were analysed from Huseby Klev (Hk1, Hk2, Hk3 and Hk4), a Preboreal/Boreal site that was subjected to a rescue excavation in 1993–94 by Bengt Nordqvist (*Nordqvist 2000*). Next we analysed six individuals from the Skateholm site (burials 4, 5, 7, 12, 63a and 63b) that was excavated in the early 1980s by Lars Larsson (*Larsson 1988*).

The first Neolithic site, Ire on the island of Gotland (Fig. 1), is a cemetery belonging to the Pitted Ware culture complex (GRK) which was excavated in diffe-

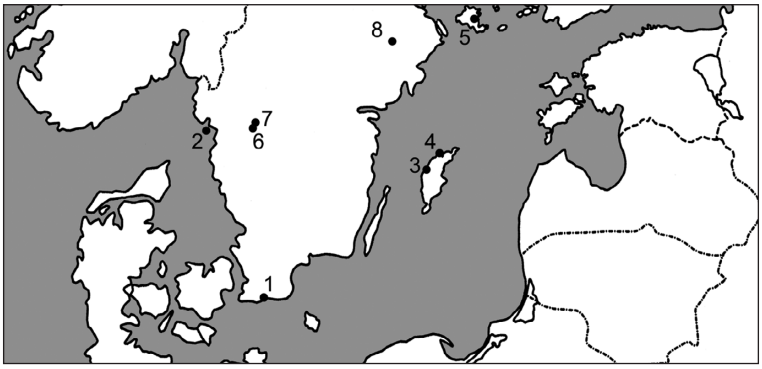


Fig. 1. Southern Scandinavia with Mesolithic and Neolithic sites 1. Skateholm, 2. Huseby Klev, 3. Visby, 4. Ire, 5. Jettböle, 6. Rössberga, 7. Hjelmars Rör and 8. Dragby. The Δ32 mutation of CCR5 was found in human material from Skateholm, Rössberga, Visby, Ire, and Dragby, indicating that the mutation is at least as old as these sites.

rent periods after its discovery in 1914 (*Janzon 1974*). Five individuals (burials 6b, 6c, 7a, 7b and 7c) were analysed from this site, which has been ^{14}C dated to 3000–2100 cal BC (*Janzon 1974*). We also extracted DNA from a horse deposited in the settlement layers connected to the burials, in order to control for contamination and bone preservation. The other GRK site on Gotland, Visby (Fig 1.), is a cemetery that was last excavated in 1960–62 by Erik Nylén (*Janzon 1974*). Here 12 individuals were selected for analysis (burials 2/09, 2/24, 2/39, 3b, 13, 19, 19/37, 23, 27, 30b, 31 and 33). They have been ^{14}C dated to 3000–2500 cal BC (*Janzon 1974*).

The next site to be analysed is Jettböle (Fig 1.), also a GRK settlement on an island in the archipelago of Åland, excavated by Björn Cederhvarf from 1905 until 1911 (*Cederhvarf 1912*). From this site, 3 individuals were analysed (J1, J2 and J3). They have been radiocarbon dated to 3370–2910 cal BC (*Lidén et al. 1995*).

The other samples are from two passage graves, Rössberga and Hjelmars Rör (Fig. 1), both from Västergötland in central Sweden and belonging to the Funnel Beaker culture complex (TRB). Five different individuals from each passage grave were analysed. Fourteen out of sixteen ^{14}C samples date Rössberga to 3506–2143 BC; the other two samples date Rössberga to the late Bronze Age (*Persson & Sjögren 1995*). Rössberga, which was excavated in 1962 by Carl Cullberg, will be treated here as a middle Neolithic passage grave (*Cullberg 1963*). Eight ^{14}C samples date Hjelmars Rör to 3350–2700 BC. The passage grave was first excavated in 1868 by Bror Emil Hildebrand, but was revisited in the 1990s by Tony Axelsson and Per Persson (*Persson & Sjögren 1995*). We added a bone from a cow deposited in this passage grave, for the same reason as stated above.

The last samples are from Dragby, a passage grave excavated by Mårten Stenberger in 1958/59 (*Gejvall 1963*). The dating of this tomb is complicated, since it was superimposed by a Bronze Age mound. However, the ^{14}C dates, 2290–1690 cal BC (*Roumelis 2002*), imply that this site was in use during the late Neolithic. Four individuals were analysed (H4/A, F15/44, F8/44 and F2f2/45).

Most publications on DNA from prehistoric material concern mitochondrial DNA (*e.g. Hagelberg & Clegg 1991; Krings et al. 1997; Krings et al. 1999; Handt et al. 1994, Torroni et al. 2000, Hofreiter et al. 2002, Forster 2004, Starikovskaya et al. 2005*). However, a number of studies have also been performed on nuclear, single copy markers from ancient tissue (*e.g. Beraud-Colomb et al. 1995; Zierdt et al. 1996; Ovchinnikov et al. 1998; Götherström et al. 1997; Greenwood et al. 1999; Noonan et al. 2005; Poinar et al. 2005*).

We designed a suitable (<150bp) primer system for the part of CCR5 that carries the 32 bp deletion, i.e. in this study we use a single copy nuclear marker applied to ancient DNA.

In all cases, except for the cow, teeth were used as the source material for DNA extraction. Samples were extracted and prepared for PCR according to Lidén et al. (*1997*) and Anderung et al. (*2005*). This study was conducted in two stages, and because of this the DNA extraction methods varied. Part one was done using a guanidium thiocyanate and silica extraction (*Lidén et al. 1997*), and the second part was done using an extraction method called fishing (*Anderung et al. 2005*).

A set of three primers was designed to give an easily detectable indication of the presence or absence of the 32bp deletion (Tab. 1), i.e., a system that amplifies fragments of different length depending on whether the 32bp deletion is present or not, and to amplify highly degraded DNA. This primer system was used in both set-ups.

DNA was amplified with Amplitaq gold™ (Perkin Elmer)/HotStarTaq (Qiagen) to receive the hot start

and time-release effect (*Götherström et al. 1997*). The 25 µl reactions contained 50 mM KCl, 10 mM Tri-HCl pH 8.3, 2.25 mM MgCl2, 0.2 mM of each dNTP, 0.5 µM of each primer, 1 U Taq-polymerase (Amplitaq gold™, Perkin Elmer, HotStarTaq, Qiagen), 10/9 µl template DNA and 2% glycerol/none. Hot start was performed automatically, due to the enzyme used. The amplification cycles were initiated by a 45 sec/5 min. denaturation step at 95° C to activate part of the enzyme and save the rest for later cycles; this was then followed by 45/30 sec. at 94° C, 1 1/2/1min. at 50° C and 1 min/30 sec. at 72° C. This cycle was repeated 55/45 times. Finally, an extension step at 72° C for 7/5 min. followed. The result was detected on a 3%/1.5% ethidium bromide stained agarose gel exposed to 40V for 1h. One primer (CCR5:1) anneals upstream the sequence, one (CCR5:2) anneals downstream on the other side of the 32bp deletion, and the third primer (CCR5:3) anneals within the 32bp deletion. Thus, an individual homozygous for the deletion will have one fragment (91bp) amplified, an individual homozygous for the wild type will have two fragments (105bp and 123bp) amplified, and a heterozygous will have three fragments (91bp, 105bp and 123bp) amplified. The result was confirmed by sequencing on a Pharmacia ALF express™ with an Amersham Pharmacia Biotech Cycle Sequencing kit.

A short mtDNA fragment, 16131–16303, according to the reference sequence from Anderson et al. (*1981*), was amplified and sequenced from a part of the material to confirm that the DNA was from different individuals in the first set-up. If authentic DNA was extracted, there should among all samples be several haplotypes present based on this short HVR1 sequence, but only one haplotype in each sample. The same protocols, with minor changes, used for CCR5 amplification and sequencing were used for the amplification and sequencing of the mtDNA fragment. However, only 45 cycles were used, and L16131 and H16303 (Tab. 1) replaced CCR5:1, CCR5:2 and CCR5:3. The primers used for the horse and cow were HBB:1 and HBB:2 (*Marklund et al. 1994*) and HTG10:1 and HTG10:2 (*Steffen et al. 1993*) respectively.

Primer name	Primer sequence
CCR5:1	5'TCCTTAGTAGAAATGGTCTAG3'
CCR5:2	5'GTCGGGGTTCTACTGATAG3'
CCR5:3	5'GAAATTACAGACCTTTAAGAAG3'
L16131	5'CACCATGAATATTGTACGGT3'
H16303	5'TGGCTTTATGTACTATGTAC3'
HBB:1	5'GATATAAAAAAGAAGACCCAGTAG3'
HBB:2	5'TACCTGAGTCATATGTAATATTCC3'
HTG10:1	5'GAATTCCCGCCCCACCCCCGGCA3'
HTG10:2	5'TTTTTATTCTGATCTGTCACATTT3'

Tab. 1. Primer name and primer sequences used in the study. The system used to detect presence of the 32bp deletion of the CCR5 gene is based on three primers CCR5:1, CCR5:2, CCR5:3. The D-loop system is a simple two-primer system L16131 & H16303 (*Anderson et al. 1981*). The primers used for the horse were HTG10:1 and HTG10:2 (*Marklund et al. 1994*) and for the cow HBB:1 and HBB:2 (*Steffen et al. 1993*).

In the second part of the study, all replications were performed in an independent laboratory, Centro Mixto UCM–ISCIII de Evoulción y Comportamiento Humanos (Madrid) in order to detect contaminations and prove the authenticity of the ancient DNA (*Hofreiter et al. 2001*).

One tooth permits one extraction, which gave enough material for ten PCRs. Whenever possible, at least two samples were taken from each individual, but only one extraction could be carried out on each individual from the passage graves due to the problem of separating individuals in a passage grave. However, thanks to high reproducibility within the extraction, we could trust the results from the ten individuals from the passage graves. Moreover, a robust protocol including extraction blanks, carrier effect blanks, PCR blanks, UV irradiation of reagents, fragment size control etc was applied (*Götherström & Lidén 1998*). To further test the state of preservation, we extracted another large bone protein, collagen, according to Brown et al. (*1988*) on both human and animal samples. Here the extracted amount of collagen, the absolute amounts of carbon and nitrogen, as well as their ratio provide information on the state of preservation (*DeNiro 1985*). We also tried to amplify DNA extracted from the horse and the cow with the primers used for the humans, to test for contamination.

Results and discussion

The collagen data were all in accordance with bones that are well preserved. In bones positive for DNA, no samples contained less than 0.66% of collagen, calculated on total bone, and the C/N ratios were all within the accepted limit of 2.9 – 3.4 (except for 3 samples), as well as the absolute values of carbon and nitrogen (Tab. 2) (*De Niro 1985*). It is therefore reasonable to believe that DNA was also well pre-

served in the samples (*Götherström et al. 2002*). There is also a correlation with previously published quantitative data (*Malmström et al. 2005*), where good preservation has been indicated on the Baltic island of Gotland. That the extracted DNA is authentic was further proved by the result of the mtDNA, where we have four different haplotypes distributed over two cemeteries, and that no products were obtained from the extracted animal DNA amplified with the human primers (Tab 2.).

We were able to extract DNA from 19 out of 50 samples, representing in total 46 individuals, i.e. a 38% success rate (Tab. 2). We were also able to extract and sequence DNA from two different teeth from the same individual in two of the burials from Ire. Of the 19 samples, now representing 17 individuals, one individual was dated to the Mesolithic and came from Skateholm, and 16 individuals were dated to the Neolithic. Of the Neolithic samples, six individuals can be attributed to the pitted ware culture, nine to the funnel beaker culture, and one to the late Neolithic.

The complete sample is in Hardy-Weinberg equilibrium ($p = 0.661$), and does not differ in frequencies (17.1%) of the CCR-Δ32 mutation from a modern Swedish population (14.3%). It could be argued that the small sample size, 17 individuals or 34 alleles, is not statistically significant. A further argument could be that the five individuals from one megalith tomb could be related i.e., providing a smaller number of alleles than we calculate. This is also obvious in the case of Ire, where the individuals were sampled from one burial, and one individual proved to be a heterozygous, while the others proved to be homozygous for the mutant allele.

Two alternative explanations for the specific distribution of the CCR5 32bp allele have been suggested, where one is a selection process related to a specific disease within a population; alternatively, the appearance of a higher gene frequency could be related to the migration of individuals already having the deletion. One such migration that has been discussed and that is of interest here is the transition from the Mesolithic to the Neolithic. Traditionally, this is connected to a change in economy from a hunter-gatherer way of life to pastoralism-farming. This change in economy is most often explained by three major themes, of which immigration is one.

Subsistence during the Mesolithic was based on hunting and gathering, as we can see in the individuals analysed from Skateholm and Huseby Klev (*Lidén et al. 2005*). This lifestyle continued during the Neolithic for the Pitted Ware culture. Their main economy seems to have been based on maritime hunting and fishing, as seen in the sites studied here: Ire, Visby and Jettböle (*Lidén 1995*). The Funnel Beaker culture is partly differentiated from the GRK by the change in subsistence towards an economy based on agro-pastoralism, and this pattern is clearly visible in the passage graves analysed here: Rössberga and Hjelmars Rör (*Lidén 1995*). In the late Neolithic, agro-pastoralism continued, as seen in the Dragby samples (*Roumelis 2002*). However, since we only have one individual from whom it was possible to extract DNA dating to the Mesolithic, we cannot draw any conclusions relating to the migration hypothesis. However, the sample allows for testing the frequencies between the two Neolithic cultures, GRK and TRB, and when using Fishers's exact test ($p = 0.005$), we do find a significant difference. This difference is in itself interesting, in that these cultures represent different economies, and where the "farming culture" has the lower frequency of the deletion. Does this mean that the hunting GRK culture could be regarded as original, and that the TRB were the newcomers? We cannot say.

The second explanation for the distribution of the CCR5-Δ32 gene was connected to a selection process due to a specific disease. It is, however, obvious that the 32bp deletion in the CCR5 gene had spread and reached a relatively high frequency in Scandinavia at least during the Neolithic, and that selective advantage due to the plague is evidently not a likely cause of the present day allele distribution. Previous studies also suggest that this is an unlikely hypothesis, as the short period during which the plague ravaged Europe would not have caused a selection pressure strong enough to alter frequency to any greater extent (*Galvani and Slatkin 2003*). Consequently, we will have to seek other explanations for the spread of the 32bp deletion in the Mesolithic and thereafter in Scandinavia. Galvani and Slatkin (*2003*) proposed that the more continuous smallpox mortality that afflicted European children since the origin of the allele could have provided the necessary selective pressure to generate the rise of CCR5-Δ32 deletion to current frequencies of 10%.

Our evidence pushes the dating of the CCR5 32 bp deletion back to around 5000 BC, which supports the suggested date for the deletions first occurrence to more than 5000 years ago (*Sabeti et al. 2005*).

Site	# extract.	Success. ampl.	WT/WT	WT/Δ32	Δ32/Δ32	^{14}C age BC	Collagen (%)	C/N	C (%)	N (%)	mtDNA haplotype
Skateholm 4	2	–	–	–	–	5250–4900	n.a.	n.a.	n.a.	n.a.	n.a
Skateholm 5	2	–	–	–	–	5250–4900	n.a.	n.a.	n.a.	n.a.	n.a
Skateholm 7	2	–	–	–	–	5250–4900	4.0	3.2	41,1	15,0	n.a
Skateholm 12	2	–	–	–	–	5250–4900	n.a.	n.a.	n.a.	n.a.	n.a
Skateholm 63a	2	–	–	–	–	5250–4900	n.a.	n.a.	n.a.	n.a.	n.a
Skateholm 63b	2	2/2			X	5250–4900	n.a.	n.a.	n.a.	n.a.	n.a
Huseby Klev 1	2	–	–	–	–	7000–6500	0.2	3.8	15.2	3.7	n.a
Huseby Klev 2	2	–	–	–	–	7000–6500	4.3	3.5	42.0	14.1	n.a
Huseby Klev 3	2	–	–	–	–	7000–6500	2.0	3.3	37.7	13.3	n.a
Huseby Klev 4	2	–	–	–	–	7000–6500	1.7	3.3	39.7	13.6	n.a
Visby 2/09	2	2/2		X		3000–2500	3.5	3.1	39.5	14.7	n.a
Visby 2/24	2	–	–	–	–	3000–2500	4.4	3.2	39.2	14.5	n.a
Visby 2/39	2	–	–	–	–	3000–2500	6.0	3.2	42.2	15.4	n.a
Visby 3b	2	–	–	–	–	3000–2500	2.8	3.5	42.4	14.2	n.a
Visby 13	2	–	–	–	–	3000–2500	1.2	3.1	31.6	11.9	n.a
Visby 19	2	–	–	–	–	3000–2500	6.2	3.1	37.5	14.1	n.a
Visby 19/37	2	–	–	–	–	3000–2500	3.6	3.1	44.6	15.3	n.a
Visby 23	2	2/2		X		3000–2500	2.2	3.4	41.9	14.2	n.a
Visby 27	2	2/2		X		3000–2500	1.3	3.5	38.2	12.6	n.a
Visby 30b	2	–	–	–	–	3000–2500	2.3	3.4	39.7	13.4	n.a
Visby 31	2	–	–	–	–	3000–2500	1.7	3.5	42.1	14.0	n.a
Visby 33	2	–	–	–	–	3000–2500	1.9	3.4	37.6	12.6	n.a
Ire 6b m_2	2	–	–	–	–	3028–2141	1.9	3.1	40.1	13.2	n.a.
Ire 6c m_2	2	–	–	–	–	3028–2141	1.1	3.6	33.2	11.1	n.a.
Ire 7a i_1	2	2/2			X	3028–2141	1.2	3.2	31.2	11.5	n.a.
Ire 7a p_3	2	–	–	–	–	3028–2141	1.8	3.1	34.7	11.3	n.a.
Ire 7a m_2	2	2/2			X	3028–2141	1.7	3.2	29.8	10.9	n.a.
Ire 7b dm_2	2	–	–	–	–	3028–2141	2.1	3.3	27.0	9.4	n.a.
Ire 7c i_2	2	–	–	–	–	3028–2141	4.3	3.0	37.9	12.7	n.a.
Ire 7c m_1	2	2/2		X		3028–2141	3.6	3.0	39.0	13.2	n.a.
Ire 7c m_2	2	2/2		X		3028–2141	4.2	3.5	28.3	9.5	n.a.
Jettböle 1	2	–	–	–	–	3370–2910		2.9	n.a.	n.a.	n.a
Jettböle 2	2	–	–	–	–	3370–2910		3.2	n.a.	n.a.	n.a
Jettböle 3	2	–	–	–	–	3370–2910		3.1	n.a.	n.a.	n.a
Rössberga 1	4	3/4		X		3506–2143	2.2	3.2	37.7	135	CRF
Rössberga 2	4	3/4	X			3506–2143	5.8	3.3	40.5	14.5	16224C
Rössberga 3	4	3/4		X		3506–2143	4.0	3.4	33.0	11.3	CRF
Rössberga 4	4	3/4	X			3506–2143	3.1	3.3	37.8	13.2	CRF
Rössberga 5	4	3/4	X			3506–2143	3.8	3.8	33.8	10.3	CRF
Rössberga 6	4	–	–	–	–	3506–2143	n.a.	n.a.	n.a.	n.a.	n.a
Hjelmars rör 17	4	–	–	–	–	3350–2700	n.a	n.a	n.a	n.a	n.a
Hjelmars rör 18	4	3/4	X			3350–2700	5.5	3.3	41.6	14.7	CRF
Hjelmars rör 19	4	3/4	X			3350–2700	5.2	3.3	42.0	14.8	16189C
Hjelmars rör 20	4	3/4	X			3350–2700	5.6	3.2	42.2	15.2	CRF
Hjelmars rör 21	4	3/4	X			3350–2700	2.9	3.2	40.1	14.4	16145A, 16231C 16261T
Hjelmars rör 22	4	3/4	X			3350–2700	3.3	3.2	40.3	14.5	16189C
Dragby H4/a	2	–	–	–		2290–1690	1.0	3.3	36.3	13.0	n.a
Dragby F15 p1	2	2/2			X	2290–1690	0.6	3.2	32.5	12.3	n.a
Dragby F8 p1	2	–	–	–	–	2290–1690	1.0	3.3	30.7	11,4	n.a
Dragby F2 p2	2	–	–	–		2290–1690	0.7	3.1	34.4	12.7	n.a
Site and animal	**# extract.**	**Success. ampl.**	**SCN**			**^{14}C age BC**	**Collagen (%)**	**C/N**	**C (%)**	**N (%)**	
Ire horse	2	2/2	X			3028–2141	6.4	3.2	39.7	14.5	
Hjelmars rör cow	2	2/2	X			3350–2700	5.2	3.2	39.5	14.3	

Tab. 2. Presence of the 32bp deletion of the (Δ32) gene in the prehistoric samples compared to the wild type (WT), (–) = no result (X) = positive indication, when the number of extractions are 2 it indicates that a reproduction has taken place in a laboratory in Madrid, i = incisor, m = molar, p = premolar, n.a. = Not analysed, SCN = Single Copy Nuclear. Collagen % is given as compared to bone weight. Mitochondrial DNA haplotypes are given as compared to Anderson et al. (1981). Samples from Ire represents in total 5 individuals 6b, 6c, 7a, 7b and 7c.

Conclusions

The CCR5–Δ32 results indicate that the frequency of 17.1% in our samples corresponds to the frequencies of CCR5–Δ32 mutation in present-day Sweden. Thus there seems to be no difference in the occurrence of the deletion from the Neolithic and onwards in Sweden.

The mutation occurs in two different Neolithic cultures, both the GRK and the TRB, despite differences in subsistence and lifestyle. This indicates that the selective pressure that caused this deletion to evolve had nothing to do with subsistence or way of life. There is also evidence for the mutation having occured in one of the Mesolithic populations, although the sample size is small and no definite conclusions can be drawn from this. The fact that the CCR5–Δ32 is present during the Mesolithic is interesting in itself, and pushes the date of the first occurrence back to around 5000 BC.

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Clash of cultures? Archaeology and genetics

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ABSTRACT – *This paper examines the ways in which genetic data have been used to interpret the transition to agriculture in Europe over the past two decades, and the relationship of these interpretations to more strictly archaeological explanations. It is suggested that, until recently, those working within the two disciplines have been using not only different data sets and methodologies, but also working within different disciplinary traditions which have inhibited communication and collaboration, and the production of a genuinely integrated field of 'archaeogenetics'.*

IZVLEČEK – *V članku analiziramo pristope, ki so v zadnjih dveh desetletjih uporabljali genetske podatke pri interpretaciji prehoda na poljedelstvo v Evropi ter odnos med temi interpretacijami in striktno arheološkimi razlagami. Ocenjujemo, da so raziskovalci v okviru teh dveh disciplin do nedavna uporabljali različne metodologije in serije podatkov ter delali znotraj različnih raziskovalnih tradicij. To je preprečevalo komunikacijo in sodelovanje ter izdelavo pristno integriranega področja 'arheogenetike'.*

KEY WORDS – *Genetics; archaeology; Neolithic; rhetoric*

Introduction

Archaeology has often had a strange and occasionally fraught relationship to science; the discipline is often described as straddling the humanities-science divide, and many of us would not be averse to being described as social scientists. Nevertheless, on occasions and especially, perhaps, in Anglo-American archaeology, academics have sometimes tried to urge archaeological practice more forcefully in the direction of harder science, or alternatively and perhaps in reaction towards the 'softer' humanities. Such arguments have tended to be about philosophical and epistemological positions rather than methodological ones, and have their basis in the nineteenth century. For example, in 1858 Johann Droysen proposed that there were three types of systematic knowledge: the speculative, which related to the kind of knowledge produced by philosophy and theology; the mathematical or physical, grounded in logic and in empirical facts; and the historical. He suggested that these three realms of knowledge had what he called three 'essences' or characteristics: respectively, to know (*Wissen*), to explain (*Erklären*) and to understand (*Verstehen*). The last two roughly equated respectively to the 'hard sciences' – physics, chemistry, biology and so forth – and the 'humanities'. The social sciences including archaeology can, however, be seen to partake of both 'essences'. Archaeology is an unusual discipline in drawing on both types of 'knowledge' and their associated theories more or less equally and in an internally-integrated manner; other disciplines such as geography, for example, have ended up with divisions which more or less equate to these distinctions, with physical and human geography. The history of archaeological theory and indeed its disciplinary culture and even status can thus in part be characterised as leaning towards one side or the other – towards science or the humanities for its inspiration.

As usual, though, the picture was and is more complicated: archaeologists are perhaps better described as theoretical magpies. Archaeologists of any persuasion routinely use statistical analysis and scientifically obtained environmental data, for example. In the Anglo-American world, 'scientific' New and processual archaeologists *were* interested in social and cultural phenomena, and not just in explaining energy extraction from the environment. Scientific methodologies and procedures and data are important to all of us; the necessity to be something of a jack-of-all-trades, having to be aware of isotope analysis *and* cultural theory, Bayesian modelling *and* social anthropology, is what makes the discipline particularly challenging. It has therefore been interesting to observe disciplinary reactions when a new and undoubtedly scientific technique from a hitherto unrelated discipline, which I shall here call 'genetics', came to impinge on archaeological understandings of the past.

This seems to have been a particularly divisive area, particularly in addressing the question of the Mesolithic-Neolithic transition, primarily in Europe, and which I shall use as my case study in this paper. By and large, archaeologists were hostile to the outcomes and apparent implications of relevant genetic research: very few archaeologists embraced the genetic data (and controversial 'evidence' from linguistics) with fervour. Equally, geneticists often appeared as though they considered archaeological data irrelevant for studying the prehistoric past. Why should this be? After all, this particular relationship started as collaboration. In this paper I will mainly examine some of the rhetoric and practices associated with this debate as a way of considering whether there are, despite archaeology's hybrid position, fundamentally different disciplinary cultures involved. I shall conclude by looking at some of the implications for methodologies – not for genetics or molecular biology, which I am totally unqualified to offer – but rather ways of collaboration and means of approach.

Genetics and archaeology

Thirty five years ago (and subsequently elaborated in detail), Albert Ammerman and Luigi-Luca Cavalli-Sforza (*1971; 1973; 1984*) presented an interesting idea relating to a potential new source of evidence about the spread of farming in Europe. Discussing the apparent rate of spread of the Neolithic, and explaining this through an initially exogenous population expansion associated with early farming in Europe, they mentioned the 'possible genetic implications of the model'.

"*The population wave of advance accompanying the spread of early farming should be reflected, if this [demic diffusion] explanation is the correct one, in the genetic compositions of the resulting populations.*"

(*Ammerman and Cavalli-Sforza 1971.687*)

This was – and is – a powerful idea. Since that time there has been a huge amount of genetic data and analysis published which is often stimulating, which has undoubtedly raised new questions and perhaps offered new insights, through looking not just at overall genetic frequencies of classical markers such as blood proteins, but subsequently also at different regions and sites within the genome, and suggesting genetic histories – phylogenetics – and putative dates for mutations and haplotypes, and consequently histories of haplogroups; and of differences between female-inherited (mtDNA) and male-inherited (Y-chromosome) genetic material, for example. For the purposes of this paper, though, it is worth noting that the question as posed initially by Ammerman and Cavalli-Sforza was primarily an *archaeological* question: genetic information, it is suggested, may be able to illuminate the process of transition, given certain primarily demographic conditions. The demographic modelling was in part based on ethnographic data relating to hunter-gatherer and small-scale farming societies.

Since then, and especially since the 1990s, the discipline of what some call 'archaeogenetics' (*Renfrew 2000.3*) has seen the production of large numbers of datasets and numerous interpretations in relation to the transition to and spread of farming, especially in Europe, as well as much evidence related to migratory population movement elsewhere – Polynesia and the Americas in particular (see *e.g. Jones et al. 1999; Renfrew and Boyle 2000*). So far, these datasets have been derived primarily from modern populations, and the information explored in terms of their phylogenies – the genetic histories – and modern spatial distribution. Ancient DNA, which would appear to offer much more specific information from individuals and groups of individuals who can be placed, culturally-situated and dated archaeologically, is rarely sought, mainly because of the potential problems of identifying contamination (but see *e.g. Chandler et al. 2005; Haak et al. 2005*). This is not the place to explore the use (and abuse) of such data in detail: but see *Mirza and Dungworth 1995; Fix*

1996; Pluciennik 1996, Sims-Williams 1998; MacEachern 2000; Zvelebil 2000; Bandelt et al. 2002). There has been a persistent and major problem of the conflation of genetic, linguistic and cultural 'entities' and (pseudo-)archaeology, with the assumption that these forms of biology, culture and identity almost inevitably go together (see *Moore 1994; Terrell and Stewart 1996*), at least until 'modern' times.

I would suggest that archaeologists already 'knew', and certainly by the 1980s, that the process of the Mesolithic-Neolithic transition in Europe was complex socially, culturally and therefore almost certainly, biologically. However, one gets little sense of this from looking at the genetic literature, until very recently. And even here the methodology seems, to many archaeologists, rather upside-down. 'We would argue that it would be worthwhile to turn the scientific procedure around', argued Pinhasi et al. (*2000. 55*). That is, the apparent injunction to start with a simple model – even though obviously, archaeologically-speaking, wrong – is presented as a methodological necessity. In the case examined here, it is that the spread of farming represents *either* population expansion by genetically-distinct farmers, *or* the adoption of farming by genetically distinct foragers. To be fair, a few later publications – led by archaeologists – have asked whether the genetic and other biological signatures supported archaeological interpretations on a regional scale (*e.g. Lalueza Fox 1996; Jackes et al. 1997; Pinhasi and Pluciennik 2004; Chandler et al. 2005*). Another and arguably more productive approach would be, for example, to model the relevant genetic histories in terms of archaeological understandings of the processes involved (in the plural!), and at least ask what kinds of genetic outcomes we might expect. Yet after 20 and more years of research, this kind of question is apparently only now beginning to be asked. It is these kinds of intellectual propensities and resistances which suggest that at least some of the tensions between 'archaeological' and 'genetic' explanations of the Mesolithic-Neolithic transition are best explained as matters of disciplinary preferences and traditions of thought and practice; that is, of culture.

The great divide

One of the striking aspects of the relevant literature is that for a very long time the 'archaeology' was swept aside and the debate was very largely driven by the genetic data – and hence, de facto, by the geneticists. This was so even though we had here a potentially powerful new set of techniques for saying something about the past, although exactly what they 'say' certainly is not yet clear. Thus in relation to the Neolithic in Europe (the area where many of the best data sets tended to come from), the approach in the publications basically became a question of supporting (or much more rarely disagreeing with) this model of 'demic diffusion'. Even in a recent review, this is still how the question is characterised: 'The primary issue remains whether agriculture spread by contact or by farmers moving into Europe' (*Armelagos and Harper 2005.109*). So powerful was this drive that some archaeologists, too, decided that the 'truths' of genetics were more plausible than those suggested by the archaeology. The debate became strongly polarised: in general, geneticists (and a few others) accepted the 'fact' of demic diffusion and published evidence which apparently supported it. Meanwhile, many archaeologists had been moving just as strongly away from demic diffusion models and were increasingly arguing for the Mesolithic-Neolithic transition as a highly variable socio-cultural phenomenon (including demographic and other biological processes) on the regional, let alone the continental scale (*Zvelebil 1986a; Price 2000*). But they were not – and I include myself here – engaging with geneticists through collaboration and joint publication; instead, there were critical papers and conference sessions in which archaeologists were primarily talking to archaeologists, in the same way that geneticists were primarily writing for and speaking to other geneticists. Thus there were a series of papers, referred to above, critical of genetic interpretations which by and large ignored the archaeology and continued to confuse and conflate biological constructs – genetic histories – with social entities, including linguistic and ethnic groups and names.

This polarisation is seen in Table 1. Here some papers by geneticists and published primarily in journals in that discipline in the 1980's and 1990's are summarised. The fact that these are generally multi-authored is, of course, itself an aspect of disciplinary culture: the convention is for entire laboratory teams to be named as authors. More interesting, perhaps, is the fact that archaeologists were rarely involved in producing these papers: their 'contribution' was limited to a very few items (and those often out of date) cited in the bibliographies. There were notable exceptions: I would single out Martin Richards (see this volume), and also note that where archaeologists were involved (such as Colin Renfrew) appropriate archaeological and other citations were frequent, various and up-to-date. Nevertheless, the widespread

Authors	Date	Geneticists	Archaeologists (linguists)	Subject	Archaeology references (n)
Torroni et al.	1998a	11	–	Late Paleolithic re-colonization	1990 (1)
Wilkinson-Herbots et al.	1996	4	–	Late Palaeolithic re-colonization	1986, 1995 (2)
Sajantila et al.	1995	13	(–)	Genes & languages	1987, 1988 (2)
Torroni et al.	1998b	11	–	Late Palaeolithic re-colonization	1990 (1)
Sokal & Menozzi	1982	2	–	Neolithic diffusion	1971, 1973 (2)
Richards et al.	1996	10	–	Palaeolithic & Neolithic diffusion	1983–1995 (10)
Semino et al.	1996	5	–	Neolithic diffusion	1889, 1943, 1984, 1989 (4)
Pult et al	1994	6	–	Modern humans in Europe	–
Rendine et al.	1986	3	–	Neolithic diffusion	1953–1984 (8)
Barbujani et al.	1994	3	1	Neolithic diffusion	1971–1992 (17) plus linguistics
Jones	1991	1	–	Neolithic diffusion	–
Sokal et al.	1991	3	–	Neolithic diffusion	1953–1991 (7)

Tab. 1.

problem amongst geneticists of their ignorance of socio-cultural processes and archaeological interpretations and debates – or perhaps the failure to see their possible relevance – is best epitomised by the astonishing paper by Robert Sokal and colleagues. Rather than seeking archaeological advice, he preferred to use a 'European ethno-history database, developed in our laboratory' which 'documents the known locations and movements of 891 ethnic units over the last 4000 years' (*Sokal et al. 1993.56*). The database purported to 'list the name of a "gens" or tribe (or that of an archaeological horizon in the case of prehistoric records...)' (*Sokal et al. 1993.57*).

Thus, even though Renfrew (*2000.3*) claimed that the new discipline of archaeogenetics involved 'the study of the human past using the techniques of molecular genetics', it tended to be a very partial view. Renfrew continued: 'In practice this is likely to involve the collaboration of molecular geneticists with archaeologists, anthropologists, historical linguists and climatalogists'. But so far and despite the integrative work of Renfrew and other grand theorists such as Peter Bellwood (*Bellwood 2001; 2004; Bellwood and Renfrew 2002; Renfrew 1992; 1996; 1997*) and indeed Cavalli-Sforza himself (*1996*), such collaboration has not been substantiated, at least in terms of joint authorship, with rare exceptions (*e.g. Barbujani et al. 1994*). Indeed, even in the volume Archaeogenetics itself, the division between papers by archaeologists, and papers by geneticists, is as strong as elsewhere.

Many other similar papers have been published, of course: those summarised in Table 1 are merely a selection of those claiming to deal explicitly with an archaeological issue, namely the transition to farming in Europe, or occasionally, the late Palaeolithic re-colonisation of post-Last Glacial Maximum northern Europe. These latter are included because they often discuss the 'Mesolithic' and 'Neolithic' input as compared with 'Palaeolithic' contributions to gene pools. Also excluded are those papers which only allude to possible 'prehistoric scenarios' in passing, and are primarily methodological or papers descriptive of genetic data, and for which the audience will be other geneticists. Other papers not included here examine the supposed relationships between genes and languages. While one could show a similar table for relevant papers written by archaeologists, it would not be so informative. Inevitably, there were up-to-date references for genetics papers (because that is what they were criticising), but (apart from those of Ammerman and Cavalli-Sforza) there were virtually no joint cross-disciplinary papers in the 1980s and very few in the 1990s, but more in the last five years and other evidence of efforts to bring archaeologists and geneticists together (*e.g. Bentley et al 2003; ESF 2004; Gamble et al. 2005; this volume*).

Apart from the methodological and epistemological facts of the matter, we should also be interested in this as a socio-political phenomenon. Why did the 'debate' unfold in the way that it did? Where are we now? And where we might realistically look for synergies between archaeology and genetics?

Rhetoric and politics

There are other contexts for this, which perhaps also suggests that other more subtle socio-politics are playing a role here. First of all, we can note that of the broadest set being examined, the most high profile archaeogenetics papers and the greatest volume

of work related to either big issues (the origins of modern humans and Neanderthal DNA; origins and spread of agriculture; origins of contemporary peoples such as Polynesians or Native Americans): apparently foundational episodes, rather than the implications of day-to-day demographics and genetic exchange – sex – across or within group boundaries. Overall there are three major groups of relevant papers in order of volume:

❶ Papers describing the structure of genetic material and distributions both phylogenetically and geographically: this is basically about genetic data production;
❷ Papers dealing with methodologies and model building;
❸ Papers dealing with histories: these tend to be stated in terms of 'Neolithic', or 'Indo-European' contributions; only recently have geneticists started to model admixtures.

The emphasis in the last group seems to me to demonstrate the well-known prevalence of historical questions dealing with origins – what led to 'us' (*e.g. Piazza 1993*). Were this archaeology, one might argue that this focus also relates to the continued influence of stadial social evolution, and hence on apparent moments of transition understood as radical change. In archaeology these biases have at least been considered and critiqued, while geneticists, in a different tradition, typically, are not necessarily au fait, or used to dealing with such political and critical issues of structures of thought and narratives. However, it seems that within genetic studies the more likely explanation is that, to begin with, at least, the methodological need to distinguish between populations led to and maintained the focus on the 'new' or distinctive, genetically speaking.

Other factors

In the late 1980s Ammerman (*1989*) and Zvelebil (*1989*) exchanged views on how to approach the Mesolithic-Neolithic transition in Europe, and what was structuring those views. Ammerman suggested, broadly, that the bias towards and interest in processes of cultural diffusion and adoption of Neolithic traits by indigenous forager populations á la Zvelebil was a result of post-colonial guilt within Europe (see also *Keeley 1992*). Whatever one's view about the influence of politics on archaeological interpretations, no such doubts assailed many looking at demic diffusion from the genetic point of view. The important thing about the Mesolithic-Neolithic transition was the incoming, novel populations: the interest was in the 'contribution' of farmers, a bias which has been noted in the construction of modern European identities (*Zvelebil 1996*). Thus presentations tended to be couched in terms of Neolithic (or Indo-European) immigrants, rather than of mixing, or hybridism. This was so when estimates of the 'Neolithic contribution' through a 'wave of advance' were higher than the consensus is now – in Cavalli-Sforza et al's famous map obtained from Principal Components Analysis it was suggested that the Neolithic contribution to the gene pool might be of the order of 28% (*Cavalli-Sforza et al. 1994.291*). Subsequently revised downwards, most genetic models now suggest a 'Neolithic' genetic contribution of perhaps 15%–20% on the continental scale (*Richards 2003*; but see *Barbujani and Dupanloup 2002; Chikhi 2002*). This initial estimate was in marked contrast to archaeological interests and, indeed, models developed over the same period (*e.g. Zvelebil 1986b; Gronenborn 1990; 1999; Skeates 1994; Zilhao 1993*), all of which suggest marked variation in the nature of 'Neolithic' distribution, although authors do not necessarily agree on the form that it took). Nevertheless, even on the the basis of the earlier figure it is clear that the overall 'Neolithic' contribution was a minority, regardless of whether other 'contributions' derived from earlier or later demographic and genetic events and processes. It is less certain whence this apparent bias towards farmers derives. One argument would be that from a genetic point of view researchers were, as a matter of practical methodology, necessarily looking for markers of change (understood as some form of colonisation), and that the underlying substrate (equated with indigenous and relatively static Mesolithic populations) was simply less interesting. Work on mtDNA, in fact, subsequently raised the question of the genetic impact of late Palaeolithic re-colonisation. Nevertheless, it is interesting to note (assuming the 20% figure is roughly correct) that, inadvertently or not, such a focus on the impact of the 'new' is a continuation of long-established culture historical interpretations: the role and identification of colonisers and invaders assumes priority over processes of cultural hybridism and mixing. More generally, for archaeologists, periods of non-migration or colonization (or demographic or other forms of stability) are just as interesting as any other.

The present scenario

It seems to me that in relation to the Mesolithic-Neolithic transition, the way that this source of informa-

tion has been utilised has not been a happy one: there appear to have been a series of lost opportunities especially throughout the 1990s. Unfortunately, I am unable to engage in debates about the best way to model and (re)construct phylogenies, and the relationship they have to demographic processes. But it is noticeable that from the 1980s onwards, the consensus *in archaeology* about the Mesolithic-Neolithic transition has been that this process, or rather this set of processes, was highly variable in time, space, tempo and nature; and that demic diffusion as originally defined was probably always only part of the answer in specific locales. Thus it is arguable that archaeologists and others should collaborate in modelling the production of genetic diversity relating to this period by

- Identifying relevant demographic, biological, social, and cultural processes on a variety of regional and temporal scales;
- Identifying potential variability in parameters;
- Considering the problem of equifinality (and lack of resolution in genetic data);
- Discussing the limits of resolution, and identifying appropriate techniques and modelling;
- Modelling potential genetic outcomes.

It is surprising that no-one was doing at an earlier stage in the development of 'archaeogenetics' what Ammerman and Cavalli-Sforza set out to do in their initial model: namely, this is what the archaeology (in their case, the radiocarbon dates) suggests might be happening in this period; these are the kinds of cultural (and demographic, and social, and biological) processes: what might the genetic outcomes of these kinds of small-scale, regionally variable biological and demographic processes be like? A similar plea was made by three archaeologists (or physical anthropologists) at the conference from which the Renfrew and Boyle *Archaeogenetics* volume derived:

"*Instead of generating historical hypotheses from the present genetic patterns, and trying to fit the archaeological record onto these, it would be useful to build hypotheses from the actual record of the past in time and space, which could then be tested with genetic data*."

(*Pinhasi et al. 2000.55*)

But although many of us were critical of many of the assumptions associated with the wave of advance – or at least its continent-wide application – none of us went on (or was able to) develop [in collaboration!] the kinds of models that were actually required to make 'sense' of much of the genetic data. Zvelebil (*2000*) described the variety of relevant potential processes and problems with genetic approaches, but could not be expected to deal with the genetic aspects of population modelling.

Perhaps one reason for this lack of explanation (or interpretation) of the genetic data as the result of complex processes is simply the difficulty of conceiving and producing such models. It is also part of a wider disciplinary cultural difference: the use of binary logic to begin an explanation or modelling process (either p or not-p; either demic diffusion or adoption). But even though much has changed in attitude at least over the last five years or so, the underlying problems remain. For example: Currat and Excoffier (*2005*) examine some of the reasons for contradictory signals from different types or sources of genetic data (e.g. Y chromosomes, mtDNA, 'classical' markers). They build a model which simulates various scenarios of genetic exchange between indigenous 'Palaeolithic' and exogenous 'Neolithic' populations. But this, archaeologically well-informed, paper also notes:

"*Our simulations were performed in a homogenous environment with g [a measure of forager-farmer genetic interaction] identical in every deme, regardless of its location. While this assumption may seem unrealistic at a regional scale, it is quite reasonable at a continental scale... It would be interesting to test ... the influence of some heterogeneity of the migration wave, and to incorporate, with considerable additional work and computer power, more realism in the simulation... It, however, appears necessary to understand the genetic signature expected under a relatively simple demographic scenario, before considering more complex ones*." (*Currat & Excoffier 2005.684*)

We find very similar phrases used by Dupanloup et al. (*2004*), but again working on the effects of 'admixture' on a continental scale:

"*In the future, it will be important to incorporate detailed archaeological information into the population models, so that the assumptions will become both more complicated and more realistic*."

(*Dupanloup et al. 2004.1370*)

It is a rather sad commentary on academic communication that it appears to have taken some twenty years to reach this conclusion.

Discussion

This raises a whole series of other questions. One of which is: even if such detailed archaeological information were incorporated, what effect might it have on our *archaeological* interpretations? That in turn suggests another: what is it that we, as archaeologists, are interested in, what kinds of phenomena? Clearly, demographic processes *per se* are only a part of the answer – it is cultural and social process (which, of course, incorporates demographic and other biological factors and outcomes). There remain, as described above, marked cultural differences between 'sciences'; as a social science looking at and interested in primarily social phenomena, archaeology always deals with the already complex; to apply 'harder' science criteria to cultural processes is often unhelpfully reductionist.

"*When historians look back on the 21st century, they may well conclude that this was the moment when the biological and medical sciences finally began to appreciate the multi-layered complexity of all living things... As Francis Crick put it: "While Occam's Razor is a useful tool in the physical sciences, it can be a very dangerous implement in biology. It is thus very rash to use simplicity and elegance as a guide in biological research*."
(*Weatherall 2006*)

Archaeology is very much a mixture of disciplines, methods, techniques and approaches. Pinhasi & Pluciennik (*2004*) also examined the mesolithic-neolithic transition in southern Europe using relatively 'hard' data (skeletal morphometrics), which is partly related to genotypes and gene frequencies. However, we suggested that such data are rather another point of triangulation in the complex debate about some aspects of the demographic and cultural processes in this period of prehistory. It is a necessarily woolly picture. In that paper we wrote:

"*Neither skeletal, nor genetic, nor archaeological [nor linguistic] data alone will provide "solutions" to questions about the nature of the Mesolithic-Neolithic transition. Different data sets address a variety of processes at different scales and chronological and geographical resolutions*."
(*Pinhasi & Pluciennik 2004.74*)

What does seem to tell us much more of interest as archaeologists is when we can start talking with some degree of certainty about regional and local processes, whether through excavation, dating, or combinations of such things as genetic and skeletal isotope and archaeological information (*e.g. Bentley et al. 2003*). This is because larger continental or even global phenomena are emergent from and dependent on the local. The global usually does not necessarily tell us that much of interest on its own, although it may also give us a framework; we need at least to tack back and forth between the local and 'global' to answer the kinds of questions about cultural shift and social change with which many of us are concerned. Genuine archaeogenetics must be informed by the archaeological, just as the archaeological should draw on the genetic.

There remain problems of chronological resolution and scale. For much of prehistory we are often constrained to discuss general, structural, relatively long-term change (in settlement patterns, in modes of exploitation, in patterns of material culture, in belief systems as evidenced in burial practices, and so on); however, we can and often do illuminate these structural shifts by tightly-constrained contexts (in duration and location) which act as snapshots of practices at a particular place and time. We have the macro-scale and we have the micro-scale; what archaeology often finds difficult is the meso-scale, at which much social change could be argued to manifest itself most clearly.

When, however, we look at the dating of events – demographic or genetic – drawing on strictly genetic data, we are even less likely to be able to discuss meaningfully events or processes in socio-cultural terms, simply because the standard deviation associated with such 'molecular clocks' is much greater even than that associated with radiometric dating. And in any event, even if, say, mutations can be dated, it does not necessarily help an understanding of the subsequent process of geographical and biological dispersal on the kinds of scales with which we are concerned for socio-cultural processes. Similar issues arise from the lack of spatial resolution. I would suggest that it is still the case that we cannot discuss prehistoric demographic 'events' in a meaningful social scientific (rather than biological) way, certainly not from modern genetic data. The kinds of resolution which might help us as archaeologists to discuss the socio-cultural and biological processes in the past might be available from palaeogenetic data (especially if allied with other techniques such as isotope analysis), but so far there are simply insufficient surviving samples of old DNA, and I suspect that (archaeo)geneticsts have also found it easier and more profitable in the academic sense to work

through the much more accessible modern data. This perhaps suggests that we have sometimes asked the wrong questions, and that we should be able to use this new data source in more illuminating ways than simply in terms of the old dichotomies of colonisation and adoption in which both geneticists and some archaeologists seem to be entrapped. The potential use of genetic data in conjunction with archaeological, and in this case other palaeoclimatic evidence is admirably demonstrated by Gamble et al. (*2005*) discussing the archaeology of Late Glacial (re)colonization. Although the methodologies will not be the same for the early Holocene and the Mesolithic-Neolithic transition, there are equally relevant 'databases' which can be used to investigate questions of population history and human and cultural dispersals and shifts.

Conclusion

There has been a welcome shift from the description and exploration of genetic data sets (e.g. genetic structure of Europe) to interpretations of 'real world' history. But this is still a limited focus, from an archaeologist's point of view, on demography and biological history and structure, which is perfectly understandable, and also interesting and relevant, but also only part of the kinds of histories we are interested in. For various reasons, the intellectual investment by some (archaeologists and geneticists) in modelling or explaining 'the Neolithic' as demic diffusion has proved a hindrance. As Gamble et al. note (*2005.218*):

"*When the genetic data were first suggested to support Late Glacial expansions in the mid-1990s, the dominant view in population genetics was that the major signal was Neolithic. This came as something of a surprise and seems to have been resisted by some ever since*."

This paper has been an attempt to understand why genetic data have been presented in the way that they have in the debate on the Mesolithic-Neolithic transition; and to discuss some problems of cross-disciplinary communication and the effects of different disciplinary aims and cultures. Is it just that genetics is too large, too self-sufficient, too complex a field? Or is it that 'archaeogenetics' was initially an interesting sideline to most geneticists, and the historical (or socio-cultural) side was simply not worth the intellectual investment? Or is it that (anthropologically-trained) archaeologists have in the main found it difficult to engage with the data and implications of the methodologies – such as the modelling of population genetics and molecular biology – at the level of detail required? If geneticists may have been disappointed in the inability of most archaeologists to be able to engage at the technical/methodological level, on the archaeological side such frustration and even resentment was compounded by the lack of consultation from geneticists and the minimal or dated use of archaeological data, publications and relevant theory. Equally, geneticists may have found the comparatively slow productivity of archaeologists and relevant archaeological data irritating: anecdotally, Cavalli-Sforza was said to want to stop working with archaeologists because they took so long to produce results, as compared with genetic analyses. National and international disciplinary expectations (surely compounded by exercises such as the UK government's system of measuring and rewarding research output, or similar systems in other countries such as citation counts), really do structure different norms of activity, especially across very different disciplines, and what it is intellectually worth 'investing' in. Such barriers are likely to be particularly high at the inception of a new and initially unrelated technique/approach.

Nevertheless, we have to find ways of not just talking to, but communicating with each other in meaningful ways in which we can all start to understand the challenges and limitations as well as possibilities of new methods and ideas. Genetics is, of course, also a continually changing field, with new data and new techniques continually being produced, explored and refined. We certainly have not reached the limit of what genetics can tell us about some past processes. Such studies also often act to stimulate new archaeological approaches and interpretations, or suggest boundaries to existing explanations, and this will continue to happen. Archaeology is an especially multi-disciplinary practice; genetics will for the foreseeable future be one of a battery of techniques, approaches, ideas and datasets that we will incorporate into our interpretations.

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Gene-flows and social processes: the potential of genetics and archaeology

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ABSTRACT – *During the past four decades, genetic information has played an increasingly important part in the study of the Mesolithic-Neolithic transition in Europe. However, there sometimes seems to be a degree of disjunction between the patterns revealed by genetic analysis and the increasingly complex social and economic processes that archaeology is starting to identify. In this contribution, I point to the multiplicity of identities, subsistence regimes and patterns of social interaction involved in the introduction of the Neolithic into northern and western Europe, and consider the implications for genetic research.*

IZVLEČEK – *Genetske informacije so v zadnjih štirih desetletjih igrale pomembno vlogo pri študiju mezolitsko-neolitske tranzicije v Evropi. Včasih se zdi, da prihaja do odstopanja med vzorci, ki jih razkrivajo genetske analize in med kompleksnimi socialnimi in ekonomskimi procesi, ki jih proučuje arheologija. V tem prispevku poudarjam mnogoterost identitet, prehrambenih režimov in vzorcev socialne interakcije, ki so bili vpleteni v uvajanje neolitika v severni in zahodni Evropo in ocenim, kakšne so implikacije za genetske raziskave.*

KEY WORDS – *archaeogenetics; demic diffusion; agency; frontiers; cultural hybridity*

Scales and units of analysis

Over the past forty years, a fascinating dialogue has been developing between archaeology and genetics, specifically in relation to the question of the dispersal of domesticated plants and animals into Europe and its relationship with the movements of human populations. This debate has often been marked by a degree of mutual confusion, owing largely to the different temporal and spatial scales at which the two disciplines operate, and the different questions that they address (*Brown and Pluciennik 2001. 101*). While genetics generally concerns itself with the global or continental scale, archaeology is often more focused on the regional and the local, with the result that phenomena that are described at different levels of magnitude may appear to contradict each other. Some common ground is now beginning to emerge, but from an archaeological point of view it is especially interesting to ask whether the fine-grained patterns that we *think* we can discern in the evidence can be accommodated by the broader sweep of the genetic information, or whether there is a degree of dissonance between the two, whose investigation might prove fruitful.

We are indebted to Albert Ammerman and Luca Cavalli-Sforza (*1971; 1973*) for initially stimulating debate with their discussion of the expansion of agriculture into Europe through demic diffusion, developed in the first instance in relation to radiocarbon dates from Neolithic sites, and later used as a means of explaining the distribution of genetic markers across the continent. The model of farming communities gradually expanding as their population rose, fuelled by the productivity and reliability of their subsistence base was explicitly differentiated from migrationary arguments, in which communi-

ties are imagined to leave one area in order to settle in another (*Cavalli-Sforza 2002.82; Bellwood 2002.17*). None the less, subsequent debate has generally been framed in terms of the contrast between demic and cultural diffusion; the physical spread of farming societies versus the transmission and adoption of Neolithic innovations amongst indigenous hunting societies. While Ammerman and Cavalli-Sforza have been careful to acknowledge the diversity of the processes that might have been involved in the Neolithic transition in Europe, and to recognise a role for indigenous peoples in that process, some of the geneticists who have followed in their wake have tended toward a more categorical view (*Cavalli-Sforza 2003.303*). Recent publications by Barbujani and Dupanloup (*2002*), and by Chikhi (*2002*), seem to imply that demic and cultural diffusion are polar opposites, and that if the presence of substantial Near Eastern genetic material attributable to a post-Palaeolithic horizon can be identified in Europe, the Neolithic must have spread into the continent primarily, or exclusively, by population movement.

At a philosophical level, many of the difficulties that we encounter in trying to reconcile archaeological and genetic evidence arise from the ways in which we conceptualise past human communities and populations. Here, archaeology must take much of the blame for developing and perpetuating the image of human groups as self-contained and bounded entities. It is instructive to remember that Gordon Childe formalised the notion of the archaeological culture precisely in the context of his study of the early agricultural societies of south-east and central Europe, in work that led up to the publication of *The Dawn of European Civilisation* (*Childe 1925*) and *The Danube in Prehistory* (*Childe 1929*). While Childe was adamant that culture and race did not coincide (*1950.1*), and even though he was an enthusiastic proponent of cultural diffusion, he none the less instituted the expectation that a variety of different aspects of human identity should be congruent, so that definable distributions or assemblages of artefacts could be identified as the material signatures of 'peoples' who existed in the past (*Jones 1997.17*). I would argue that this is an understanding that arises from the modern experience of living within the nation-state, where political, ethnic, linguistic and expressive entities are generally bounded at the same level. This, then, grounds our expectation that in prehistory we should be dealing with neatly bounded social units (*Thomas 2004a.Ch. 5*). Of course, such an emphasis on bounded and internally homogeneous social wholes was by no means exclusive to culture-historic archaeology: it was also a hallmark of much processual archaeology (*Brumfiel 1992*).

Indigenism and evolutionism

One of the most innovative and attractive aspects of Ammerman and Cavalli-Sforza's work was that it challenged both the culture-historic image of bounded ethnic groups in prehistory, and the processual vision of autonomous communities in parallel evolution, influenced only by environmental selective pressures. As they point out, their initial papers were written at the high point of anti-diffusionist sentiment in archaeology, the time of 'the autonomy of the south-east European copper age' and of 'Wessex without Mycenae' (*Cavalli-Sforza 2003.299*). More recently, Albert Ammerman has explicitly juxtaposed the internationalist aspect of a perspective based on demic diffusion, spreading agriculture across the continent in a wave of advance, with what he calls 'indigenism' (*Ammerman 2003.4*). Indigenism holds not only that each society is independent and autonomous, but also that its development can be attributed to internal processes, or to its specific relationship to its environment. As such it chimes with the culture-historic image of the bounded cultural unit, and shares its affinity with nationalistic approaches, which often hark back to a mythical golden age of ethnic homogeneity (*Gellner 1983.57*). Each nation has its own tribal ancestors, who were responsible for their own independent domestications, and their own rise to statehood. So at a time of heightened friction between the western and Islamic worlds, Ammerman is absolutely correct to emphasise the importance of a Near Eastern contribution to the European genetic inheritance.

But on the other hand, there is the equal and opposite danger of a crude social evolutionism which presents hunters and farmers as representatives of different stages of cultural development (*Borić 2005; Warren 2005;* etc.). While demic diffusion is a population model, the peril is of casting hunters and gatherers as passive and powerless in the face of the oncoming Neolithic steamroller, while the farmers are active and dynamic, even if only in demographic terms (a position apparently adopted by *Rowley-Conwy 2004.97*). Mesolithic populations are thus understood as being 'absorbed', 'incorporated' or 'recruited'. Here again, we are faced with a problem of scale, for while there is a virtue in describing and explaining a pattern at a pan-European level, it

leaves little space for any consideration of agency and contingency: outcomes that could have been otherwise, and decisions made in the context of inherited historical conditions. So the fate of hunting and gathering groups appears determined and unavoidable. Similarly, by discussing the change from Mesolithic to Neolithic at a continental scale, such models run the risk of relying on stereotypical and over-generalised models of hunters and farmers. Yet as we are well aware, prehistoric Europe contained colossal variation, between mobile and sedentary hunter-fisher-gatherers, and between tell-based, longhouse and broad-spectrum forms of the Neolithic (*Zvelebil 2004.45*). It may be that in the near future the questions that genetic information will be able to help us unravel are ones concerned with the kinds of interactions that took place between these diverse communities.

Of course, most authorities now maintain that the Neolithic transition in Europe involved some combination of population movement and acculturation, as in the framework that Marek Zvelebil describes as 'integrationism' (*2002.397*). Zvelebil suggests that we should imagine a mosaic of different processes, ranging from demic diffusion to leap-frog colonisation, frontier mobility, contact and exchange. I would very much concur with him, but would wish to add a further element to the argument. Zvelebil described a series of different mechanisms by which agro-pastoral farming expanded. I would like to question whether it was necessarily the same *thing* that was expanding throughout, or whether the Neolithic did not undergo a series of fundamental transformations in the course of its translocation (see, for example, *Arias 1999.445*). The key question is whether there was a single, constant causal motor for change throughout, such as population growth. I am inclined to doubt this. While in some areas a strong argument can be made for density-driven expansion (*cf. Van Andel and Runnels 1995.498*), in others it may be that processes were at work to which agriculture was no more than incidental. That is to say, in some parts of Europe the Neolithic may have represented as much an identity process as an economic package.

The indigenous component

One of the original reasons why the demic diffusion model was considered pertinent to the spread of the Neolithic was that the process was evidently so slow, apparently progressing at around 1.1 kilometers per year over a period of more than two and a half millennia (*Ammerman and Cavalli-Sforza 1971.684*). By contrast, the cultural transmission of innovations might be expected to have proceeded much faster. But again, this neglects the agency of hunter-gatherers, who appear to have resisted the adoption of agriculture under some circumstances. In order to spread from one community to another, a cultural innovation needs to confer some perceived advantage on the recipient. Agriculture is somewhat ambivalent in this respect: it brings the advantages of higher yield and lower risk, but it might easily be recognised as corrosive of a hunter-gatherer way of life in restricting mobility and personal autonomy, imposing greater labour investment, and transforming property relations. There is certainly good ethnographic evidence of communities resisting economic and technological change for social and cultural reasons (*e.g. MacCormack 1978*).

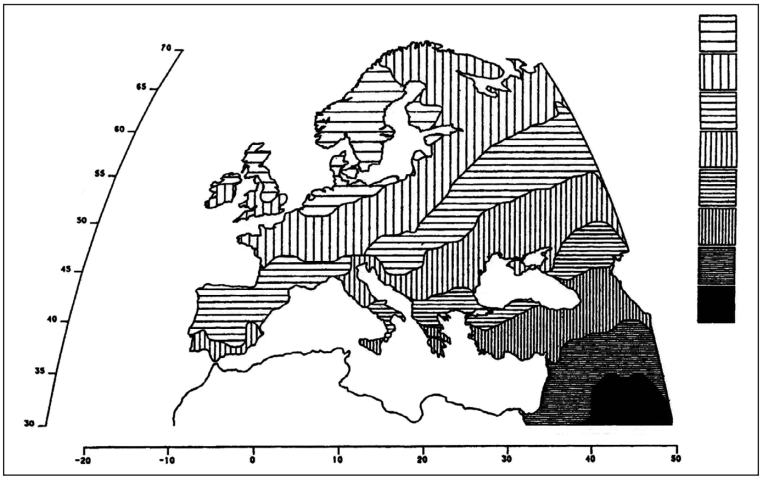


Fig. 1. Synthetic map of the first principal component of variation in 95 classical genetic markers (from* Cavalli-Sforza et. al. 1994*, copyright Princeton University Press).

Now, of course, the first principal component of protein genetic markers shows a gradient across Europe, from south-east to north-west (Fig. 1), and Cavalli-Sforza explains this in terms of the combination of demic diffusion and recruitment or acculturation, so that as the wave of advance swept westwards the expanding Neolithic population would have been characterised by a greater and greater proportion of indigenous genes (*Cavalli-Sforza 2002.82*). At the peripheries, Neolithic people would have been largely 'Mesolithic' in genetic terms, and there appears to be a level of agreement between classical markers, mitochondrial DNA

and the Y-chromosome in suggesting roughly a 20% Near Eastern Neolithic contribution to the overall European gene pool (*Underhill 2002; Richards 2003*). However, this is another instance in which the broad picture of human genetics and the fine grain of archaeology rub up against one another, because for a specialist in the study of the British Neolithic the critical issue is that of what transpired when these population processes washed up against the Atlantic façade. At this point the Near Eastern genetic inheritance becomes so etiolated as to be virtually invisible. Neither classical markers nor Y-chromosomes detect any 'Neolithic' presence in Britain, yet it is of considerable importance to consider what this non-presence represents, and what the processes might have been that gave rise to it.

For instance, in proposing a 'staged population interaction' wave of advance, Colin Renfrew (*2002.100*) argues that a process of demic diffusion and the incorporation of hunter-gatherers might have continued uninterrupted beyond the point where any of the genes of Near Eastern framers were present. Martin Richards, however, indicates that this is not compatible with the mitochondrial DNA evidence (*2003.153*). On the other hand, there is the suggestion that the classical marker plots represent palimpsests of a series of north-westerly population movements throughout pre- and proto-history, which potentially reduces the impact of Neolithic population movement (*Zvelebil 2002.385*). Perhaps most interesting is Richards' suggestion that mitochondrial haplogroups J1a and J1b may relate to the very swift dispersals of the Cardial complex and the *Linearbandkeramik*, at speeds swifter than those predicted from demic diffusion (*2004.152; Sykes 2003.323*).

This is significant because it harmonises both with the idea of the Neolithic transition as a patchwork of diverse population processes, and with that of alternating phases of rapid expansion and prolonged standstill. Some of these episodes of expansion may represent so-called leap-frog colonisation, which I take to be comparable with the modified form of demic diffusion described by Van Andel and Runnels (*1995.495*) in the earliest Neolithic of Greece: the selective and targeted colonisation of optimal areas. However, we should be wary of assuming that such processes were homogeneous, for while there may be a case for such colonisation in Thessaly, sites like Franchthi Cave may indicate a degree of continuity from Mesolithic to Neolithic, although the extent of this is open to debate (*Thissen 2000*). Similarly, the very particular locational preferences demonstrated by LBK settlements in central and western Europe, and the extensive unoccupied areas between settlement cells might be indicative of swift expansion into favourable landscapes rather than slow, population-driven movement (*Lüning 1982.14; Bakels 1982*).

Recently, Chris Scarre (*2002.400*) has suggested that the Villeneuve-St-Germain sites of Normandy and the Loire might represent small and dispersed pioneer agricultural groups, who moved into areas of the landscape which complemented those occupied by hunters and gatherers (Fig. 2) (although other authorities argue that the VSG groups were themselves indigenous, and that their somewhat disparate long-houses represent *copies* of Danubian prototypes: Jeunesse, *pers. comm.*). Scarre implies that these communities were effectively absorbed by the Mesolithic population, but it is arguable that *both* groups contributed the subsequent formation of the Cerny group (*Cassen 1993; Scarre 1992*). Similarly, in east-central Europe, Nowak (*2001.582*) describes a situation in which distinct *enclaves* of Neolithic settlement existed in the period between 5600 and 4800 BC. These were migrant *Linearbandkeramik* groups and their successors, who settled on areas of highly fertile soil, creating 'small islands of farmers in the immense sea of foragers' (*Nowak 2001.590*) (Fig. 3). In a process analogous to that in western France, it was only when the indigenous communities began to make extensive use of domesticates and Neolithic artefacts that a more culturally homogeneous landscape began to develop, with the formation of the TRB.

In Britain, similar arguments have been made concerning the arrival of pioneer Neolithic groups (*Sheridan 2000; 2003; 2004*, for example), but it is arguable that they are far less convincing. In contrast to the west French or east European examples, there is no clear evidence for the coexistence of Mesolithic communities and Neolithic enclaves, and the start of the Neolithic was abrupt and uniform. Indeed, it is the complete and sudden disappearance of the Mesolithic assemblage in Britain that is the most remarkable aspect of the period, and it is my belief that it can only be explained by a transformation that the Mesolithic population were themselves instrumentally engaged in. While this may not have involved the movement of entire population groups as distinct entities from the continent to Britain, it is extremely likely that the exchange of personnel between groups took place both during and prior to the transition. For, while the manufacture of new stone tool types

and conceivably aspects of animal husbandry might have been learned by indigenous people, the techniques of potting and cereal cultivation are more likely to have been transmitted by inter-marriage or prolonged visiting and apprenticeship. While it has conventionally been maintained that Britain and Ireland had no contact with the European continent during the later Mesolithic (*e.g. Jacobi 1976*), this argument has been made on the basis of the morphological distinctiveness of microlithic assemblages. Yet the degree of similarity of artefacts *cannot* be taken as an index of the degree of interaction between social groups, while there is now evidence of the presence of domesticated cattle in Mesolithic Ireland (*Woodman and McCarthy 2003*), demonstrating that indigenous hunter-gatherers did have some dealings with continental Neolithic groups (see *Thomas 2004b* for more detailed discussion). This means that the transfer of domesticates and Neolithic material culture into Britain is likely to have taken place in the context of long-established relationships with continental communities. In this connection, it is important to remember that most of the Neolithic groups that existed along the Atlantic coasts facing the British Isles by 4000 BC (in Brittany, Normandy, the Low Countries, Northern Germany, Denmark and southern Sweden) were most likely indigenous peoples who has adopted a new way of life through acculturation or appropriation (*Arias 1999.432*). Their connections with British hunter-gatherer societies are therefore likely to have been long-established.

Frontiers, interaction and hybridity

These arguments suggest that our investigation of the genetics of prehistoric communities in Europe needs to take more account of what happens when personnel are exchanged between spatially juxtaposed communities which are not bounded but permeable. After all, recent strontium isotope analysis by Bentley et. al. (*2003*) on skeletons from Vaihingen and other LBK sites in Germany suggests that between 30 and 50% of the burials there were of non-local origin, putatively Mesolithic people who had married in to the community. This was happening not in the context of expansion, but of a period of prolonged stasis in which some form of interaction took place between Mesolithic and Neolithic communities. It is these extended periods during which the Neolithic did not expand that I want to emphasise. Recently, Dušan Borić (*2005*) has offered a cogent critique of the post-colonial assumptions implicit in the notion of a 'frontier' between Mesolithic and Neolithic groups in Europe. He argues that such a model reinforces a dichotomous relationship between two essentialised and ahistoric ideal types, hunters and farmers, and that it implies a social evolutionary scheme in which the replacement of foraging by farming is an inevitable outcome. As an alternative, Borić presents an account of Lepenski Vir in which multiple, complex identities existed side by side (*2005.99*). Undoubtedly, Borić is correct to reject the view that the Mesolithic and the Neolithic re-

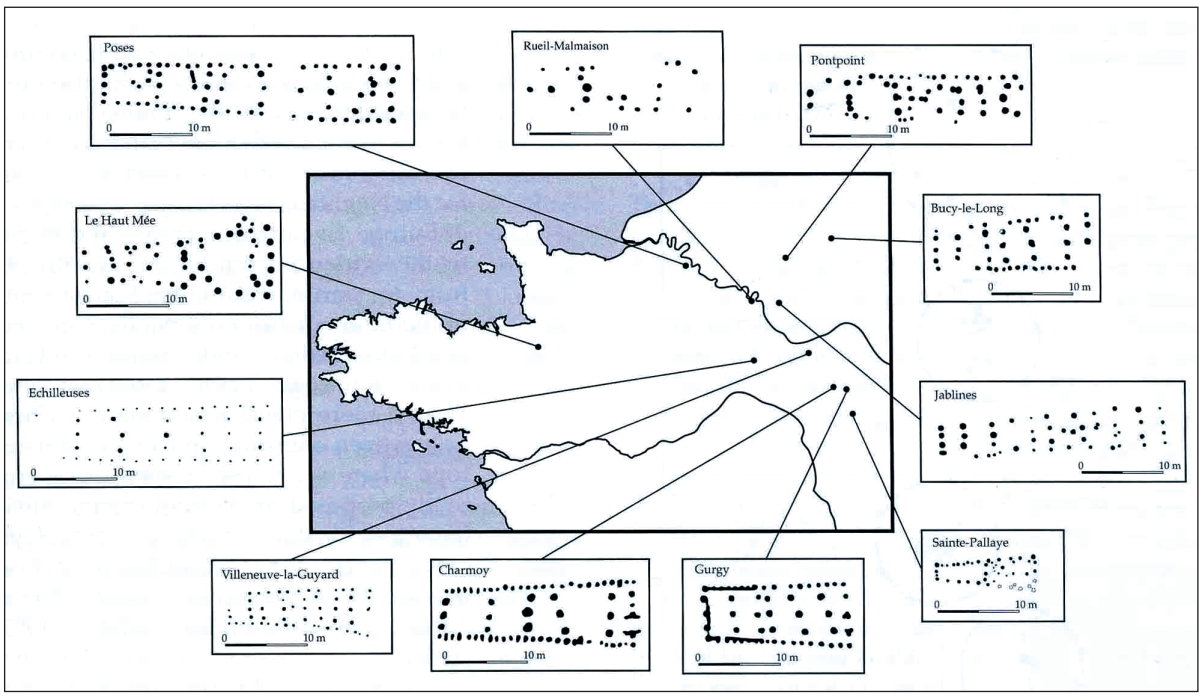


Fig. 2. Villeneuve-Sain-Germain longhouses in northern France (from* Scarre 2002*).

presented two fixed and opposed entities. However, it may still be worth retaining the terminology where we acknowledge that sixth-fourth millennium BC Europe was a patchwork of different *kinds* of Mesolithic and Neolithic societies, each of whose social and economic arrangements were continually open to transformation.

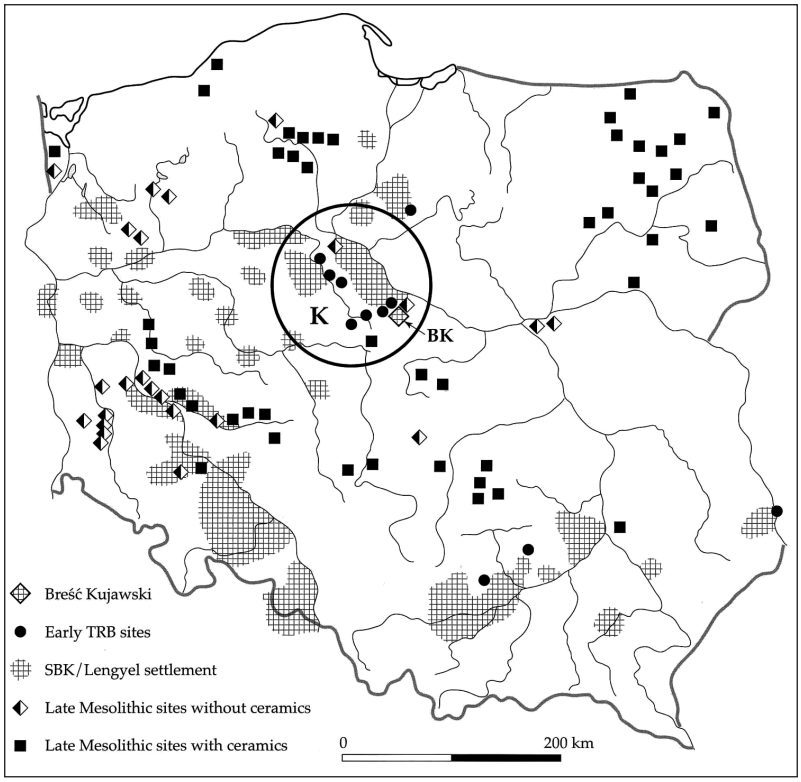


Fig. 3. Poland at the time of the formation of the TRB, showing 'enclaves' of SBK/Lengyel Neolithic settlement in relation to Late Mesolithic sites (from* Zvelebil 2004*).

Wherever formally 'Mesolithic' (that is, indigenous hunter-fisher-gatherer) and 'Neolithic' (having access to domesticates, ceramics and polished stone tools) communities came into spatial juxtaposition, the potential was created for social interaction and cultural innovation. The 'frontier' between such groups is best seen as a zone in which unpredictable social and cultural exchanges might take place: possibly violent (*Gronenborn 1998*), but also potentially creative and transformational. It is unhelpful to think of such interactions as taking place under the sway of a 'law of cultural dominance' (*Sahlins and Service 1960.69*), in which the 'inferior' Mesolithic was always influenced or dominated by the 'superior' Neolithic. Rather, the encounter might affect either group equally, through a process of hybridization or creolization of cultural repertoires that were never 'pure' to begin with. Thus, while hunter-gatherer groups in central and northern Europe adopted ceramics and other Neolithic innovations, it is arguable that in the post-*Bandkeramik* era, the various forms of Neolithic that emerged incorporated elements of a Mesolithic cultural inheritance (*Arias 1999.445*). Simply because societies that used ceramics, polished stone tools and domesticates eventually replaced aceramic hunting and gathering groups across much of Europe, we should not accept the teleological argument that this was the only possible outcome.

I suggest that through these episodes of interaction at relatively long-lived 'frontiers', indigenous groups acquired and assimilated new cultural and material resources, but in addition the Neolithic was itself repeatedly transformed. There are a series of reasons why such situations of contact and interaction might persist over lengthy periods: where pioneer farmers operated under conditions in which land and resources were plentiful, and had no need to expand further; where populations of hunter-gatherers were dense, and operated elaborate subsistence regimes; where physical circumstances restricted the expansion of farming economies; and where economically diversified Mesolithic groups would have perceived no benefit in adopting new resources and technology or being incorporated into different cultural or symbolic regimes.

There are at least three distinct areas in which we can identify such phases of standstill and interaction. The first would be following the following the establishment of the Neolithic in the northern Balkans, where Esther Bánffy (*2004.57*) points to prolonged contact between Starčevo farmers, Körös communities who may have been of indigenous origin but who combined the use of wild and domesticated resources, and Mesolithic hunters in Transdanubia during the earlier sixth millennium BC (see also *Whittle 2005*). Out of this interaction emerged the earliest *Bandkeramik*, which combined elements of the Starčevo ceramic tradition with timber longhouses. The longhouse implies the formation of an entirely new mode of sociality: not the imposition onto central Europe of a Balkan model, but something that developed in the protracted negotiation

between hunters and farmers, and which facilitated the subsequent pioneer expansion into the loess country of Europe north of the Alps and Carpathians (*Gronenborn 1999*). Similarly, in the period following the *Bandkeramik* expansion we can identify parallel processes in western France and the North European plain which began with the exchange of ceramics, stone tools, livestock, furs, and presumably also personnel between Neolithic and Mesolithic communities, and culminated in the formation of hybrid forms of sociality which drew on both traditions, with Cerny and the earliest TRB (*Domanska 2003; Nowak 2001; Zvelebil 2004.51*). Just as the formation of the LBK introduced an entirely new social focus and forum in the shape of the longhouse, so with Cerny and TRB it was monumental funerary architecture that was central to a new kind of social life (*Midgley 2005.36*). Again, I would stress that this was a transformation of the Neolithic, arising out of interaction, and introducing elements which had simply not been there before.

It was the development of a new form of Neolithic, in which kin relations were expressed through mortuary monuments as much as in the domestic context, that facilitated the final phase of the Neolithic expansion in Europe: into Scandinavia and the British Isles. Here the process was more thoroughly one of acculturation than elsewhere (*Price 2000. 299*). It is important to note that the significance of domesticated species altered subtly at this point. Where agriculture spreads by population movement, we might expect domesticated plants and animals to form an integrated food-production system, and to represent staples. However, where we have populations of hunter-gatherers who have a stable economic base of their own, the initial occurrence of domesticates beyond the 'agricultural frontier' is likely to be as exotica and novelties. Interestingly, there is a growing pattern of the identification of domesticated cattle in pre-Neolithic contexts in southern Scandinavia, southern Brittany, the Rhine Basin, the Alpine foreland, northern Poland and Ireland (*Zvelebil 2004.49; Woodman and McCarthy 2003*). In the Mesolithic context, the acquisition of a single domesticated cow and its slaughter for communal consumption might have had an appreciable impact on local social relationships, in terms of status, prestige and personal obligation. It is arguable that the penetration of north-west European Mesolithic societies by Neolithic systems of consumption and prestige was one of the mechanisms that led to their transformation. But as we have stressed above, it should not be presumed that this was a one-way process, for the acquisition of goods and raw materials, and the incorporation of personnel from Mesolithic communities would have held a transformative potential for Neolithic societies.

Clearly, the societies that inhabited northern and western Europe between the sixth and fourth millennia BC were diverse in terms of their various combinations of hunting, gathering, fishing, herding and horticulture, their material culture, and their social organisation. The contacts and relationships between these groups will have been more complex still. The articulation of social reproduction and social interaction will, under these circumstances, have resulted in elaborate sequences of non-reversible historical change. I have dwelt on all of this complexity because each of these processes will have had their own demographic consequences and correlates. The patterns that we observe in the DNA evidence are the outcome of these processes, overlaid with four millennia of further developments. There remains a massive contribution that human genetics can make to the study of this period, but it may be that it is now time for it to address a finer-grained picture of the Neolithic transition.

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Neolithic skull shapes and demic diffusion: a bioarchaeological investigation into the nature of the Neolithic transition

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ABSTRACT – There is a growing body of evidence that the spread of farming in Europe was not a single uniform process, but that it involved a complex set of processes such as demic diffusion, folk migration, frontier mobility, and leapfrog colonisation. Archaeogenetic studies, which examine contemporary geographical variations in the frequencies of various genetic markers have not succeeded in addressing the complex Neolithisation process at the required level of spatial and temporal resolution. Moreover, these studies are based on modern populations, and their interpretive genetic maps are often affected by post-Neolithic dispersals, migrations, and population movements in Eurasia. Craniometric studies may provide a solid link between the archaeological analysis of past events and their complex relationship to changes and fluctuations in corresponding morphological and thus biological variations. This paper focuses on the study of craniometric variations between and within Pre-Pottery Neolithic, Pottery Neolithic, and Early Neolithic specimens from the Near East, Anatolia and Europe. It addresses the meaning of the observed multivariate morphometric variations in the context of the spread of farming in Europe.

IZVLEČEK – *Vedno več je dokazov, da širjenje poljedelstva v Evropi ni bil enkraten, enoten proces, temveč je obsegal kompleksen niz procesov, kot so demska difuzija, migracije ljudstev, mobilnost meja in kolonizacija na način žabjega skoka. Arheogenetske študije, ki preučujejo sodobne geografske variacije in pogostost različnih genskih označevalcev, niso uspele pojasniti kompleksnost prostorske in časovne strukturiranosti procesa neolitizacije. Ker te študije temeljijo na modernih populacijah, na njihove interpretativne genetske zemljevide pogosto vplivajo post-neolitske razpršitve, migracije in premiki prebivalstva v Evraziji. Kraniometrične študije lahko preskrbijo trden člen med arheološkimi analizami preteklih dogodkov in njihovimi kompleksnimi razmerji s spremembami in nestalnostmi v ustreznih morfoloških in bioloških variacijah. Ta članek se osredotoča na preučevanje kraniometričnih variacij med in znotraj predkeramičnih in keramičnih neolitskih ter zgodnje neolitskih populacij na Bližnjem vzhodu, v Anatoliji in v Evropi. Loteva se pomena opazovanih multivariantnih morfometričnih variacij v kontekstu širitve poljedelstva v Evropi.*

KEY WORDS – *neolithisation of Europe; Early Neolithic; craniometric analysis; multivariate statistical methods; sex-specific variability*

Introduction

The Neolithic period in the Near East and Anatolia was a period of experimentation, innovation and change. It was particularly demarcated by the 'cultural explosion' during the pre-pottery Neolithic B period (*Aurenche and Kozłowski 1999*) in the Levant, Mesopotamia, Iran and Anatolia. Preliminary analyses of the space-time dynamics of these cultures indicate that observed changes in the Levant's settlement patterns, population density and size, and cultural aspects such as architectural style, lithic typological attributes, etc. are possibly associated with a diffusive process to island and mainland Greece dur-

ing this period (*Perlès 2001*). It is not clear, however, whether this process was for the most part cultural, demic, or a combination of both, and nor if it combined with a process of overland dispersal from western Anatolia to southeast Europe (*Özdoğan 1997*).

It is clear that the Neolithisation process in Europe varied by region/culture and that it comprised a series of complex processes involving population fusion, fission, leapfrog colonisation, dispersals and migrations. Analyses of radiocarbon dates (*Pinhasi et al. 2005*), and craniometric data (*Pinhasi & Pluciennik 2004; Pinhasi 2003*), highlight the complexity of the Neolithic transition in the various regions, and stress the need to examine its spatiotemporal, archaeological and biological aspects in greater scope and resolution.

Some analyses of the craniometric data set, utilising skeletons from Pre-Pottery and Early Neolithic occupational phases from Near Eastern, Anatolian and European sites, have demonstrated a high degree of morphological heterogeneity between and within populations. In particular, a high degree of morphometric heterogeneity has been detected and reported for the Near Eastern/Anatolian Pre-Pottery Neolithic specimens (*Pinhasi 2003*). This heterogeneity contrasts with the morphological homogeneity among the Central Anatolian Çatalhöyük skeletal population and that of mainland Greece, the Balkans and southern Hungary.

But what does this observed craniometric pattern tell us about the nature of the Neolithisation process in the various regions of the Near East, Anatolia, and Europe?

Ammerman & Cavalli-Sforza (*1971*) suggested that the 'Wave of Advance' (WOA) of the Neolithic farmers progressed at an averege speed of 1 km/yr, but that it was twice as rapid along the coasts of the Mediterranean (Cardial Neolithic and associated cultures). At present, however, the mosaic chronometric pattern of the Neolithisation of Italy (*Skeates 2003; Forenbaher and Miracle 2005*) does not support a straightforward linear demic diffusion, but points to the involvement of other processes, specifically the maritime colonisation of certain parts of the peninsula.

A recent analysis of the wave of advance, using radiocarbon dates from 735 early Neolithic sites in Europe, the Near East, and Anatolian sites (*Pinhasi et al. 2005*), has demonstrated high correlation coefficients ($R > 0.8$) for some of the Mesopotamian, southeast Anatolian and Levantine Probable Centres of Diffusion (POAs) and thus supports both in magnitude and average speed (km/year) the original approximation of Ammerman & Cavalli-Sforza (*1971*). In fact, the obtained average rate of the Neolithic spread over Europe was 0.3–0.6 km/yr, which is consistent with the prediction of the demic diffusion model. Pinhasi et al. (*2005*) examined whether the chronometric correlations between early Neolithic occupation in Europe and the Near East/Anatolian zone allow the interpolation of a best-fit geographic region in the Near Eastern/Anatolian from which a WOA probably originated. They reported that the most likely region was the northern Levant/Mesopotamia. This observation is in disagreement with results obtained from the craniomentric study, which suggests a centre of dispersal in Central Anatolia (*Pinhasi & Pluciennik 2004*).

At this stage, it is not clear whether or not the slow rate of overall spread and its essentially linear character, as shown by the above-mentioned analysis, is a true reflection of a single historical process which was for the most part demic in nature, or perhaps is merely an artefact – possibly the outcome of a series of movements and transitions that, when combined (i.e. when examining pan-continental trends), appear to be linear. Another possibility is that the chronological cline reported by Ammerman & Cavalli Sforza (*1971*) is the outcome of cultural diffusion, and thus that the Neolithisation process involved for the most part an economic/cultural transformation of in situ Mesolithic populations. It is therefore evident that we are now entering a new phase in the study of the Neolithic transition, one that requires greater attention to details and a finer focus on the application of specific archaeological and morphometric methods to tackle the process of Neolithisation on a regional-level.

It appears that a Neolithic dispersal from the Near East/Anatolia to Europe may have occurred at least twice: once as a PPN maritime expansion from the Levant/southern Anatolia, and later on during the Pottery Neolithic period as an overland dispersal from Central/Western Anatolia to southeast Europe (*Perlés 2001; Özdoğan 1997*). This means that more than one founder Neolithic population dispersed out of the Near East/Anatolia to Europe, and that each dispersal event must have left certain demographic and genetic signatures on modern Europeans. At the same time, the rise of regional variations in cultural

aspects, as one can deduce from the certain differences in artefact styles, and the like, may have been the outcome of a period of fragmentation and isolation of certain communities, possibly associated with the severing of existing trade and exchange networks. Processes of fission, fusion, consolidation and isolation should therefore leave biological traces that to a certain extent correspond to those that can be read from the material record.

A demic diffusion process involves gene flow, which in general reduces the genetic and morphological difference between populations. In contrast, cultural diffusion will not have a direct effect on the morphological attributes of these populations, so that new artefacts, domesticates, and architectural features may appear in a given period in a certain region without any apparent change in the morphology of the skeletons from this period.

Genetic studies have not provided the required resolution to address this question (*Pluciennik 1996*). In particular, the time resolution applied in most genetic studies is too vast to recognise archaeological/historical processes of the scale involved in Neolithic studies (*Brown & Pluciennik 2001*). Craniometric studies may provide the 'missing link' between genetic studies, which for the most part examine geographically-based variations in a given marker among modern populations, and the Neolithic archaeological record. But can craniometric studies 'translate' observed biological affinities and variability among skeletal populations from various archaeological sites to corresponding historically-based population variations between archaeological cultures? The answer to this question requires examination of the relationship between 'archaeological cultures' and past human populations, whereas the latter is assumed to correspond to past ethnicity. Thus, the question may be rephrased, and one should ask whether the appearance of specific 'archaeological cultures' defined according to certain non-functional characteristic elements of their archaeological toolkit (such as pottery style) is directly associated with a corresponding biological process such as population differentiation, admixture, isolation and the like.

This paper will attempt to take an initial step towards furthering our current understanding of this complex polemic by systematically examining morphometric relationships and variations between Near Eastern, Anatolian and European Neolithic populations from specific sites that were allocated to a specific group on the basis of their archaeological attributes (e.g. Cardial, Starčevo-Körös-Çris, etc.). Morphometric variations and similarities between the groups should therefore shed some light on the relationship between archaeological entities and the corresponding biological attributes of past populations.

Materials and Methods

The skeletal sample is described in Table 1. It consists of Pre-Pottery Neolithic specimens from the sites of Zawi Chemi, Hotu, Abu Hureyra, and Çayönü in the Near East and Anatolia; Pottery Neolithic specimens from Çatalhöyük-Turkey; Early Neolithic specimens from Nea Nikomedeia-Greece, Vlasac and Lepenski Vir-Danube Gorge; various specimens from the Cardial Neolithic, Starčevo-Körös-Çris (SKC) complex; and the Linienbandkermik (LBK) sites of Visenhauser Hof, Sonderhausen and Schwetzingen. The sample is first analysed by groups (Tab. 1) which are defined according to either specific archaeological cultural entities (e.g. "Cardial") or site/culture (e.g. "Sondehausen-LBK").

The following set of standard craniometric variables that best define the gross moprphological shape and dimensions of the craniofacial complex are utilised:

- Vault height: BBH;
- Vault length: GOL;
- Vault breadth: minimal- MFB and maximal- XPB;
- Facial dimensions:
  Nasal height- NLH and breadth- NLB;
- Orbital height- OBH;
- Upper face height-NPH;
- Bizygomatic breadth- ZYB.

Three statistical methods are then applied to the samples:

1. Squared Mahalanobis Distances

The generalised distance, D^2 is a statistic that is often applied in the estimation of group differences between biological populations. It has been extensively applied in craniometric studies of prehistoric populations (see, for example, *Howells 1973; Keita 1990; 1992*).

2. Discriminant Function Analysis

The method is used in order to discriminate between groups, and to derive posterior probabilities for the correct classification of cases to one of the existing groups (thus indicating the degree to which it is possible to correctly assign a give case to a given group on the basis of the derived discriminant functions).

Another important use of discriminant function analysis is the actual positioning of populations and the interpretation of functions (*Howells 1973*). The b coefficients of each function can be interpreted in a similar manner to factor loadings – that is, the larger the coefficient, the greater the contribution of the respective variable to the discrimination between groups. However, these coefficients do not tell us between which of the groups the respective functions discriminate. This can be quite effectively achieved, however, by plotting group centroids and individual discriminant function scores (per case for the first two discriminant functions).

Location	Latitude	Longitude	N	M	F	Period	Group code
Abri De Pendimoun	43.48	7.30	1			Cardial	6
Arene Candide	38.33	16.12	1			Cardial	6
Arma Dell'aguila	42.37	13.37	2	1	1	Cardial	6
Castellar	43.48	7.30	1	1		Cardial	6
Chateau neuf	43.24	5.12	1	1		Cardial	6
Condeixa	40.06	8.30	26	11	15	Cardial	6
Finale Ligure	44.12	8.18	2	1	1	Cardial	6
Grotte Sicard	43.24	5.12	1	1		Cardial	6
Sabassona	41.38	2.18	1		1	Cardial	6
Salces	42.54	2.54	2	1	1	Cardial	6
Çatalhöyük	37.10	32.13	16	7	9	Pottery Neolithic	2
Lepenski Vir	44.33	22.03	5	4	1	Danube Gorge	5
Vinča	44.48	20.36	3	2	1	Danube Gorge	5
Schwetzingen	49.38	8.58	10	7	3	LBK	7
Sonderhausen	51.12	10.54	12	5	7	LBK	8
Viesenhäuser Hof	48.50	9.13	17	9	8	LBK	9
Nea Nikomedeia	40.65	22.30	10	3	7	Greek Neolithic	3
Abu Hureyra	35.87	38.40	2		2	PPN	1
Çayönü	38.23	39.65	3	2	1	PPN	1
Hotu	35.81	53.90				PPN	1
Zawi Chemi	37.08	43.87	1	1		PPN	1
Deszk	46.22	20.25	2	1	1	SKC	4
Devetaškata Peštera	43.23	24.95	1	1		SKC	4
Endröd	46.94	20.78	1	1		SKC	4
Gura Bacului	46.48	23.36	1		1	SKC	4
Kasanlak	42.36	25.24	1		1	SKC	4
Vészto-Mágori	46.94	20.23	6	6		SKC	4

Tab. 1. Samples analysed by location and archaeological period.

3. Principal Components Analysis

Principal Components Analysis (PCA) is a data reduction technique. It reduces dimensionality by calculating a series of uncorrelated factors, or PCs, whose total number should be significantly less than the total number of variables. PCA is for the most part an exploratory method, which is therefore to a certain extent subjective. However, its strength lies in the fact that it can be applied directly to the data set without the need to assign each case to a given group.

The first PC explains the largest amount of the total variation, and in most biological studies it mostly covers size-related variation. The second PC explains even less of the variation, and so on in descending percentages. It is therefore usually sufficient to examine only the first few PCs (depending on the percentage of variation that each one explains). Each case has a set of factor scores corresponding to each PC. By plotting bivariate graphs of the factor's scores (usually for the first vs. second component) it is then possible to assess any detectable relationship between the cases (in this specific case, Neolithic specimens). Furthermore, each PC contains a set of factor loadings for each variable, and it is therefore possible to examine which specific variables have the maximum positive or negative loadings on a given PC. It is then possible to interpret the relationship between the reduced set of variables and the obtained PCs, or in other words, to see if there is a meaningful biometric relationship between the variable set and the obtained PCs.

Results

The following is a description of the results obtained by analysing the same set utilising each of the above methods.

a. Squared Mahalanobis Distances

Results of the analysis are provided in Table 2. The largest Square Mahalanobis Distances (D^2) between a single site/culture, and the remainder are detected

in the case of the Pre-Pottery Neolithic set and the rest with the exception of the Starčevo-Körös-Çris (SKC) and the Cardial Neolithic complexes. The second cultural complex with large D^2 distances is the Danube Gorge Neolithic (comprising specimens from the sites of Lepenski Vir and Vlasac). The group has large D^2 distances from all other sites/complexes. The third site with large D^2 distances from the remainder is the south-western LBK site of Viesenhauser Hof. Surprisingly, the specimens from this site have large D^2 distances not only from most other Neolithic complexes, but also from the two other LBK sites of Schwetzingen and Sonderhausen.

Small D^2 distances (< 4.0) are observed in the case of three sites/complexes: Çatalhöyük, Nea Nikomedeia and SKC. The D^2 distances between the three complexes are all below 3. Furthermore, Çatalhöyük shows small distances from all other complexes except PPN, Danube Gorge and Viesenhauser Hof. Exactly the same trend is noticed in the case of Nea Nikomedeia. The SKC complex differs from the other two only by having a slightly lower D^2 value for its distance from Viesenhauser Hof (3.98). In sum, the following trend is apparent from the Square Mahalanobis Distances analysis of the sites/complexes: the largest distances between a given complex/site and the remainder is indicated in the case of the PPN complex, the Danube Gorge complex and the site of Viesenhauser Hof. Small D^2 distances are observed between Çatalhöyük, Nea Nikomedeia and SKC, Cardial Neolithic and two out of the three LBK sites. The small distances point to minimal morphometric differences between the crania from each of these sites/complexes. It therefore suggests minimal morphological differentiation between these groups. The sharp contrast in D^2 distance trends between the LBK site of Viesenhauser Hof and the LBK sites of Schwetzingen and Sonderhausen is intriguing.

b. Discriminant Function Analysis

i.) Discrimination

In general poor discrimination is achieved between the various groups (Tabs. 3a–b). The lack of discrimination between most groups does not indicate a flaw in the data, but points to the fact that there are minimal inter-group morphometric differences and maximal intra-group differences. In other words, the selected groups are not biometrically (and hence biologically) distinct enough on the basis of the utilised craniometric set to facilitate group-based discrimination. This leads us to the next question, which is why there is no sufficient difference between these groups. And what does the lack of difference indicate? It is now necessary to focus on the range of variability in each group by looking at the contours that delimit some of the groups in relation to the centroids for each group (numbered black squares, Fig. 1). It is evident that the second discriminant function (the Y axis in Fig. 1) in fact manages to differentiate between the PPN group and the others. It therefore indicates that differences in the morphometric dimensions of the PPN specimens and the rest of the groups allow one to discriminate between them. It also suggests that if we apply this function to new specimens, it will allow us to successfully discriminate and classify PPN and "non-PPN" specimens on the basis of their craniometric dimensions. It therefore follows that the PPN specimens as a group share a distinct set of craniometric dimensions, reflecting a distinct skull vault/face shape. The position of Çatalhöyük within the Nea Nikomedeia group boundaries further point to the lack of biometric differentiation between them. A great degree of variability is evident in the case of the Cardial Neolithic complex, and the LBK groups. The latter show a pronounced degree of differentiation. Two of the Danube Gorge specimens fall near the PPN centroid, while the other one falls near the Sonderhausen

	Code	PPN	Çatalhöyük	Nea Nikomedeia	SKC	Danube G.	Cardial	Schwetzingen	Sonderhausen
PPN	1								
Çatalhöyük	2	**6.14**							
Nea Nikomedeia	3	**7.02**	1.32						
SKC	4	3.67	1.31	2.65					
Danube Gorge N.	5	**6.88**	**6.72**	**5.67**	**5.66**				
Cardial	6	3.61	2.87	1.55	2.12	**4.98**			
LBK- Schwetzingen	7	**5.00**	1.91	1.84	1.51	**4.95**	2.00		
LBK- Sonderhausen	8	**6.01**	2.88	2.62	3.74	**8.00**	2.44	**5.96**	
LBK-Viesenhäuser Hof	9	**8.07**	**6.30**	**5.43**	3.98	**7.20**	4.62	**5.16**	**6.71**

Tab. 2. Squared Mahalanobis distances between the samples. Distances greater than 4 D^2 units are in bold.

centroid. As only three specimens from this group were included (due to missing data), it is not possible to draw any conclusions based on the sample.

The large degree of morphometric variability within the Cardial Neolithic group suggests that it may in fact include several biological populations. Thus, both the PPN and the Cardial groups comprise specimens from various sites that span a large geographical range (see Tab. 1).

a. Structure Matrix

Function	1	2
BBH	0.35	0.50
NLB	0.19	0.34
OBH	0.14	−0.01
XPB	0.12	−0.01
NLH	0.33	0.22
NPH	−0.27	0.44
MFB	0.10	−0.18
ZYB	−0.01	−0.11
GOL	0.02	0.21

b. Summary of canonical discriminant functions

Function	Eigenvalue	% of Variance	Cumulative %
1	0.455	30.268	30.268
2	0.326	21.700	51.969
3	0.305	20.316	72.285
4	0.190	12.638	84.923
5	0.149	9.924	94.847
6	0.063	4.214	99.061
7	0.010	0.674	99.735
8	0.004	0.265	100.000

Tabs. 3a–b. Discriminant Function Analysis

ii) Classification

Table 4 provides the results of the classification of the various specimens for each group. Only 44.6% of the cases were correctly classified. The highest percentage of correct classification was in the case of Sonderhausen (75%), Viesenhauser Hof (66.67%), and PPN (60%). Poor classification was noted for the SKC, Danube Gorge, Cardial Neolithic and LBK-Viesenhauser Hof.

C. Principal Components Analysis

i.) Total sample (pooled sexes)

The principle components analysis examined the specimens from the above-mentioned groups using the same craniometric variable set. However, the method does not require the assignment of specimens to groups, thus allowing a 'natural' pattern of group differentiation to appear. The analysis shows no clear differentiation between the groups (Tabs. 5a–c). Figure 2 is a scatterplot of the factors scores values of the various skulls on the first and second principal components. The SKC, Cardial and LBK complexes display the most extensive range of variability. It therefore appears that it is not possible to detect clear morphometric differences between groups on the basis of this method when using the craniometric set provided. Also, note that most of the variability is accounted for by PC1 (55.67%), while only 12.29% of the variability is accounted for by PC2. It therefore seems that as PC1 is unipolar (factors loadings of all variables are positive), it mainly accounts for size-related variability. The positive factor loadings of the second component are for facial height measurements – more specifically, upper facial height, nasal height, and orbital height load positively on PC2, while the other variables have negative loadings. It therefore appears that the Danube Gorge Neolithic specimens have particularly low faces, while some of the SKC, LBK and Cardial specimens have long faces.

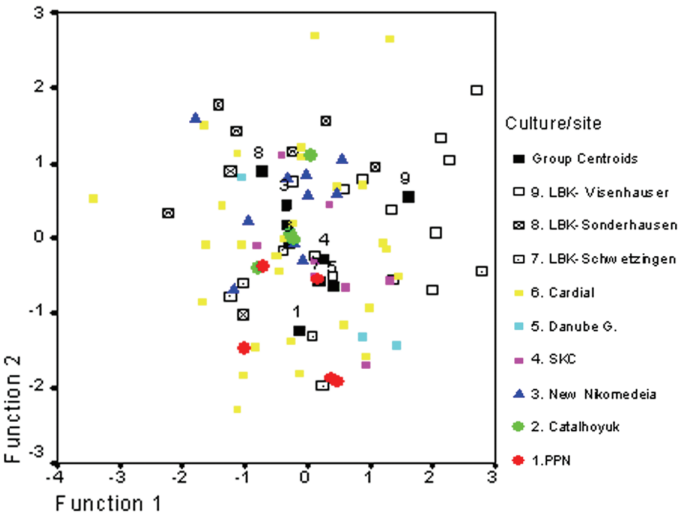


Fig. 1. Discriminant function analysis of craniometric measurements of skulls from 9 Early Neolithic cultures/sites.

ii.) Sex-specific patterns

A fair degree of overlap is expected when running a PCA on pooled rather than sexed samples (i.e. when male and females of each group are combined). A sex-specific analysis may allow one to differentiate between some of these groups. Figure 3 is a scatterplot of the same PCs, but indicating the values of each case (i.e. skull) by sex. Good separation is indicated between male and females: female specimens for PC1 < −0.8 values and male specimens for PC1 > 1. However, males and females overlap for −0.8 < PC1 < 1. About 2/3 of the males and 2/3 of the females fall on the overlapping range. It therefore means that a sexed analysis of the same set will only partially reduce the overlap between the groups, as only a third or so of

the overlap is directly related to sexual dimorphism.

Discussion

The Squared Mahalanobis Distance analysis clearly indicates that D^2 distances between Çatalhöyük, Nea Nikomedeia, SKC, Cardial Neolithic, and two out of the three LBK sites are small. These distances indicate minimal inter-group morphometric differences in crania from each of these sites/complexes. The sites/cultures with the largest distances from the rest are PPN, Danube Gorge, and the LBK site of Viesenhauser Hof. The large D^2 distance between the LBK sites of Viesenhauser Hof and the LBK sites of Schwetzingen and Sonderhausen shows extensive craniometric variation between these LBK populations. The LBK culture dispersed across Central Europe in less than 500 years (*Bogucki 2003*). Considering the rapid speed of this dispersal and the extensive gene flow between LBK communities (as there were no major geographic barriers to prevent it), it is necessary to rule out the possibility that the observed morphological differences between the LBK populations analysed were the outcome of selection and/or stochastic changes to the genetic structure of these populations due to drift. It therefore appears that the only plausible explanation is that one or more of these populations either mixed with local Mesolithic hunters, or even that some of these populations were indigenous hunters that adopted farming. However, these hypotheses can only be tested with the analysis of Mesolithic populations, which is beyond the scope of this article (see *Pinhasi 2003*).The Discriminant Function analysis did not discriminate well between the groups. However, discrimination was achieved between PPN on the one hand and Nea Nikomedeia and Çatalhöyük on the other. Moreover, the function discriminated between Sondehausen, Viesenhauser Hof and Schwetizngen. The Principal Components Analysis (PCA) did not provide any additional information about the relationship between the specimens in relation to their archaeological cultures. However, it has been shown that differentiation between populations is hindered to a fair extent by the pooling of male and female samples. It is possible that sex-specific PCA will result in better differentiation between the groups. Furthermore, it is evident that specimens from some of the archaeological cultures, such as LBK and Cardial Neolithic, vary greatly in their morphologies, while others, such as the Danube Gorge Neolithic, are more tightly clustered and thus are morphologically more similar.

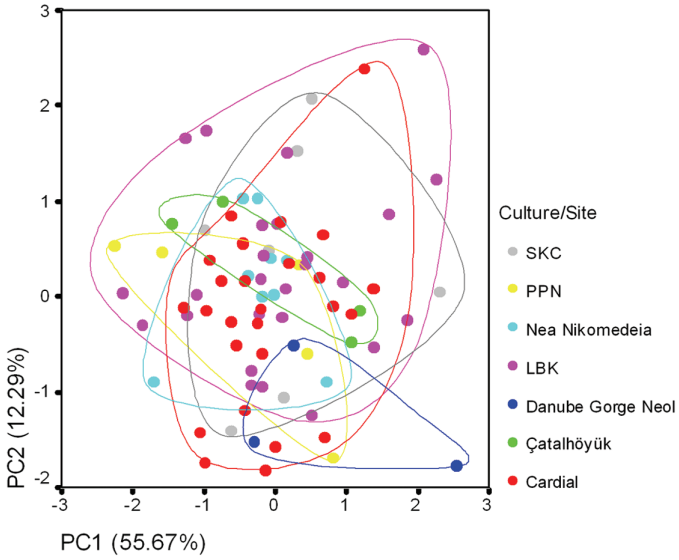


Fig. 2. Principal components analysis of craniometric measurements of skulls from Early Neolithic sites.

Özdoğan (*1997*) points out that the Neolithic communities of the Central Anatolian plateau form a distinct entity which differs from the south-eastern Anatolian, Levantine and Mesopotamian contemporaneous cultures in settlement pattern, architecture, lithic technology, bone tools, and other archaeological aspects. There is no simple corollary between specific cultural-archaeological entities and biological populations. However, in the case of the above analyses, the population of Çatahöyük differed biologically from the populations of the Near East and southeast Anatolia and were similar to the SKC and Nea Neikomediea cultures. Indeed in a previous publication (*Pinhasi 2003*), it was demonstrated that the Squared Mahalanobis Distance between Çatalhöyük and Çayönü is twice to three times the average distance between the former and any of the Early Neolithic southeast or central European Early Neolithic populations. The above analysis therefore confirms the archaeological observations made by Özdoğan (*1997*) and reaffirms in this specific case a correspondence between cultural boundaries that define a prehistoric culture and its biological basis.

A similar factor may explain the position of the Danube Gorge specimens. Pinhasi and Pluciennik (*2004*) pointed out that the craniometric analysis of the Danube Gorge Mesolithic and Neolithic specimens indicate a possible continuity in cranial morphology in this micro-region that contrasted with the Mesolithic-Neolithic morphometric discontinuity in the case of other regions in southeast Europe. This observa-

tion is also in accord with that made by Tringham (*2000*), who asserts that it is "*...unjustifiable to assume that the complexities of hunter-gathering society and the scenarios of their contact with agriculturalists that have been developed in the Danube Gorges sites also apply to southeast Europe outside the Danube Gorges*".

Group	1	2	3	4	5	6	7	8	9	Total
1	60				20	20				100
2		50					25	25		100
3			50	10			10	30		100
4	14.29	14.29		28.57	14.29	14.29	14.29			100
5					33.33		33.33	33.33		100
6	10.71		17.86	7.14	3.57	32.14	0.00	7.14	21.43	100
7		11.11	11.11		11.11	11.11	33.33	0.00	22.22	100
8	12.5							75	12.5	100
9					11.11	22.22			66.67	100

*Group codes legend: 1 – PPN, 2 – Çatalhöyük, 3 – Nea Nikomedeia, 4 – SKC, 5 – Danube Gorge Neolithic, 6 – Cardial Neolithic, 7 – LBK– Schwetzingen, 8 – LBK- Sonderhausen, 9 – LBK-Viesenhäuser Hof.

Tab. 4. Results of the classification of cases to each of the nine groups* (in percentages) on the basis of the discriminant functions.

According to Perlès (*2001; 2003*) the first pioneer colonisers of Greece were Near Eastern PPNB farmers who brought with them the 'Neolithic package', minus pottery. She then asserts that Nea Nikomedeia and other mainland Early Neolithic Greek sites are not associated with a westward 'wave of advance' of Anatolian populations

There are no grounds for believing that the settlement of mainland Greece, either by land or sea, can be compared with the slow movements of populations characteristic of the Cardial or Danubian 'waves of advance'. On the contrary, it seems to relate to these long-distance expeditions, well exemplified in the Mediterranean by the colonisation of Crete, Corsica and the Balearic Iislands, for instance" (*Perlès 2001*).

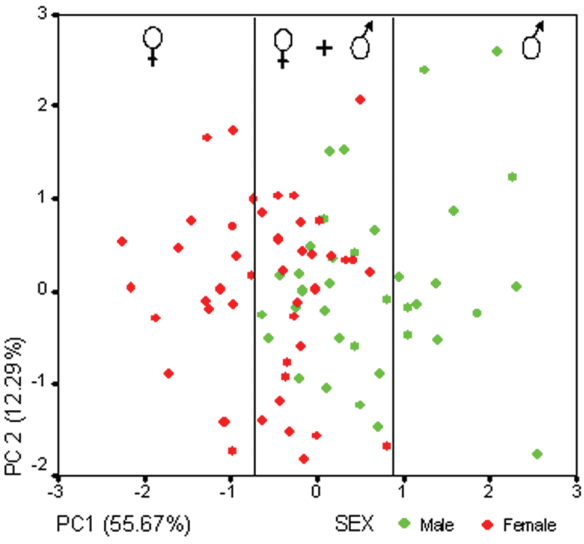


Fig. 3. Sexual dimorphism in craniometric measurements. The left and right sections comprise females and males only, respectively, while the middle section shows the range of PC1 scores in which the two sexes overlap.

However, the craniometric analysis indicates no morphological differences between Nea Nikomedeia and the Çatalhöyük populations, which contrasts with the differences between these and the PPN Levantine/ Anatolian samples.

The morphometric relationship between the LBK populations and those of southeast Europe and Anatolia appear to be complex. The separation between the sites of Viesenhauser Hof, Sonderhausen and Schwetzingen (Fig. 1) points to pronounced morphometric differences between these populations. This finding is in accord with Jochim's assertion (*2000*) that new archaeological evidence indicates greater regional differentiation within the LBK area than was previously assumed. It also supports the observation made by Bentley et al. (*2002*) using strontium isotope analysis which indicated that about 25% of the Schwetzingen individuals were non-local migrants, thus pointing to extensive mobility and mate exchange among LBK populations, possibly also involving local Late Mesolithic hunters.

The position of the Cardial Neolithic in the abovementioned analyses is unclear. Perhaps the large range of variability observed in the sample utilised reflects the fact that we are dealing with several biological populations spread across a vast geographical region. Only more analyses with a finer geographical and archaeological resolution will allow one to examine the biological nature of this cultural entity.

Conclusions

This work attempted to investigate the biological relationship between skeletal specimens from various Pre-Pottery and Early Neolithic sites from the Near

a. Descriptive statistics

	Mean	Std. Deviation
GOL	181.43	7.24
XPB	137.40	5.25
MFB	95.21	4.82
BBH	136.14	6.52
ZYB	124.59	7.82
NPH	66.32	4.76
OBH	31.67	2.05
NLB	24.28	2.03
NLH	48.03	3.65

b. Total variance explained (of first 4 Principal Components)

Function	Eigenvalue	% of Variance	Cumulative %
1	3.909	43.436	43.436
2	1.475	16.391	59.827
3	0.815	9.056	68.883
4	0.740	8.221	77.105

c. Factor loadings

	1	2
GOL	0.82	−0.03
XPB	0.45	−0.45
MFB	0.70	−0.02
BBH	0.69	−0.29
ZYB	0.80	−0.21
NPH	0.76	0.35
OBH	0.22	0.78
NLB	0.57	−0.34
NLH	0.69	0.54

Tabs. 5a–c. Principal Components Analysis of the total (unsexed) sample.

East, Anatolia, southeast Europe, Danube Gorge, Mediterranean Europe and Central Europe. By applying three specific methods to the same set of specimens, it investigated not only the affinities and differences between these specimens, but also the type of answers that one may obtain from the interpretation of biometric data. Furthermore, some specimens were categorised according to archaeological units of vast spatiotemporal scope, such as 'Cardial Neolithic', while others had a much narrower spatio-temporal scope (such as LBK- Viesenhauser Hof). This categorisation scheme was applied in order to see whether groups that share a given archaeological culture and are from a relatively narrow spatio-temporal range (LBK sites) are biologically more similar to each other than to other groups from different archaeological contexts. The results show that this was not the case, and therefore reaffirmed the previous observations (*Pinhasi 2003; Pinhasi and Pluciennik 2004*) that while biological differences between specimens relate to the specific archaeological culture-specific context, the relationship is complex. Nevertheless, the similarities between SKC, Nea Nikomedeia and Çatahöyük, and the differentiation between the PPN and other Early Neolithic groups show that craniometric studies can shed more light on the nature of the Neolithisation process in various regions, and provide an essential link between genetic studies and archaeology.

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Neolithisation in southwest Asia – the path to modernity

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ABSTRACT – *Two questions are discussed that turn out to be related. The first was posed originally by Robert Braidwood more than fifty years ago, and concerns why farming was adopted in southwest Asia early in the Neolithic, and not earlier. The second concerns the usually opposed processualist and post-processualist approaches to the Neolithic. The paper seeks to model the processes at work through the Epi-palaeolithic and early Neolithic, showing how the trend towards sedentism and storage of food resources coincided with the emergence of fully symbolic cognitive and cultural faculties. The former fed more mouths, and led to the adoption of farming practices that further intensified food productivity. The latter made possible and desirable the symbolic construction of large, permanently co-resident communities. The spread of farming may then be understood as the expansion of a complex way of life that involved communities living together in larger groups, with denser, richer cultural environments, controlling not only the built environment of their own settlements, but also the productivity of the agricultural environments that surrounded them.*

IZVLEČEK – *Razpravljamo o dveh vprašanjih, za kateri se je izkazalo, da sta povezani. Prvo je zastavil Robert Braidwood pred več kot petdesetimi leti in se ukvarja s tem, zakaj je bilo poljedelstvo sprejeto v jugozahodni Aziji v zgodnjem neolitiku in ne prej. Drugo pa se nanaša na nasprotujoče se procesualne in post-procesualne pristope v neolitiku. V članku skušam modelirati proces, ki je deloval v času epi-paleolitika in zgodnjega neolitika. Pokažem, kako je trend v smeri sedentizma in shranjevanja hrane sovpadal s pojavom čisto simbolnih, kognitivnih in kulturnih zmožnosti. Prvo je nasitilo več ust in je pripeljalo do sprejema kmetijskih praks, ki so pospešile proizvodnjo hrane. Drugo pa je oblikovalo takrat mogočo in željeno simbolno strukturo velikih, sobivajočih in stalno naseljenih skupnosti. Širitev kmetovanja lahko tako razumemo kot ekspanzijo kompleksnega načina življenja, ki je vključevalo življenje velikih skupnosti druge ob drugi, bogato kulturno okolje in nadzor vasi in polj ter pašnikov, ki so jih obkrožali.*

KEY WORDS – *Epi-palaeolithic; Neolithic; cognitive archaeology; cultural evolution; origins of farming*

Introduction

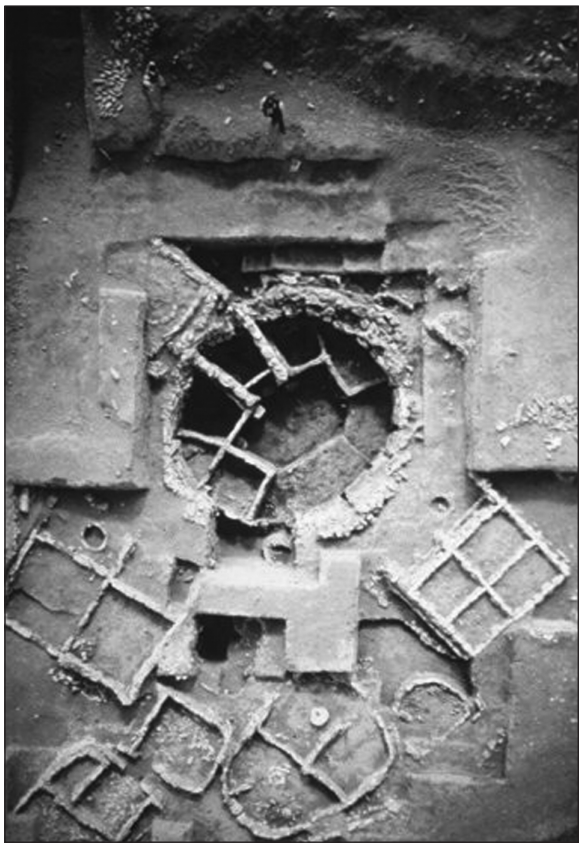
There are two problems in the Neolithic of southwest Asia that have proved resistant, and neither have been the central concern of those working on the Neolithic. One of them has persisted since the middle of the twentieth century, while the other appeared more recently. I shall attempt solutions to those problems. The process of Neolithisation as I will model it in a sketchy outline leads to the conclusion that the early Neolithic societies had evolved minds and symbolic cultures that were for the first time in human history recognisably like those that we enjoy. In that sense, the Neolithisation process in southwest Asia was the path to modernity. At the end of the period with which this essay is concerned, around 7000–6500 BC, there are archaeological indications of increases in the form, extent and density of settlement around the southwest Asian core area. These indications may suggest that there was demographic growth (together with other factors) within the region that required expansion of the set-

tled area. However, the rest of southwest Asia was by no means an empty quarter. I suggest that expansion from the core area produced a ripple effect as societies in other parts of the region began to feel demographic pressure expanding from the core area, and were themselves also adopting the new, dynamic symbolic cultural package that included mixed farming, and beginning to experience population growth. The pressures within southwest Asia thus expanded in whichever directions were possible, and may have provided the initial pulse of Neolithic cultural forms and farming economies into southeast Europe.

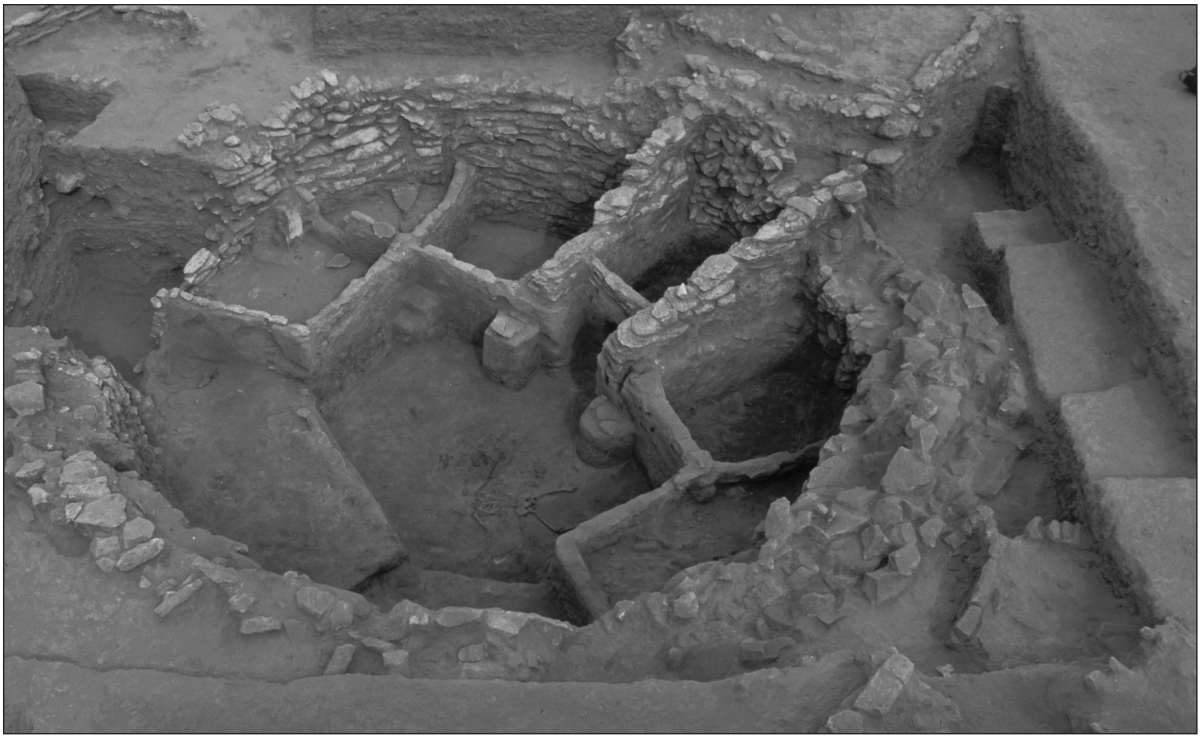
The persistent question that has hovered over us since the middle of the twentieth century was that posed by Robert Braidwood when he sought to unravel and understand what we would now call the process of Neolithisation on the basis of his multidisciplinary research programme in northeast Iraq (*Braidwood 1960* is a simple, direct and accessible statement of his views). Following the conclusions of the early work by his environmentalist collaborators, Braidwood dismissed climate and environmental change at the end of the Pleistocene period (Gordon Childe's hypothesised driver) as the pressure that prompted early Neolithic societies to adopt crop cultivation and animal herding. His collaborators found no evidence of significant climatic or environmental change in the final Pleistocene and earliest Holocene. In any case, Braidwood reasoned, similar sequences of cold phases followed by warming had occurred frequently during the Pleistocene without prompting human societies in southwest Asia to adopt farming. If the context of the initial adoption of farming was not one of environmental pressure, then there must be some cultural reason; the vulnerability of Braidwood's proposals were his inability to suggest in what way culture might have been 'ready' 12 000 years ago, at the end of the Pleistocene, and unready at earlier times.

The second question is how to integrate two views of the Neolithic that have been completely opposed to one another, each claiming to be the only proper way to approach the problems to the exclusion of the other. The first view, the processualist, ecological view, was first articulated in the later 1960s. Two American scholars, Lewis Binford and Kent Flannery, took quite a different view from that of Braidwood (*Binford 1968; Flannery 1969*). Lacking evidence of a driving force in climatic and environmental change, they opted for an ecological process in which an increase in population growth became the environmental pressure that pushed certain groups of hunter-gatherers. For our purposes, the processualist view may be characterised by Ofer Bar-Yosef, who has great authority within the field and international respect, and who has co-authored a more sophisticated synthesis in the light of the great volume of recently available data (*Bar-Yosef & Meadow 1995*). The other view may be characterised by the figure of Jacques Cauvin, who would shudder at the idea that he might be thought a post-processualist, but whose dismissal of processualist explanations puts him in the same camp (*Cauvin 1994; 2000*). Cauvin's account stresses the priority of the emergence of symbolic culture in a psycho-cultural transformation of the human mind.

I am attempting to relate these two approaches to Neolithic phenomena, the adoption of farming economies, and what I call the facility for the symbolic construction of complex, multi-layered concepts of community, by relating them back to a single prior cause. In the terms used by Bruce Trigger in his essay on the rival epistemologies underlying schools of archaeological explanation, there is an epistemologically based opposition between the processualist



Jerf el-Ahmar. A vertical view of the subterranean communal building 1 at the centre of the early settlement, among houses of various shapes.



Jerf el-Ahmar. Communal building 1 was more than two metres deep and about 9 metres across. At least part of it had been roofed, presumably the cells, symmetrically arranged about an axis. At the end of the structure's use, a body was placed face down on the floor of the open area to the left, and the empty building was set on fire before the void was filled with soil.

(positivist) and the post-processualist and other idealists' camp (*Trigger 1998*). And I am perhaps attempting a realist synthesis that follows Trigger's proposed solution. In that regard, I find that I am following a similar path to that recently outlined by Marc Verhoeven in his essay proposing 'a holistic approach to domestication' (*Verhoeven 2004*), and I shall return to this major paper when I have proposed my own synthesis. The prior cause to which I refer above will be described as a complex of interacting cognitive, social and economic factors. Key aspects of the complex are the emergence of larger social groups resident in permanent village communities, and the emergence of fully symbolic culture and cognitive faculties in human minds to match. It will be apparent that this complex of factors includes one that is universal (the co-evolutionary process of mind and culture) with others that are regional (how societies in southwest Asia constituted themselves and how they operated at the level of strategies of subsistence economics within the resources of the natural environment).

Braidwood's killer question

We can go right back to Robert Braidwood's work in the 1950s and early 1960s. Based on his multi-disciplinary research, he rejected the idea that Neolithic farming was a response to environmental pressures brought about by climatic change. Similar climatic and environmental changes had occurred repeatedly in the Pleistocene without bringing about the human response of adopting farming. He concluded that there must have been some cultural factor involved. Jacques Cauvin labelled that factor psycho-cultural, but was still unable to explain why such a psychological revolution in the use of symbols occurred at the end of the Pleistocene and the beginning of the Holocene. Finally, he published his proposed explanation as a hypothesis that would need to be debated and, discussed, and for which further evidence would need to be sought (*Cauvin 1994; 2004*).

Lewis Binford's essay on Post-Pleistocene adaptations (*Binford 1968*) modelled a process that was not grounded in the archaeology of southwest Asia. But Kent Flannery drew upon his field research experience in southwest Iran, when he developed a closely comparable processualist model which he called the broad spectrum revolution (*Flannery 1969*). His ideas about the importance of the change to a broad spectrum hunting strategy and his neglect of the significance of stored plant foods mean that the model needs some modification, but it can be

made strong in the context of our current knowledge, mostly derived from Epi-palaeolithic sites in the southern Levant. For Flannery, the revolutionary moment occurred when hunter-gatherers began to focus on broad spectrum hunting and gathering (which we can redefine somewhat as harvesting and storing nutritious, hard seed plant species together with broad spectrum hunting), which implied the adoption of a more sedentary life. I prefer to call them hunter-harvesters. From that time in the Epi-palaeolithic, it only required pressure on finite wild food resources, and both Binford and Flannery argue for population growth as the force exerting pressure to adapt.

Both Bar-Yosef, and Gordon Hillman with Andrew Moore depend upon the Younger Dryas reversal in the last millennium of the Epi-palaeolithic as the environmental force pushing communities to adopt cultivation and thus to initiate plant domestication (*Bar-Yosef & Belfer-Cohen 1989; Bar-Yosef & Meadow 1995; Hillman 1996; Moore & Hillman 1992; Moore, Hillman & Legge 2000*). Moore and Hillman are concerned essentially with the final Epi-palaeolithic period and the impact of the Younger Dryas, whereas Bar-Yosef, taking a deeper perspective starting from the end of the LGM, employs a push-and-pull model, in which there were alternating environmental phases that encouraged expansion or offered opportunities, followed by phases that exerted pressures requiring urgent adaptation. Bar-Yosef's model adds a social factor to the economic-ecological and environmental factors. Thus, the recovery from the LGM encouraged groups to focus on the increasingly available plant foods such as cereals and pulses. But then the Younger Dryas reversal pressed on final Epi-palaeolithic communities which had become larger sedentary groups, unable to opt for the flexibility of small-group mobility because the environment was too packed with other groups. But once again, similar climatic and environmental oscillations had happened earlier in the Pleistocene, and Braidwood's killer question still applies. Processualists like Bar-Yosef would probably respond that an inevitable process was set in motion when Epi-palaeolithic hunter-harvesters adopted the trend towards sedentism; at least in Bar-Yosef's view, the hunter-gatherer population had tended to concentrate at a higher density in the Levant in consequence of the LGM, and there was a trend among Epi-palaeolithic hunter-harvesters to live in larger, more permanent groups. Although the hypothetical concentration of hunter-gatherer populations in the Levant in the LGM remains speculative, the size and number of Epi-palaeolithic open sites and the expansion of the occupied area around the mouths of caves and rock-shelters in the Levant seems real. But this only pushes Braidwood's question back to an earlier stage. Instead of asking why some groups began to engage in cultivation when they did, we now ask why they began to engage in harvesting and storing nutritious, hard-seeded crops, or why they sought to exchange their traditional mobility and fluidity of group membership for a trend towards sedentary life in permanent village communities. Once again, the opportunities offered by the recovery from the LGM (greater availability of wild cereals and pulses) would have occurred several times earlier in the Pleistocene, without the consequences that we observe in the Epi-palaeolithic.



Jerf el-Ahmar. A hand of the human body that was laid face down on the floor of communal building 1 before the structure was set on fire and filled.



Jerf el-Ahmar. When the first communal building was destroyed, posts were removed and in one of the post-sockets a human skull was buried.

As far as concerns the adoption of cultivation leading to plant domestication, the force that exerted pressure to invest in the added labour of clearing the ground, digging and planting is contested. Some appeal to population growth leading to population pressure, while others believe that the Younger Dryas exerted a climatic-environmental pressure. In

truth it is practically impossible to decide between them, and one could add another hypothetical force in the shape of environmental degradation brought about by over-exploitation by intensive hunter-harvesters who were (semi-) sedentary. Whatever the source of the pressure for societies that had been practising the hunter-harvester way of life for millennia, living in relatively large and socially coherent communities, there was no way back to small-group mobility. The response of further intensification (cultivation) in the production of their food resources sooner or later resulted in domestication. The adoption of agriculture was the end of a process, not the beginning, as Flannery emphasised almost forty years ago. The questions of why and how Epi-palaeolithic communities were drawn or pushed to develop a way of life that was so different from that of their Palaeolithic predecessors remains.

The nexus of Epi-palaeolithic social and subsistence strategies and the inevitability of farming

We can agree that the Epi-palaeolithic was a critical period, and we should note that it was a long period. Many who write with a central concern for the beginnings of farming use the final Epi-palaeolithic of the Levant (the Natufians) as a prelude to their main period of interest. In the Epi-palaeolithic period, new kinds of social group emerged, and new subsistence strategies were adopted. We should not under-estimate the significance of the new, permanently sedentary communities that were an order of magnitude (approximately ten times) larger than earlier Palaeolithic groups. The new subsistence strategies involved storage of food resources, and the management and allocation of those resources required major changes in society and the development and adoption of new concepts.

Ohalo II illustrates the Epi-palaeolithic process particularly well, and shows how early it began (*Kislev, Nadel & Carmi 1992; Nadel, Carmi & Segal 1995; Nadel & Hershkovitz 1991; Nadel & Werker 1999; Piperno et al. 2004*). It is a very early Epi-palaeolithic site, dating to the boundary between the Upper Palaeolithic and the Epi-palaeolithic (around 20 000 years ago in uncalibrated radiocarbon terms). It may represent a precocious group, but there is no reason to think that they or the ecological niche that they chose were unique. The site emphasises that the characteristics that are frequently associated with the final Epi-palaeolithic (Natufian) of the Levant were already effectively present or presaged at the very beginning of the Epi-palaeolithic period, many millennia earlier. The site of Ohalo II is usually submerged in shallow water at the southern side of the Sea of Galilee, but is partly exposed at times when water levels drop. There has been little or no subsequent erosion or disturbance, and there are extraordinary conditions of organic preservation.



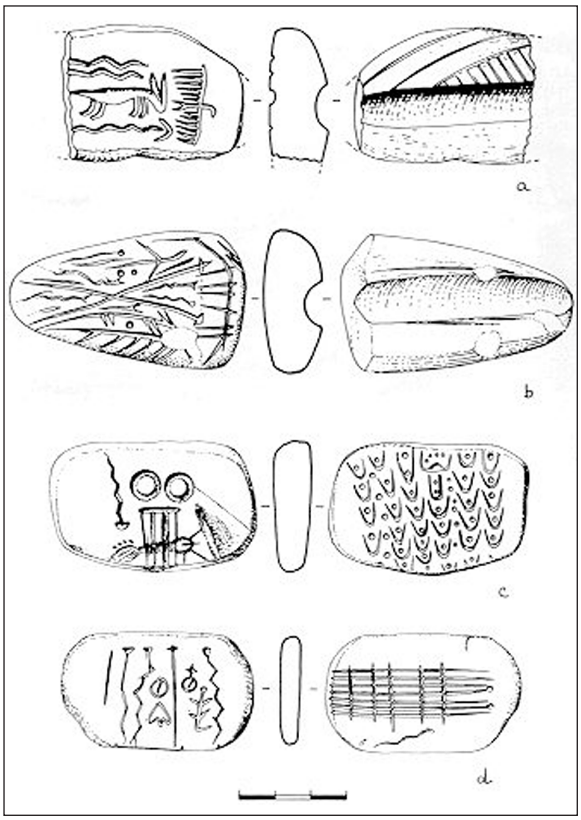
Jerf el-Ahmar. General view of communal building 2, which succeeded the earlier communal building in another part of the village. It was also subterranean, and the cavities where wooden posts that supported the roof have decayed can be seen behind the mud plaster of the wall. The interior had six large timber posts in a circle, and a series of large kerb-stones between the posts.

Ohalo II was a cluster of brush huts and hearths. There were also occasional burials among the huts. There is heavy stone equipment for grinding and pounding plant foods, and 120 species of plants, including cereals, large-seeded grasses, lentils, and vetches are evidenced. Traces of starch recovered from the surface of a grinding slab set in the floor of one of the huts have been identified as derived from the grinding of cereal (*Piperno et al. 2004*). The evidence of seasonality from the plant and animal and bird remains indicates year-round occupation. By the middle of the Epi-palaeolithic in the Levant there are examples of large, semi-sedentary or sedentary groups. In the last phase of the Epi-palaeolithic in the Levant (the Natufian) there were sedentary village communities numbering around 250 living

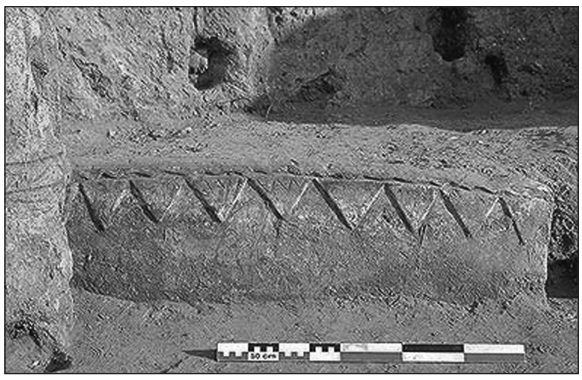
in the same place for many centuries, for example Abu Hureyra in north Syria (*Moore, Hillman & Legge 2000*), and Eynan ('Ain Mallaha) in north Israel (*Valla 1991*). Some of the phenomena that are so dramatic in the early Neolithic can be seen developing in the last phase of the Epi-palaeolithic period, and to a lesser extent in the earlier millennia.

Situating the process in the context of cognitive and cultural evolution

In response to what I called Braidwood's killer question – why then, why not earlier? – I want to situate these developments in new forms of social organization and new subsistence strategies in the context of the longer term evolution of human cognitive faculties. In particular, I am sure that the critical factor in long-term human cognitive evolution has been – and still is – the co-evolution of mind and culture. What I shall go on to argue here is that a particular stage in the co-evolution of mind and culture was essential if human social groups were to grow in size and permanence beyond the scale of earlier Palaeolithic mobile, flexible hunter-gatherer groups. That stage was marked by the emergence of human minds fully capable of managing systems of symbolic representation beyond language, using symbolic material culture as a mode of 'external symbolic storage' (a key phrase from Merlin Donald, see below). That stage having been reached, over the last ten thousand years or so, the rich cultural environment has become the essential environment within which further (increasingly rapid) cultural evolution has taken place, rather than the physical environment, or much slower biological evolution. Before developing that case, I will very briefly outline some of the background in cognitive and evolutionary psychology and its application in archaeology and prehistory.



Jerf el-Ahmar. (a) and (b) Two grooved stone objects (known as shaft-straighteners). (c) and (d) Two small limestone plaques. All four objects are decorated with incised motifs, but the left sides of (a), (c) and (d) are arguably groups of signs, rather than mere decoration.



Jerf el-Ahmar. One of the carved kerb-stones in communal building 2.

Ahead of and separate from the recent explosion of publication on cognitive and evolutionary psychology and neuro-science, we should note the remarkable work of Peter Wilson on what he calls the domestication of society (*Wilson 1988*). Wilson, an anthropologist with a seemingly encyclopaedic acquaintance with the ethnographic literature, has written about hunter-gatherer settlement without apparently recognizing the relevance of his ideas for the prehistoric sedentary hunter-gatherers in southwest Asia. He differentiates between open and domestic societies. He argues that the adoption of a built environment had a profound effect on people's evolved social psychology. People's perception of their social selves was challenged. Buildings introduced privacy for interior space, as distinct from life in the public space. While challenging the evolved social psychology, living in what Wilson calls domesticated circumstances also offered exciting opportunities to use the built environment for symbolic representation (see *Watkins 2004* or *2005* for a fuller discussion of Wilson's ideas, and a general survey of anthropologists, architects and social theorists on the symbolic potential of architecture).

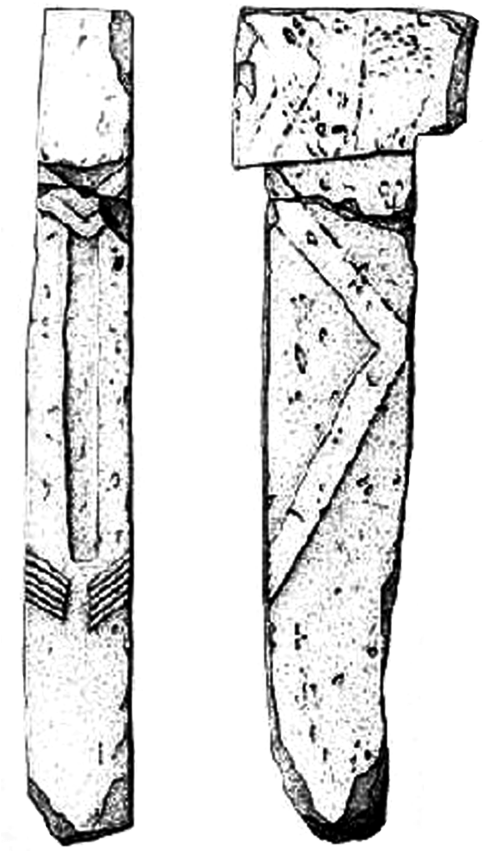
Lesley Aiello (anthropologist at UCL) and Robin Dunbar (psychologist at Liverpool University) have been interested in the long-term evolution of the hominid mind, and the emergence of language (*Aiello & Wheeler 1995; Aiello & Dunbar 1993; Dunbar 1992*). They point to the unique trajectory of hominid evolution in developing a brain that supports larger social groups of inter-dependent individuals. Their studies conclude that the evolved human brain is biologically adapted for operating with social groups of a maximum number of 120 people. Dunbar has developed the theory that language evolved to facilitate gossip as a more efficient mode of communal grooming than the one-to-one grooming that serves in other sociable primate species (*Dunbar 1996; 2004*). Larger group sizes require advanced cognitive and cultural symbolising skills in order to frame the concepts that make large human societies work. Dunbar is one of a number of biologists, ethologists and psychologists who have worked on the question of how human societies overcome this biological barrier by using cognitive and cultural symbolising skills to formulate the powerful abstract concepts that underpin all modern social life (see, for example, *Dunbar 1999*).

Boyd and Richerson, another anthropologist-psychologist team, have been working and writing on the theme of the co-evolution of mind and culture for a number of years (*Boyd & Richerson 1982; Richerson & Boyd 2005*). They are just one example of those who work on the principle of mind-culture co-evolution. By means of culture, humans have learned how to build up, communicate and share huge bodies of information. By means of language and symbolic culture in general, human minds have developed extraordinarily and quite uniquely complex modes of storing abstract information. Merlin Donald is a Canadian psychologist, whose first major book, *Origins of the Human Mind*, has had a major impact on the thinking of a number of archaeologists (*Donald 1991*). Donald argues that humans evolved new modes of cultural communication, each of which has changed the way that human minds work. The emergence of a full, modern language faculty, in Donald's view, was the second stage in that evolution. The third and most recent stage was the emergence of what he calls 'external symbolic storage', by which he means the ability to read and write, to store and communicate accumulated knowledge, information, stories, music, or mathematics. In his more recent book, Donald has developed his theories much further, elaborating the argument that the very consciousness that we contemporary (western) humans enjoy depends completely on the cultural environment within which we have grown up from infancy (*Donald 2001*).

Homo sapiens symbolic representation and the emergence of external symbolic storage

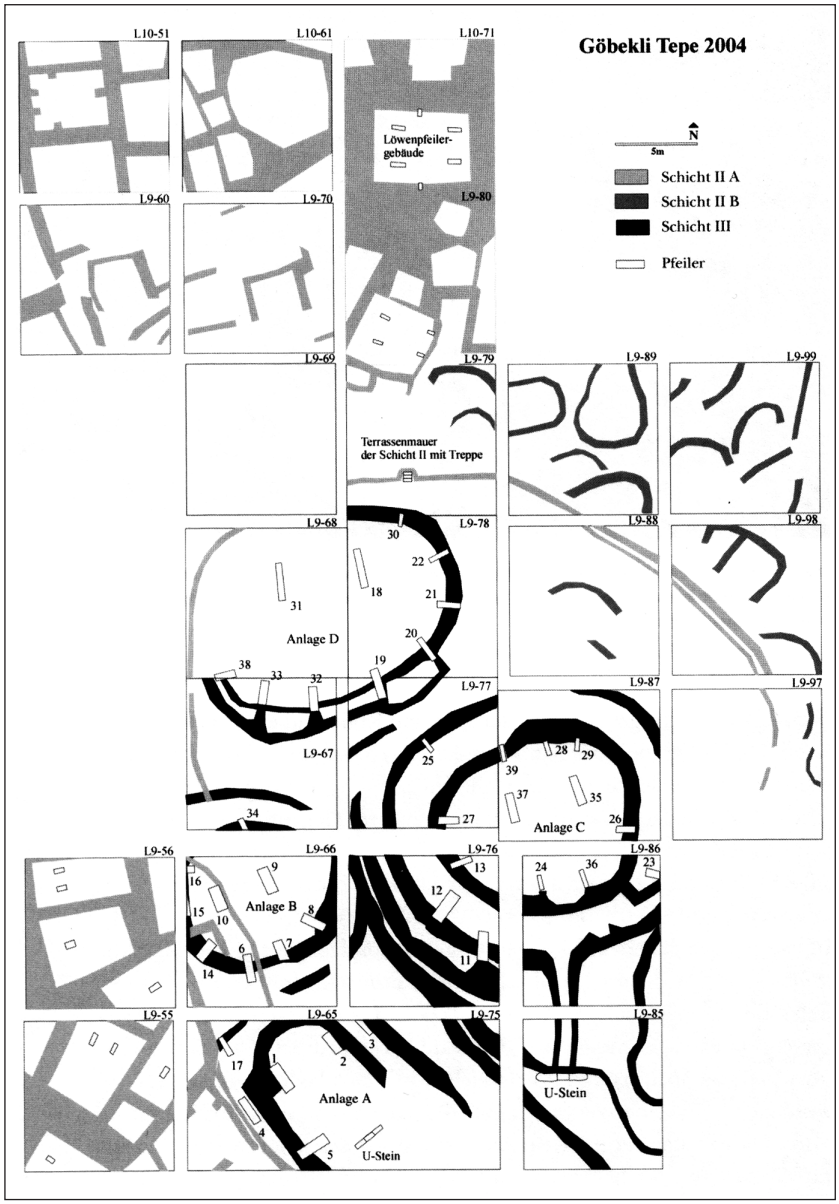
Let us recapitulate the situation then. *Homo sapiens* emerged in Africa 160k years ago. Before 100k years ago, some *Homo sapiens* were present in modern-day Israel, and by 60k they had spread as far as SE Asia, colonising Australia by 50k. Some time around 100–50k years ago, a full modern language faculty evolved. *Homo sapiens* had therefore evolved the capacity for conceptualising systems of symbolic representation. And by 70k years ago the first building-blocks of emergent symbolic material culture, such as incised pieces of red ochre, were present at Blombos and other sites in South Africa.

A fully modern language capability is the second of Merlin Donald's three stages in 'the evolution of cul-



Nevalı Çori. One of the T-shaped monoliths from the "shrine" at the centre of the village. Some of these monoliths show that they were anthropomorphic, having arms, bent at the elbows, and hands with clearly indicated fingers.

ture and cognition' (*Donald 1991*). It is important to recognize that our modern languages – and their predecessors for the last few tens of thousands of years – are complex systems of symbolic representation (*Deacon 1997*). The definition of words as arbitrary *signifiers* for things *signified* is only a small part of the story, and the addition of grammar and syntax takes us only a certain distance further towards understanding the extraordinary cognitive complexity of symbolic representation that underpins the actual linguistic skills of all modern humans. Language does more than make indexical links between signifiers and signified. In a system of symbolic representation, the tokens take their meaning in relation to one another. A sentence makes sense because statements take their meaning from the way that words are combined and interrelated. Language is a complex system of symbolic representation, but it is only one such system. Symbolic material culture offered people further opportunities for communication and storage.



Göbekli Tepe. The site is an artificial mound 300 m in diameter set on a bare mountain ridge. Each of the large structures was excavated into the mound and equipped with a pair of stones in the open centre, and more stones set into a "bench" around the sides. The oldest structures are the large, circular structures in the lower part of the plan, and they have each been rebuilt once or twice, each time on a smaller diameter.

Now it is time to relate cognitive and cultural evolutionary theory to the prehistory of southwest Asia. In the Upper Palaeolithic, which is the sole territory of *Homo sapiens*, there are distinct changes from the Middle Palaeolithic. We can note that cultural phases that have been distinguished by archaeologists studying chipped stone industries follow one another at a very much more rapid rate than in the almost static Middle Palaeololithic. Now that radiocarbon dating is available, and sufficient dates assembled, it has become clear there were parallel and different cultural traditions within the Levant that were for the most part synchronous. In the Epi-palaeolithic period in the Levant, the pace of cultural change, and the extent to which material culture was used to differentiate contemporary cultural groups, increases further. The early Epi-palaeolithic, for example, lasted a few thousand years, while the late Epi-palaeolithic was only two thousand years in duration, and three sub-phases have been distinguished by those specialising in the study of Natufian lithics. In short, we can begin to see how *Homo sapiens* was learning to use material culture to construct and maintain social identity. Indeed, the cognitive and cultural environment was becoming the evolutionary environment rather than the biological environment.

When we reach the early Neolithic, I have argued elsewhere that architecture became the means that communities used to make concrete their concepts of their village societies, their structure and their central focus on corporate rituals and shared ideology and iconography (*Watkins 2004a; 2004b; 2006*). In addition to its structural representation of a community, architecture can provide the arena within which people play out the dramas of social life, as well as the enactment of rituals that are concerned with the community's relationship with higher powers. In communities that numbered several hundreds and even several thousands, shared religious beliefs and practices were essential because what Susan Blackmore (*Blackmore 1999*) calls religious 'memeplexes', developing the idea of memes and meme-plexes as the cognitive equivalents of genes and gene-complexes that was first articulated by Richard Dawkins (*Dawkins 1976; 1986*), incidentally provide the justification for altruistic behaviours (*Watkins 2003*). We do not need to be concerned with the controversy over whether memes constitute another form of replicator in another evolutionary process of selection, as that is simply a vocabulary for articulating the results of Blackmore's social psychology research. The important point is that shared religious ideas go beyond shared beliefs and communal rituals, because they promote norms of behaviour and commend altruism. In communities that numbered several hundred and even several thousand individuals, the cognitive and cultural capacity to create and reproduce such abstract concepts as 'community' and 'neighbourliness' were essential.

I have written elsewhere (*Watkins, in press (a)*) about the complexity of symbolic construction of community, a subject on which the anthropologist Anthony Cohen has concentrated over a number of years of study and thought (see *Cohen 1985* for a succinct account). Epi-palaeolithic, and even more so early Neolithic, co-resident communities (I hesitate to call them villages) extended beyond kin-groups and beyond the scale for which the biologically evolved human brain were capable of managing the exponentially complex social relations (*Watkins in press (b)*). At a higher level, co-resident communities participated in active networks of similar communities, or some kind of interaction sphere (*Watkins in press (a)*) seeks to take up and modify Renfrew's idea of the peer polity interaction sphere – *Renfrew 1986*). In this kind of system of multi-layered networks, we can see how individual communities exchange items through a wider network (obsidian, marine shells, attractive stone or objects made of attractive stone), and share cultural ideas and practices. However, each community may articulate those ideas and practices in their own way. There were no text-books in circulation that defined how houses should be designed or how dead bodies should be treated. General observations of widespread cultural phenomena, such as the "the PPNB culture" (which I have criticized at some length in *Watkins, in press (a)*) or "the skull cult", break down as soon as they are examined in detail, because practices are usually not precisely replicated from site to site. There are domestic architectural forms that are found from site to site across a region. For example, Brian Byrd and Ted Banning have written about the pier-house in the later aceramic Neolithic of the southern Levant (*Byrd & Banning 1988*). And in southeast Anatolia, settlements had very large and substantially built houses, constructed from mud brick on stone and mud mortar foundations (*Schirmer 1990*). At one time, the foundations may consist of a series of square cells; at another time, they consist of clo-



Göbekli Tepe. View down into structure D, the largest and earliest so far investigated. The two main monoliths remain embedded in the fill of the enclosure, but it is clear that they must be at least 5 m tall. Around the sides of the structure, T-shaped monoliths are set radially in the retaining wall. At the far side, the excavations have reached a stone "bench". Traces of the walls of earlier, larger forms of the enclosure can be seen at the far side.

sely set parallel walls. It appears that the sequence of architectural changes – from grids to sleeper walls – is replicated at different sites across the region.

Intramural burials of bodies are found at many sites among or under the houses, in a special purpose building (as at Çayönü Tepesı), or in clusters closely associated with the settlement. It was a practice that began with the first open village settlements of the Epi-palaeolithic period, but in the early Neolithic it became widespread and common. There was a parallel practice, especially in the Levant, of secondary removal of skulls, which were then curated, some with facial features modelled in clay or plaster, before being re-buried in caches. But there is a lack of systematic regularity; what has been found at one site is not quite the same as has been found at others. Across the Levant the intramural burial of certain people, and the removal and curation of skulls took place within the architecture and design of the settlement. The ceremonies and rituals and symbolism were designed to find their place within the already rich symbolism of the architecture, the burial ceremonies perhaps being played out within kin-groups, while secondary ceremonies with retrieved skulls may have involved the wider co-resident community (*Kuijt 2000a; 2000b*).

There is now good evidence that settlements and their constituent buildings were laid out in accordance with some overall design. And there is now a series of settlements of the early Neolithic period that possessed monumental, non-domestic, special-purpose, communal buildings, especially in south-east Anatolia and the north of the Syrian Euphrates valley (see *Watkins 2004a* or *2005* for a fuller discussion with extensive references). The first to be recognized was at a salvage archaeology site, Nevalı Çori, close to the Euphrates (*Hauptmann 1988; 1999*). In the centre of a quite small village of houses very similar to those of contemporary Çayönü Tepesı (*Özdoğan 1999*) there was a sub-rectangular, sub-terranean structure (*Hauptmann 1993; 1999*). It had a stone "bench" around its walls, a lime plaster floor, and, in the centre of the floor area, a pair of tall stone pillars, only one of which was preserved. Similar stone pillars were set all around the perimeter in the bench. Through their lightly carved arms, bent at the elbows, and clasped hands the pillars reveal themselves as highly schematised anthropomorphs. With hindsight, it is now clear that there was a similar, subterranean building at Çayönü, which also had a pair of tall, stone pillars. In south-east Anatolia we are beginning to see a regional interaction sphere, or cultural network, of villages that are strongly constituted as communities, but which at the same time are strong participants sharing various symbolic elements of household and community life with other communities.



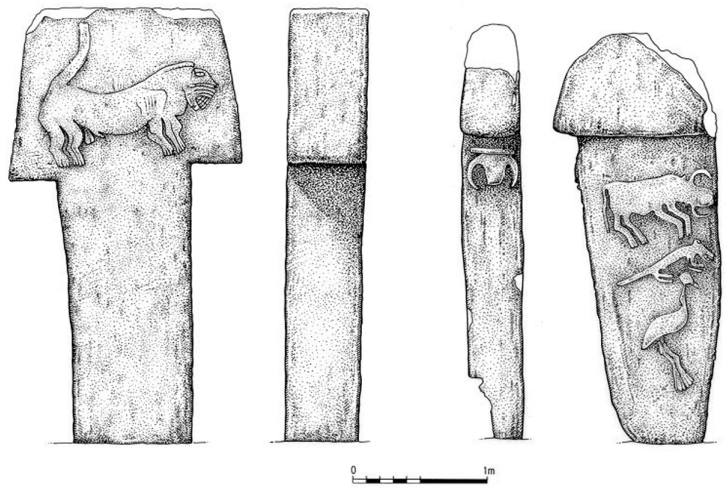
Göbekli Tepe. One of the carved T-shaped monoliths from the earliest structure so far investigated. Here one edge is viewed, showing the heads of many snakes whose bodies are interwoven like nets on the larger, flat surfaces. There is also a spider and other creatures.

Equally dramatic is the succession of communal, special purpose structures in the heart of the village at Jerf el Ahmar, on the Euphrates in north Syria, close to the border with Turkey. The settlement belongs to the earliest aceramic Neolithic period. In an open space at the centre of the community, there existed large-scale, fully subterranean buildings, which the excavator, Danielle Stordeur, calls '*communautaire*', communal or public buildings (*Stordeur et al. 2000*, and see *Watkins 2004a* or *2005* for fuller references). The first in the series was by far the largest construction in the village, and it was certainly not a house. Stordeur believes that it was a communal

food storage facility that also accommodated ritual activities. At the end of its life, it was emptied, its roof was removed, a human head was placed in an empty post-socket, and a decapitated body was placed face down in the central area. Finally, the structure was destroyed by fire, and the void that it left was obliterated. The village shifted its topographic focus, and that first structure was succeeded by a second large, circular, subterranean building. This one had a bench all around its interior, and the bench had a decorated stone kerb in which the horizontal stones were articulated with large juniper posts, sheathed with elaborate plaster cylinders, supporting the roof.

Even more remarkable is the site of Göbekli Tepe, near Urfa in southeast Turkey (*Schmidt 2000; 2002; 2005* and see *Watkins 2004a; 2004b* for fuller references). It is a man-made mound of cultural debris mixed with stones and earth, constructed over many centuries on top of a bare limestone ridge. Large circular or sub-rectangular structures were built in cavities excavated in the mound. Each structure contained an axial pair of huge limestone pillars, exactly like those at Nevalı Çori. The largest structure so far investigated has the tallest pillars, which are at least 5 m tall. Around the perimeter of each structure is a stone-built "bench", and more pillars are set at right angles into the bench. Some of the pillars, like those at Nevalı Çori, have details that make clear that they are anthropomorphic. On their surfaces there are carvings in raised relief of a range of mammals, birds, reptiles, scorpions. Because of the lack of normal domestic settlement at the site or in its immediate vicinity, and because of the common features in the iconography at Göbekli Tepe and a number of other contemporary settlements, Schmidt has begun to discuss the idea that Göbekli Tepe was a ceremonial "central place" for communities living over a very wide area, an idea quite similar in general terms to that of Colin Renfrew in relation to the great Neolithic ceremonial structures of southern England (*Renfrew 1973*).

What we are seeing in all sorts of forms, but particularly in the form of the architecture of buildings and the design of settlements, is external symbolic storage. Like language, it is a complex system of symbolic representation, but in material form. As remarked earlier, Donald originally defined the full emergence of external symbolic storage, the third and latest stage in the evolution of the human mind and culture, as being achieved with the development of alphabetic writing in the hands of the Greeks of the eighth and seventh centuries BC (*Donald 1991*). If he thought that the adoption of alphabetic writing in Greek constituted a significant point in the evolution of culture and cognition, it is not clear why other and earlier alphabetic writers (the Phrygians, the Phoenicians, or those who used alphabetic cuneiform at Ugarit, or other Semitic speakers using alphabets ancestral to the Phoenician in the second half of the second millennium BC) are passed over. For that matter, it is not at all clear what users of alphabetic scripts could write that those using hieroglyphic or hieratic scripts in Egypt, or the many peoples who used the cuneiform writing system developed in Mesopotamia, could not. The answer probably lies in what uses Greek writers soon began to find for their new writing system. But that is beside the point, for the real issue is whether non-language based systems of symbolic representation can be classed as external symbolic storage in Donald's definition of the term.



Göbekli Tepe. Two of the monoliths. The stone on the left stood in a rectangular enclosure, the latest so far investigated.

At a conference held in Cambridge, where Merlin Donald's ideas on the evolution of culture and cognition were tried and tested by invited archaeologists, Donald opened with a succinct account of the theme of his book (*Donald 1998a*). In his contribution Colin Renfrew proposed that Donald's third stage involving external symbolic storage was achieved in terms of systems of symbolic representation involving material culture among the early farmers of the Neolithic, some millennia before the earliest known effective writing systems (*Renfrew 1998*). At the end of the conference Donald responded to

what he had heard, and significantly modified his view on external symbolic storage in the light of Renfrew's contribution (*Donald 1998b*). Renfrew has developed his ideas about 'materiality' and 'the engagement of mind with the material world' (for example, *Renfrew 2005*). My own recent work has been concerned with the symbolising role of architecture in providing an arena for rich and complex multi-mode symbolic representation in communities of the early Neolithic in southwest Asia (*Watkins 2004a; 2004b; 2006*). Our modern academic preoccupation with books, journals, publications, and text should not blind us to the enormous significance of (non-verbal, non-literate) visuo-symbolic representation. In recent years, anthropologists, philosophers, social theorists, semiologists, and, of course, architects have all written enthusiastically about the capacity of architecture in particular to embody ideas, and to inspire, suggest and constrain human behaviour. It is easy to add to the cursory survey of the widespread recognition of the importance of architecture as symbolic representation in Watkins 2004a. For example, the distinguished architect Renzo Piano, in a recent interview in *The Guardian* newspaper (21 November 2005), said, "*Architecture in some way has the duty to suggest behaviour. Places are the portraits of communities...*" For those who wish to see how many twentieth-century philosophers, cultural theorists and semiologists have written about the cognitive importance of architecture, Neil Leach has collected pieces by twenty-three (*Leach 1997*).

Building the Neolithic synthesis

In the preceding sections I have argued that in the Epi-palaeolithic period the adoption of sedentary life in permanently co-resident communities coincided with and depended upon the development of a human cognitive and cultural facility with material systems of symbolic representation. For the first time in human history there emerged communities that were conspicuously larger than the biological human brain could cope with. Their size and stability depended on their ability to construct and maintain a variety of entirely novel, abstract concepts, and to concretize these in terms of the structure and architecture of their settlements. These communities were the first to realize the potential of the built environment to act as a complex system of material representation of symbolic information. Unlike books on the library shelf, the built environment is not a work of reference, but a world that we inhabit. It provides arenas for the rich symbolic representation of community in all sorts of cultural modes. People had learned to create 'theatres of memory', cultural means of proclaiming continuity and memorialising the past that had formed them.

Domestication had proceeded in other ways than that referred to by Peter Wilson (*1988*). I am sure that the major innovations to which Christian Jeunesse draws attention in his contribution to this volume, all consisting of the transformation of materials such as ceramics, lime plaster and heat-treated copper, are a part of the control and manipulation of the world in which early Neolithic communities delighted to explore and live. As Jeunesse says, these were further means of demonstrating control in a "technical system of domestication". And, as Hodder (*1990*) seems to intend, plant cultivation in fields and animal husbandry were further extensions of domestication, the bringing of elements (food plants and animals) of the natural world within the orbit and control of the *domus*. An expert survey of the most recent evidence (*Nesbitt 2002*) indicates that plant cultivation and intensive harvesting, leading to the recognizable domestication of several cereal species and a suite of pulses was practised in central parts of the hilly flanks of the Fertile Crescent by about 8500 BC (at the transition from the early aceramic Neolithic to the later aceramic Neolithic). We are now learning that, at almost the same time, animal husbandry was producing morphological signs of domestication in sheep, goat and cattle (*Helmer et al. 2005*). In short, the classic mixed farming economy, based on a suite of cereals and pulses and at least three ruminants, whether in response to some external pressure or as part of the assumption of control and management of their world, came into being in short order, and was embraced throughout the hilly flanks zone and beyond, into central Anatolia, in the following centuries. The combination of fully symbolic culture, permanent, large, sedentary communities, networking maintaining complex, multi-layered communities at different levels and scales, the control and transformation of natural materials, and the mixed farming economy were the foundations of a way of life that we can recognize as so like our own that we can call it 'modern'.

The spread of the full Neolithic

The term Neolithic has become problematic. It was associated with the appearance of people who lived in village-communities dependent on a farming economy. But in the Levant the Neolithic was also given specific material culture markers, in particular chip-

ped stone traditions that were different from those of the previous Epi-palaeolithic period. As we have seen here, the various components of society, economy, technology and culture that characterize the later aceramic Neolithic appeared at different times. And it deserves to be mentioned that the timing of the various components remains contentious. For our purposes, 'the full Neolithic' is the whole package that comes together in the later aceramic Neolithic period. After a relatively slow start over the several millennia of the Epi-palaeolithic period, when larger, sedentary hunter-harvester communities came into existence, the revolution in symbolic culture, the growth in co-resident community size, and the adoption of a number of transformative technologies, including the domestication of plants and animals, gathered pace in the early Neolithic period. The climax in the Levant is what is called the MPPNB (Middle PPNB) phase, about 8500–7600 BC. By that time, there was a human population that had colonised the island of Cyprus (*Peltenburg & Wasse 2004; Swiny 2001*), and they had introduced from the mainland the full suite of cultivated cereals and pulses, and sheep, goat, cattle, pig and fallow deer. These are the first signs of the expansive capacity of the Neolithic.

In the final phase of the later aceramic Neolithic, between 7600 and 6900 BC, there began a major cultural and settlement dislocation that took different forms in different regions within southwest Asia. In the eastern part of the arc of the hilly flanks zone, settlement continued in the intermontane valleys of the Zagros, between Iraq and Iran, but remained on a relatively small scale. In the piedmont of eastern Iraq, and particularly on the alluvium in southwest Iran, the few early agricultural villages spawned a greater and greater number of settlements through the ceramic Neolithic and on through the Chalcolithic and Bronze Ages. The alluvium of southwest Iran has been fairly intensively surveyed, and Hole and Flannery chart the expansion of settlement in the Deh Luran plain, starting from the unique small village of Ali Kosh (*Hole & Flannery 1968; Hole, Flannery & Neely 1969*). Aceramic Neolithic settlements in the northeast segment of the arc of the hilly flanks zone (N Iraq) were confined to the hill country of the Jebel Sinjar (e.g. Qermez Dere or Maghzaliyeh – *Watkins 1992*) or the piedmont (e.g. M'lefaat – *Kozłowski 1998*). From the beginning of the ceramic Neolithic, however, farming villages sprang up in great numbers across the rain-fed plains of the Jezirah, between the Euphrates in north Syria and the Tigris in north Iraq.

The process in the north Levant is unclear, beyond stating the obvious – the aceramic Neolithic settlements in the Euphrates valley in north Syria were abandoned, and their immediate successors have not yet been identified. At least we can be reasonably sure that people moved away from the valley, because the accidents of salvage archaeology that located the aceramic Neolithic sites did not produce ceramic Neolithic settlements. In the southern Levant, the classic PPNB settlements of the Mediterranean woodland zone of inner Israel, the west bank and Jordan valley, and its southern extension beyond the Dead Sea into the Wadi Arabah, all failed during the late phase of the PPNB period. For a while, in that late PPNB phase and for a couple of centuries beyond, there was what has been labelled the 'megasite' phenomenon (*Bienert, Gebel & Neef 2004*). Certain settlements in highland Jordan (the best documented is 'Ain Ghazal) saw rapid expansion to 10 or even 15 hectares of dense domestic occupation. Rollefson has argued that the rate of expansion was too fast to be accounted for by natural population growth, and he therefore inferred inward migration from abandoned settlements in the Jordan valley and further west (*Rollefson 1989; 1997; 2004*). At the end of the late PPNB period and beyond, there was a trend towards small settlements, with quite ephemeral archaeological signatures, in the margins of the semi-arid interior. At the same time, the 'megasites' imploded and were abandoned, or, as at 'Ain Ghazal, continued only as a very small settlement of a quite different character. These new settlements are interpreted as small communities dependent more on herding than on cultivation, where a part of the population remained resident, while another part spent part of the year as nomads, pasturing large flocks of goats and sheep over extensive ranges.

The picture in Anatolia (other than southeast Turkey, which is part of the central arc of the hilly flanks zone) is still unclear due to a lack of information across such a wide and environmentally varied region. In central Anatolia, there is the beginning of a cultural sequence covering the later aceramic Neolithic, pivoting about the famous site of Çatalhöyük in the early ceramic Neolithic, and continuing on into the Chalcolithic. But there is a gap, both geographically and culturally, between the Konya plain and Cappadocian sequence and the next known sites to the southeast. Some have tried to claim the central Anatolian Neolithic as part of the expansion of the Levantine PPNB culture (*e.g. Bar-Yosef & Meadow 1995 or Cauvin 1994*, though somewhat modified in *Cauvin 2000*), but it is a case that does not stand

up to scrutiny. It is at least as likely that there was a parallel cultural tradition in central Anatolia that came more and more within the orbit of an intensely active Levantine and southeast Turkish interaction sphere as time progressed. The extent to which local domestication took place, or domesticated plants or animals were introduced from the Euphrates zone in southeast Turkey or north Syria remains unclear at present. The same problems beset the relationship between central and western Anatolia. There is no case for supposing that there was a spread of people practising farming from central to western Anatolia, since cultural traditions seem to be quite strongly regional. The Neolithic package of village-sized communities, with shared systems of symbolic representation, shared transformative technologies, and established mixed farming seems to spring into existence fully formed, only shortly after a different-looking cultural package had been put together in central Anatolia.

In conclusion, there is evidence from various parts of southwest Asia of the spread of pastoralist/part-time farmers, or the rapid expansion of village societies across lands that were suited to mixed farming. But, if Anatolia is considered as the land-bridge between the heartlands of the southwest Asian early Neolithic and the Aegean islands, Greece and the Balkans, there is no plausible evidence of either demic expansion or cultural diffusion into central Anatolia, or from there to its western shores. The spread of the Neolithic to western Anatolia and into southeast Europe has a time-dimension in relation to the assemblage of the Neolithic package in the heartland of southwest Asia, but the mechanisms and processes involved in that apparent spread are likely to be quite complex. It seems possible that people in early Holocene communities (I am seeking a term that avoids the Mesolithic-Neolithic divide) were rapidly evolving the same cognitive and cultural facility with fully symbolic material culture that their neighbours in the heartland of southwest Asia had developed only a few centuries earlier. In some parts of southwest Asia, particularly in Anatolia, it is going to be difficult to disentangle exactly which elements of the Neolithic package were home-made, which were acquired by cultural borrowing and emulation, and which may have been carried by demic expansion. As far as the (Indo-European) language-and-farming hypothesis, or the 'wave of advance' model of demic diffusion are concerned, the lack of a simple, homogeneous pattern of spread from the Levant across Anatolia towards southeast Europe gives them a poor starting-point.

Concluding discussion

The main purpose of this contribution was to see if it was possible to bring together into a single account two components of the Neolithic that have tended to be viewed as exclusive of each other. The classic component of the beginning of the Neolithic has long been thought to be the adoption of mixed farming, and a large body of research over half a century has been devoted to identifying the domestication of plants and animals. In recent years, a very different approach has been proposed by archaeologists who argue for the Neolithic as a '*révolution des symboles*', or a cognitive-cultural phenomenon involving the *domus*.

I have argued that the trend towards sedentary village-communities and the trend towards dependence on stored plant food resources in the Epi-palaeolithic are two sides of a single coin. While these new strategies of settlement and subsistence may have been very well suited to the ameliorating environmental conditions after the Last Glacial Maximum, I made a point of showing that the trend had begun at the transition from the Upper Palaeolithic to the Epi-palaeolithic in the Levant. Thus, environmental opportunity cannot have been the driver of the trend. Rather, I have suggested that we should view the remarkable changes that mark the Epi-palaeolithic period as evidence of the way in which the cultural environment was becoming the ecological arena within which human cognitive evolution was developing.

Throughout hominid evolution, the predecessors of *Homo sapiens* had tended towards larger social group size and greater social coherence and inter-dependence as adaptations to their biological environment. Once *Homo sapiens* had begun to master the cultural use of systems of symbolic representation (starting with language), they had the potential to construct and articulate the abstract concepts essential to the formation and maintenance of larger, more permanent and richer communities. In sedentism, they found a fortunate conjunction between the symbolic construction of communities, and architecture and the built environment as the means to concretize their novel concepts. Sooner or later, as permanently co-resident communities grew in size and density in the landscape, for any of a variety of reasons, a greater investment of labour and intensification of food production became necessary.

The growth in size of aceramic Neolithic communities contradicts the ergonomic view of the most ef-

ficient and economic use of labour when set against the resources gained. If ergonomics and efficiency were setting the parameters of co-resident community size, we would not find settlements of several hectares, representing populations counted in thousands. Rather, we would find small clusters of houses representing communities of minimal size scattered across the landscape. There were large settlements even before intensive cultivation and animal herding were adopted. But towards the end of the aceramic Neolithic, the very large settlements emphasise that it was the rich and intensive cultural environment that constituted their raison d'être and the engine of their further growth. Efforts to define some kind of settlement hierarchy have failed, and attempts to identify any kind of social hierarchy within settlements have remained at a purely hypothetical level.

Finally, the end of small-group, hunter-gatherer mobility required a replacement for the social role of seasonal congregations and the occasional exchange of members and information; no small community is an island, whether it is a hunter-gatherer band of 25 or a sedentary community of 250. The formation of peer community interaction spheres allowed communities of whatever size to create higher-level communities. Within southwest Asia the developed aceramic Neolithic landscape consists of autonomous communities, the larger of which presumably had forms of internal social organization that were segmentary and non-hierarchical. And these communities participated in wide-ranging networks of cultural, social and economic interaction in which the non-competitive emulation of symbolic practices and symbolic entrainment tended to promote the intensification of exchange and convergence in systems of symbolic reference (*cf. Renfrew 1986*, and see *Watkins in press (a)*).

In the last section of this paper, something of the complexity of the processes involved in the spread of the Neolithic package within southwest Asia was outlined. There is no room for a simple hypothesis of demic diffusion from the heartland of southwest Asia across Anatolia towards southeast Europe. Rather, it appears that indigenous communities with their own regional cultural traditions acquired the various elements of the Neolithic package partly on their own initiative and partly through their becoming increasingly engaged with already existing and very attractive peer community interaction spheres.

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The spread of farming in the Eastern Adriatic

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ABSTRACT – *The beginning of farming in the Adriatic is a topic ripe for a new discussion and synthesis. Several lines of evidence suggest that immigration played a major role in the process. It involved, however, both the actual movement of people and the active participation of the local population, and probably unfolded somewhat differently in different parts of the region. There is provocative evidence that the transition to farming occurred in a two-stage process. There was an initial stage of very rapid dispersal, perhaps by exploratory parties along the coast in the southern Adriatic. During the second stage, the eastern Adriatic littoral was probably colonized by farming communities, while the hinterland remained an agricultural frontier zone.*

IZVLEČEK – *Začetek poljedelstva na področju Jadrana je tema, ki omogoča diskusije in nove sinteze. Predstavljamo dokaze, da je glavno vlogo pri procesu igralo priseljevanje. V regiji se je proces odvijal različno, vključeval je tako selitve ljudi, kot tudi aktivno udeležbo lokalnega prebivalstva. Dokazujemo, da se je prehod h kmetovanju odvijal v dvostopenjskem procesu. V prvi stopnji je prišlo do hitre razpršitve, morda izvidnikov, vzdolž obale južnega Jadrana. V drugi stopnji so skupine kmetovalcev verjetno kolonizirale obalne predele vzhodnega Jadrana, medtem ko je zaledje ostalo mejno področje kmetovanja.*

KEY WORDS – *Neolithic; farming; Croatia; Adriatic; colonization*

Introduction

Recent years have witnessed major advances in our understanding of the spread of farming in Europe, through the refinement of theoretical models (*e.g. Price 2000; Thomas 1999; Whittle 1996; 2003*), through the integration and comparison of archaeological, linguistic, and genetic evidence (*e.g. Bellwood & Renfrew 2002; Ammerman & Biagi 2003*), and through the characterisation of human diets and population movements by studying stable isotopes in human bones (*e.g. Milner et al. 2004; Richards et al. 2003; Price et al. 2002*). The eastern Adriatic coast lies along a major route into Central Europe from the southeast, but our state of knowledge about the spread of farming in the region remains relatively undeveloped. Maps offering sophisticated models for the spread of farming into Europe can leave the eastern Adriatic region blank (*Barker 1985.Fig. 21; Renfrew 1987; Tringham 2000.Fig. 2.1; Whittle 1996.Fig. 8.2; Zvelebil & Lillie 2000.Fig. 3.1*) or merge it with one of the neighbouring regions (*e.g. Zvelebil & Lillie 2000.Fig. 3.4*). In this brief paper we hope to put the eastern Adriatic region 'on the map' through a summarized review of the available evidence and the presentation of a new model of the spread of farming in the region (Fig. 1).

Models for the transition to farming

The transition to farming in Europe has been explained by a wide variety of models, ranging from a com-

pletely autochthonous process where local foragers turn to farming, to a completely exogenous process where foreign farmers migrate into Europe and replace the indigenous population (*Barker 1985; Perlès 2001; Price 2000*). Claims for a completely independent domestication of plants and animals in Early Neolithic Europe have been thoroughly refuted on genetic (*Jones 2002.94, 107, 130*), morphological (*Rowley-Conwy 1995; Zohary 1996.143–144*) and taphonomic grounds (*Zilhão 1993*), while models that rely primarily on migrating farmers (*e.g. Ammerman & Cavalli-Sforza 1973; 1984*) are now thought to underestimate the contribution of Mesolithic foragers to the process, whether considered in terms of the modern-day gene pool (*e.g. Richards et al. 1996; Richards et al. 2002; Jones 2002.160–161*) or the indigenous adoption and transmission of parts of the 'Neolithic package' (*e.g. Price 2000; Tringham 2000; Zilhão 2000; Zvelebil 1986; 2002*). The Mesolithic-Neolithic transition can no longer be considered in terms of a simple dichotomy between indigenous adoption and foreign migration.

The major early domesticates were introduced into Europe at the start of the Neolithic. Since the crops could not have spread naturally into Europe, and domestic animals are very unlikely to have done so, we must consider at least some form of population transfer. Zvelebil and Lillie (*2000.62*) have recently listed six different forms of population transfer that may have been important in the transition to agriculture in Europe. We use these processes to frame our discussion of the transition to farming in the Eastern Adriatic; their definition and archaeological signatures are listed in Table 1.

Much of the Adriatic literature still tends to see population change – that is, migration – lurking behind every major change in pottery style, let alone the introduction of the earliest pottery (*e.g. Benac 1979–1987; Dimitrijević et al. 1998*). The migrationist view is echoed in syntheses by Chapman et al. (*1996.259*) and Biagi & Starnini (*1999*), who note the rarity of Late Mesolithic occupation in the region and an abrupt shift from wild to domestic animals at the Mesolithic-Neolithic transition. Others have undermined the unity of the 'Neolithic package' in the region, arguing that there is no necessary association between the appearance of ceramics and domestic plants and animals (*Tringham 1971; Trump 1980*). Tringham (*1971*) makes the strongest case for continuity of economic practices and lithic use from Late Mesolithic to Impressed Ware, citing evidence of wild fauna associated with impressed ceramics. More recently, Budja has proposed a model of 'Neolithisation' in the region that acknowledges the acceptance by the autochthonous population of a limited number of innovations, while rejecting any form of migration (*Budja 1993.177; 1996.69; 1999*).

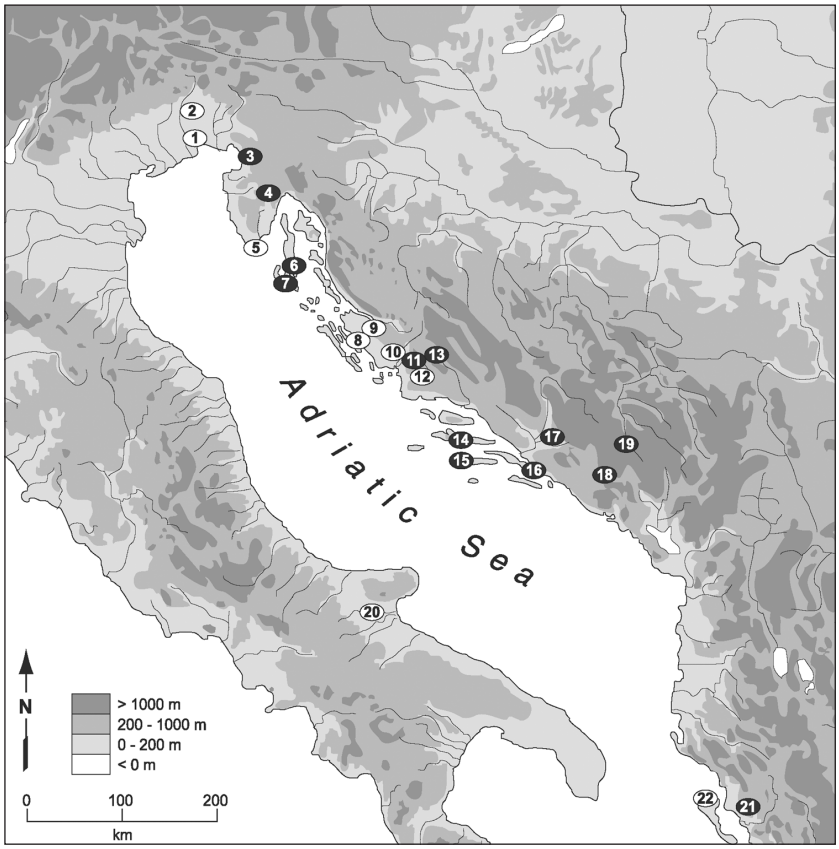


Fig. 1. Some of the sites discussed in the text. Black number on white: open-air sites; white number on black: cave sites. 1. Piancada 2. Sammardenchia 3. Selected caves of the Triestine Karst (Edera, Mitreo, Benussi, Ciclami, Vlaška) 4. Pupićina 5. Vižula 6. Jami na Sredi 7. Vela spilja (Lošinj) 8. Tinj 9. Smilčić 10. Pokrovnik 11. Škarin Samograd 12. Danilo 13. Gospodska 14. Grapčeva 15. Vela Spila (Korčula) 16. Gudnja 17. Zelena pećina 18. Crvena Stijena 19. Odmut 20. Selected open-air sites of the Tavoliere (Masseria Giufredda, Scramella San Vito, Ripa Tetta, Coppa Nevigata, Lagnano da Piede, Villa Comunale, Masseria Candelaro, Masseria Santa Tecchia, Masseria Fontanella Ulivetto) 21. Konispol 22. Sidari.

Process	Description	Archaeological expectations
Demic diffusion	Demographic expansion of farming population leads to daughter groups budding off and colonizing new areas. Migration not directional; slow rate of migration.	Full Neolithic package moves; abrupt change; slow spread (1 km/year)
Folk migration	Directional movement of population from old area to new. Not necessarily driven by demographic expansion. Similar to leapfrog colonization.	Full Neolithic package moves; abrupt change; rapid spread
Elite dominance	Penetration of area by numerical minority who subsequently seize control and impose culture/language on indigenous majority.	Piecemeal adoption of Neolithic package by socially central individuals, perhaps through feasting; gradual change
Infiltration	Gradual penetration of new area by small groups/individuals who are subordinate or perform specialist tasks for majority.	Piecemeal adoption of Neolithic package by socially peripheral individuals.
Leapfrog colonization	Selective colonization of areas only marginally exploited by indigenous foragers, creating enclave settlements from which further dispersal of farming proceeds. Often movement by seafaring.	Full Neolithic package moves; new settlements separate from Mesolithic; little interaction with indigenous people; abrput change; rapid spread
Individual frontier mobility	Individuals or small groups linked in social/economic exchanges between forager and farming communities. Direction and pace of change depends on existing social frameworks and communication routes and/or those established between forager and farming communities.	Piecemeal adoption of Neolithic package; innovations adopted within existing Mesolithic settlements; much interaction between indigenous and colonizing peoples

Tab. 1. Expectations of different models of the Neolithization Process. Descriptions and expectations based on Barnett (*2000*); Zvelebil and Lillie (*2000*).

Zvelebil and Lillie (*2000.68–71*) have recently suggested that 'Neolithisation' in Dalmatia involved the introduction of pottery into local forager communities during an 'availability phase' along the agricultural frontier. Similar models have been proposed by others, although each puts a different degree of emphasis on population movement and local adoption (*Barfield 1972.204; Skeates 2000.171–172; Zvelebil 2001.2–6*). Zvelebil's 'integrationist' model remains the most elaborate, taking into account social contexts of exchange (subsistence and otherwise) and intermarriage, and their effects on the movement of populations across agricultural frontiers. Before developing a new model for the 'Neolithisation' process in the eastern Adriatic, we summarize evidence about the pattern of change in the region.

Farming and pottery in the eastern Adriatic

The recognition of prehistoric farming sites in the eastern Adriatic region traditionally relies on the presence of pottery (*e.g. Bagolini & von Eles 1978. 46; Batović 1979; Chapman & Müller 1990.128, 132; Müller 1994; Skeates 2000.171; Sordinas 1969. 407*), although such a simplified approach overlooks the possibility of hunter-gatherer groups obtaining pottery through exchange or adoption (*Budja 2001. 40, 41*). Over a decade ago, Chapman and Müller (*1990.132*) concluded that in Dalmatia, an integrated Neolithic 'package' consisting of four critical innovations – domesticated plants and animals, ceramics, and polished stone – was identifiable only at lowland open air sites. However, a reduced version of the Neolithic 'package' – domesticated animals, pottery and prismatic blade technology – is well attested at a much larger number of sites, many of which are caves, throughout the eastern Adriatic region. By contrast, convincing evidence of domesticated animals or pottery in Mesolithic contexts is extremely rare. It follows that, although far from perfect, pottery is still the most useful 'proxy measure' for exploring the spatial and temporal spread of farming in the eastern Adriatic.

Recent work in caves shows some variety in the type of contact. The appearance of pottery may be associated with assemblages dominated by wild taxa (Crvena Stijena, Odmut, Zelena pećina, Mala Triglavca); in other caves there is a fairly even representation of wild and domestic taxa (Edera, Konispol, Azzura, Zingari), while domestic animals dominate the assemblages in a third group of caves (Pupićina, Mitreo, Podmol, Vela spila, Spila Nakovana; for references and detailed discussion, see *Forenbaher & Miracle 2006; Miracle & Pugsley 2006*). Seeds of domesticated plants have not been reported from any of the recently excavated caves where the use of flotation to recover plant remains was standard prac-

tice. This holds true not only for Early Neolithic levels of those sites, but also for all later periods, when the cultivation of domesticated plants is not in doubt. Caves are rarely located near major tracts of arable land, but are often conveniently positioned for herders – either at, or on the way to, seasonal pastures. Such a contrast between open-air and cave sites has important implications for the process of 'Neolithisation' in the region.

The Mesolithic/Neolithic 'gap'

A number of well-documented and dated northern Mediterranean sequences show a hiatus between the Mesolithic and Neolithic occupations of at least several centuries, if not several millennia (*Biagi and Spataro 2000.48; Pluciennik 1997*). The timing and duration of this Mesolithic-Neolithic gap is not synchronous, but varies widely from site to site. To examine this pattern in greater detail, we briefly discuss sequences from six sites in the Eastern Adriatic (Fig. 2, Tab. 2).

In the Triestine Karst and Istria, the age difference between the youngest Mesolithic and oldest Neolithic dates at Pupićina Cave, Edera, and Ciclami is from 1100 to 1800 years. The similarity in timing and duration of the stratigraphic gaps is striking, at first glance suggesting that caves were not being visited by Late Mesolithic bands in this area, because of a change in settlement pattern, depopulation, or both. Other evidence, however, argues against a simple demographic explanation. Nine sites from the Triestine Karst are reported to contain evidence of Late Mesolithic occupation (*Montagnari Kokelj 1993.74*). Furthermore, at Benussi, there is a sequence of three radiocarbon dates associated with Late Mesolithic assemblages (*Montagnari Kokelj 1993.70*), the youngest of which overlaps the oldest Neolithic dates from Edera and Pupićina at 2 s.d. Late Mesolithic people were clearly in the region immediately prior to the first appearance of Neolithic pottery.

In the south, only three sites have dated Late Mesolithic and Early Neolithic components. Taken at face value, dates from Odmut Cave (*Marković 1985; Srejović 1974*) show a continuity of occupation from the latest Mesolithic to the earliest Neolithic. There are, however, problems with both the dates and the stratigraphy of Odmut (*Forenbaher & Miracle 2006*), and there may, in fact, be a gap between those layers with pottery and those without pottery of at least 300 years. At Konispol Cave, the dates suggest a gap of some 130 years between the latest Mesolithic and earliest Neolithic dates (*Harrold et al. 1999*), but the stratigraphy and fauna fill this gap (*Russell 1998; Schuldenrein 1998*). The open air site of Sidari provides provocative evidence of an in situ adoption of ceramics by indigenous Mesolithic people (*Perlès 2001*). There is no stratigraphic break between the latest Mesolithic and the earliest Neolithic horizon, and the latter contains abundant plain ceramics, stone tools made using a 'Mesolithic' technology, and some sheep/goat. There is, however, a significant sterile layer between this 'earliest Neolithic' and 'Early Neolithic' (Impressed Ware) occupation of the site (*Sordinas 1969*).

To summarize, three of six sites with dated sequences (Ciclami, Pupićina, and Odmut) show a stratigraphic break and temporal gap between the Mesolithic and Neolithic. At Edera there is a temporal gap of about 1100 years, but not a stratigraphic break. The two sites (Konispol and Sidari) with dated stratigraphic evidence of continuity come from the southern

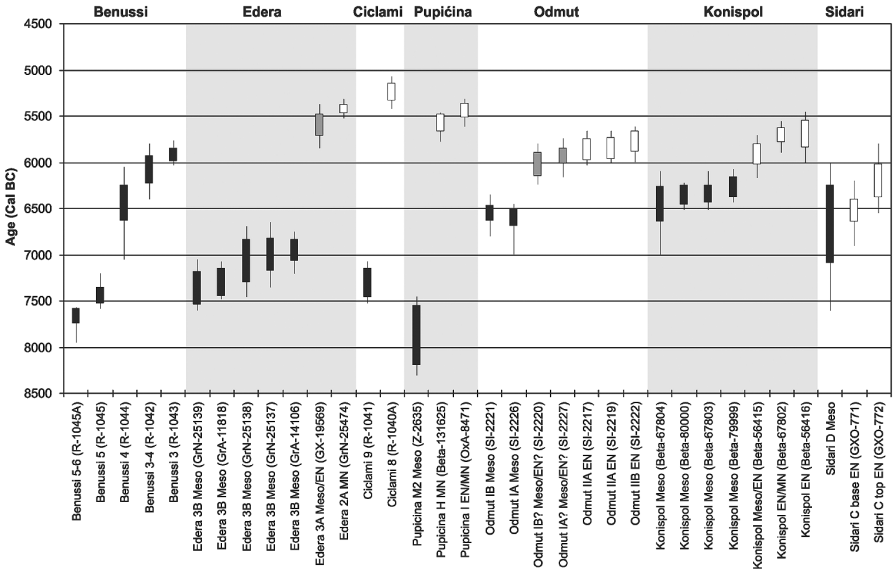


Fig. 2. Calibrated radiocarbon dates from sites with Late Mesolithic (Benussi) or Mesolithic and Neolithic assemblages in the Triestine Karst, Istria, Montenegro, Albania, and Corfu. Black symbols: Mesolithic; grey symbols: uncertain association; white symbols: Neolithic pottery.

Site and context	Lab no.	bp	s.d.	Cal BC 1 s.d. range		Cal BC 2 s.d. range		Attribution	Ref.
Benussi 5–6	R–1045A	8650	70	7750	7580	7950	7570	Mesolithic	1
Benussi 5	R–1045	8380	60	7540	7350	7580	7200	Mesolithic	1
Benussi 4	R–1044	7620	150	6640	6250	7050	6050	Mesolithic	1
Benussi 3–4	R–1042	7230	140	6240	5920	6400	5800	Mesolithic	1
Benussi 3	R–1043	7050	60	5990	5840	6030	5770	Mesolithic	1
Edera 3B	GrN–25139	8350	120	7550	7180	7600	7050	Mesolithic	2
Edera 3B	GrA–11818	8250	50	7450	7140	7480	7080	Mesolithic	2
Edera 3B	GrN–25138	8110	90	7310	6830	7450	6700	Mesolithic	2
Edera 3B	GrN–25137	8060	70	7180	6820	7350	6650	Mesolithic	2
Edera 3B	GrA–14106	8045	40	7080	6830	7200	6750	Mesolithic	2
Ciclami 9	R–1041	8260	60	7460	7140	7520	7080	Mesolithic	3
Pupićina M3	z–2635	8710	170	8200	7550	8300	7450	Mesolithic	4
Odmut IB	SI–2221	7720	85	6640	6460	6800	6350	Mesolithic	5
Odmut IA	SI–2226	7790	70	6690	6500	7000	6450	Mesolithic	5
Odmut IB	SI–2220	7150	100	6160	5890	6230	5800	Mesolithic?	5
Odmut IA	SI–2227	7080	85	6020	5840	6160	5740	Mesolithic?	5
Konispol	Beta–67804	7630	140	6650	6260	7000	6100	Mesolithic	6
Konispol	Beta–80000	7550	80	6470	6250	6510	6220	Mesolithic	6
Konispol	Beta–67803	7510	90	6440	6250	6510	6100	Mesolithic	6
Konispol	Beta–79999	7410	80	6390	6160	6430	6080	Mesolithic	6
Sidari D		7770	340	7100	6250	7600	6000	Mesolithic	7

References: 1. *Montagnari Kokelj 1993*; 2. *Biagi & Spataro 2000*; 3. *Biagi & Voytek 1994*; 4. *Miracle 2001*; 5. *Srejović* 1974; 6. *Harrold et al. 1999*; 7. *Sordinas 1969*.

Tab. 2. Radiocarbon dates associated with Mesolithic assemblages from the Triestine Karst, Istria, Montenegro, Albania, and Corfu.

edge of the Adriatic. How might we explain the recurrent gap in cave stratigraphies? Its time-transgressive nature, as well as the thick Late Mesolithic levels at several sites in both the northern and southern Adriatic, argue against a climatic cause of region-wide reduced sedimentation or erosion. In the Northern Adriatic the first pottery users visited caves that had long been abandoned. This abandonment more likely reflects a shift in settlement pattern (from caves to open air sites) than a decrease in population during the Late Mesolithic. In the two dated sequences from the south, in contrast, there appears to be a continuity of occupation from the Mesolithic to Neolithic; and pottery use appears to have been incorporated into a pre-existing strategy. We suspect that this geographic contrast in the continuity of occupation from the Mesolithic to Neolithic may correlate with a contrast in the processes involved in the adoption of pottery and farming in the two regions.

The introduction of pottery into the Adriatic

Since Chapman and Müller's (*1990*) discussion of the pattern of radiocarbon dates for the Eastern Adriatic Neolithic, there has been a slow but steady accumulation of radiometric dates from secure contexts (Fig. 3, Tab. 3). The basic pattern that they identified still holds; after the initial appearance of pottery on Corfu at the mouth of the Adriatic at ca. 6500 Cal BC, dates become progressively younger as one moves up the coast towards the northeast to the head of the Adriatic, where pottery makes its first appearance 1000 years later at about 5500 Cal BC.

Poorly fired, mostly plain pottery appears just south of the Straits of Otranto around 6500 BC (*Sordinas 1969. 401, 406, note 14*). It is roughly contemporaneous with, or only slightly later than, the earliest pottery found elsewhere in Greece (*Perlès 2001.94–95*). Around (or soon after) 6200 BC, a characteristic pottery style known as Impressed Ware emerges somewhere on the northern Ionian coast (possibly, on Corfu), and then spreads rapidly into the immediate hinterland (Albania), up the Adriatic to southern Dalmatia, and to southeastern Italy (*Sordinas 1969; Skeates 2000*). Over the next few centuries, Impressed Ware spreads deeper into the Adriatic, reaching northern Dalmatia by around 5900 BC,

and southern Istria by around 5750 BC. By that time it also reaches the deep hinterland of the eastern Adriatic (*Marković 1985*). On the Italian side of the Adriatic its spread is somewhat delayed, reaching Abruzzo by 5750/5650 BC and Eastern Romagna by 5300 BC (*Skeates 1994*).

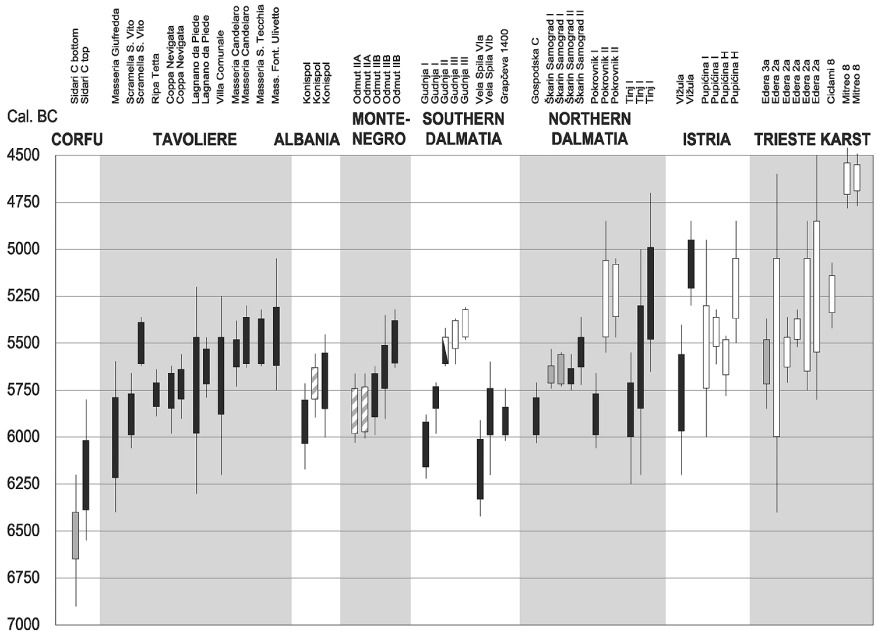


Fig. 3. Calibrated radiocarbon dates associated with Early and/or Middle Neolithic pottery from sites from Corfu, the Tavoliere, Albania, Montenegro, Dalmatia, Istria, and the Triestine Karst. Black symbols: Impressed Ware; grey symbols: plain pottery; white symbols: Danilo/Vlaška pottery; striped symbols: other Neolithic pottery.

Impressed Ware was the earliest pottery to appear almost throughout the length of the eastern Adriatic (*Batović 1979; Müller 1994*). It seems, however, that it never reached the extreme north-western part of that region – northern Istria and the Triestine Karst (*Forenbaher et al. 2004; Velušček 1997*). Some time around 5600 BC, a new style known as Danilo (or Danilo/Vlaška) emerges in the eastern Adriatic, where it soon replaces the Impressed Ware. Only at that point does Danilo-like pottery reach the interior of Istria and the Triestine Karst, and as far to the northwest as Sammardenchia in Friuli (*Pessina & Rottioli 1996. 85, Fig. 6*), where it merges with pottery styles derived from western Adriatic traditions.

Calibrated radiocarbon dates allow us to consider the rates at which the pottery was spreading (Fig. 4). It took about 1000 years for pottery technology to move from Corfu to the Triestine Karst, a straight-line distance of roughly 875 km. This gives a rate of spread of about 0.9 km/year, which is close to the 1 km/year rate of the 'wave of advance' proposed by Ammerman and Cavalli-Sforza (*1973*). If, however, these were sea-faring people, for whom there is good evidence (*Bass 1998; Forenbaher 1999*), 1 km/year seems like a fairly leisurely pace.

If, on the other hand, we consider the spread of Impressed Ware in some detail, a somewhat different pattern emerges. It took only about a century for Impressed Ware to move from Corfu to Korčula, a straight-line distance of roughly 460 km. This gives a considerably quicker rate of spread of about 4.5 km/year. Moving further to the north, it took about 300 years for Impressed Ware to move from Korčula to Istria, a the straight-line distance of roughly 300 km. The rate of spread has fallen to only 1 km/year.

Furthermore, the early dates from southern Dalmatia come from caves only, while those from northern Dalmatia and Istria come from both caves and open-air sites. From these admittedly scanty data, we suggest that the spread of the Neolithic along the eastern Adriatic was not a smooth and continuous process. There may also have been a shift in settlement from short-term visits to caves in the very earliest phase to the longer-term occupation of open-air sites in the later phase.

The processes of change

The archaeological record thus testifies to temporal and spatial variability in the cultural practices associated with the first pottery and the apparent speed with which it moved up the Adriatic, whether piecemeal or as part of a package. It suggests that several different processes were important across the Mesolithic-Neolithic transition along the eastern Adriatic.

Beginning with the southern edge of the Adriatic, Sidari and Konispol provide the most compelling evidence of the adoption of pottery and domestic animals by small groups of seasonally mobile 'Mesolithic' hunter-gatherers. The first pottery found at Sidari in Layer C base at about 6500 BC is apparently

Site and context	Lab no.	bp	s.d.	Cal BC 1 s.d. range		Cal BC 2 s.d. range		Attribution	Ref.
CORFU									
Sidari C bottom	GXO-771	7670	120	6650	6400	6900	6200	Plain ware	1,2
Sidari C top	GXO-772	7340	180	6390	6020	6550	5800	Impressed Ware	1,2
TAVOLIERE									
Masseria Giufredda	MC-2292	7125	200	6220	5790	6400	5600	Impressed Ware	3
Scramella S. Vito	R-350	7000	100	5990	5770	6060	5660	Impressed Ware	3
Scramella S. Vito	R-351	6540	65	5610	5390	5620	5360	Impressed Ware	3
Ripa Tetta	Beta-47808	6890	60	5840	5710	5890	5640	Impressed Ware	3
Coppa Nevigata	OxA-1475	6880	90	5850	5660	5980	5620	Impressed Ware	3
Coppa Nevigata	OxA-1474	6850	80	5800	5640	5900	5560	Impressed Ware	3
Lagnano da Piede	UB-2271	6790	255	5980	5470	6300	5200	Impressed Ware	3
Lagnano da Piede	UCLA-2148	6700	100	5720	5530	5790	5470	Impressed Ware	3
Villa Comunale	MC-2291	6750	220	5880	5470	6200	5250	Impressed Ware	3
Masseria Candelaro	OxA-3684	6640	95	5630	5480	5730	5380	Impressed Ware	3
Masseria Candelaro	OxA-3685	6510	95	5610	5360	5630	5300	Impressed Ware	3
Masseria S. Tecchia	BM-2414	6520	70	5610	5370	5620	5320	Impressed Ware	3
Mass. Font. Ulivetto	BM-2415	6490	150	5620	5310	5750	5050	Impressed Ware	3
ALBANIA									
Konispol	Beta-56415	7060	110	6030	5710	6170	5800	Impressed Ware	10
Konispol	Beta-67802	6830	80	5790	5560	5890	5630	Early/Middle Neolithic	10
Konispol	Beta-56416	6800	140	5840	5450	6000	5550	Impressed Ware	10
MONTENEGRO (SOUTHERN HINTERLAND)									
Odmut IIA	SI-2217	6985	100	5980	5660	6030	5740	Starčevo	9
Odmut IIA	SI-2219	6955	100	5970	5660	6010	5730	Starčevo	9
Odmut IIB	SI-2222	6900	100	5890	5620	5990	5660	Impressed Ware	9
Odmut IIB	z-412	6740	130	5740	5510	5900	5350	Impressed Ware	9
Odmut IIB	SI-2223	6530	80	5610	5380	5630	5320	Impressed Ware	9
SOUTHERN DALMATIA									
Gudnja I	GrN-10315	7170	70	6160	5920	6220	5880	Impressed Ware	4
Gudnja I	GrN-10314	6935	50	5850	5730	5980	5710	Impressed Ware	4
Gudnja II	GrN-10311	6560	40	5610	5470	5620	5420	Impressed Ware–Danilo	4
Gudnja III	GrN-10313	6520	40	5530	5380	5610	5370	Danilo	4
Gudnja III	GrN-10312	6415	40	5470	5320	5480	5310	Danilo	4
Vela Spila VI bottom	z-1967	7300	120	6330	6010	6420	5910	Impressed Ware	5
Vela Spila VI middle	z-1968	7000	120	5990	5740	6200	5600	Impressed Ware	5
Grapčeva 1400	Beta-103488	7030	60	5990	5840	6020	5740	Impressed Ware	6
NORTHERN DALMATIA									
Gospodska C	z-579	7010	90	5990	5790	6030	5710	Impressed Ware	7
Škarin Samograd I	HD-12094	6750	60	5715	5620	5740	5530	Plain ware	7
Škarin Samograd I	HD-11773	6740	50	5720	5560	5730	5550	Plain ware	7
Škarin Samograd II	HD-11950	6780	50	5720	5635	5750	5560	Impressed Ware	7
Škarin Samograd II	HD-11952	6600	100	5630	5470	5720	5360	Impressed Ware	7
Pokrovnik I	?	7000	100	5990	5770	6060	5660	Impressed Ware	7
Pokrovnik II	z-895	6300	150	5470	5060	5550	4850	Danilo	7
Pokrovnik II	HD-12842	6290	65	5360	5080	5470	5050	Danilo	8
Tinj I	GrN-15236	6980	160	6000	5710	6250	5550	Impressed Ware	7
Tinj I	GrN-15237	6670	260	5850	5300	6200	5000	Impressed Ware	7
Tinj I	GrN-15238	6280	210	5480	4990	5650	4700	Impressed Ware	7
ISTRIA AND THE TRIESTINE KARST									
Vižula	HD-12093	6850	180	5970	5560	6200	5400	Impressed Ware	7
Vižula	HD-11733	6140	70	5210	4950	5300	4850	Impressed Ware	7
Ciclami Layer 8	R-1040A	6300	50	5340	5140	5420	5070	Danilo/Vlaška	11
Edera Level 3a	GX-19569	6700	130	5720	5480	5850	5370	Plain ware	12
Edera Level 2a	GX-19568	6615	390	6000	5050	6400	4600	Danilo/Vlaška	12
Edera Level 2a	GrN-23129	6590	100	5630	5470	5710	5360	Danilo/Vlaška	13
Edera Level 2a	GrN-25474	6480	40	5480	5370	5520	5320	Danilo/Vlaška	13
Edera Level 2a	GX-19567	6445	210	5650	5050	5750	4850	Danilo/Vlaška	12
Edera Level 2a	GX-19022	6305	285	5550	4850	5800	4500	Danilo/Vlaška	12
Pupićina Horizon I	z-2575	6600	240	5740	5300	6000	4950	Danilo/Vlaška	14
Pupićina Horizon I	OxA-8471	6495	60	5520	5360	5610	5320	Danilo/Vlaška	15
Pupićina Horizon H	Beta-131625	6680	100	5670	5480	5780	5460	Danilo/Vlaška	15
Pupićina Horizon H	Beta-131624	6270	120	5370	5050	5500	4850	Danilo/Vlaška	15

References: 1. *Sordinas 1967*; 2. *Sordinas 1969*; 3. *Skeates 2000*; 4. *Chapman 1988*; 5. *Čečuk & Radić 2001*; 6. *Forenbaher & Kaiser 1999*; 7. *Chapman & Muller 1990*; 8. *Biagi & Voytek 1994*; 9. *Marković 1985*; 10. *Harrold et al. 1999*; 11. *Gilli & Montagnari Kokelj 1992*; 12. *Biagi 1995*; 13. *Biagi & Spataro 2000*; 14. *Miracle 1997*; 15. *Miracle & Forenbaher 2006*.

Tab. 3. Radiocarbon dates associated with Neolithic pottery assemblages from Corfu, the Tavoliere, Albania, Montenegro, Dalmatia, Istria, and the Triestine Karst.

unique to the region. The presence of only parts of the 'Neolithic package' and their appearance within an existing Mesolithic site suggests adoption through social interaction and exchange – probably 'individual frontier mobility' (Tab. 1). These cultural novelties were not moving between Mesolithic populations. Neither pottery nor domestic animals are present only 35 km away across the Strait of Corfu in Late Mesolithic layers dating to ca. 6500–6200 BC at Konispol Cave. It is only with the appearance of Impressed Ware that the Neolithic starts to move in the region.

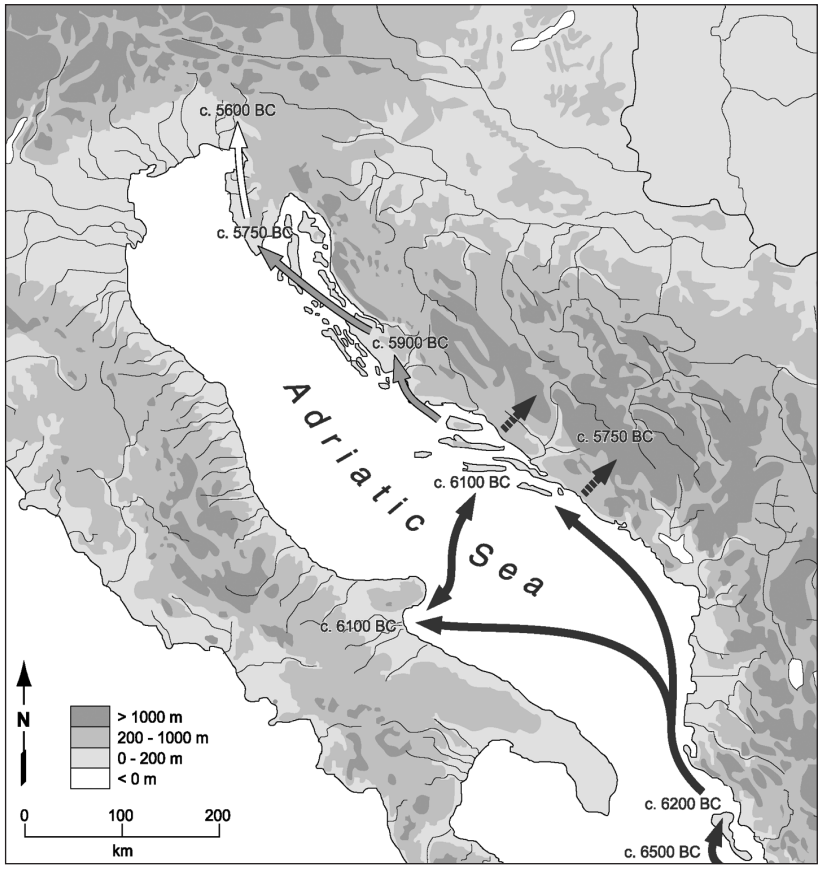


Fig. 4. Model of the spread of farming and herding in the Eastern Adriatic region. Black, solid lines: first phase of rapid 'leapfrog colonization' associated with Impressed Wares. Grey lines: second phase of slow 'agropastoral expansion' associated with Impressed Wares. White lines: third phase of 'agropastoral expansion' associated with Danilo/Vlaška pottery. Black, dashed lines: adoption of herding and farming through 'individual frontier mobility'.

The earliest radiometrically dated Impressed Ware appears at Sidari Layer C top at about 6200 BC. There is little indication, however, of cultural continuity between this and the underlying Layer C base; there is a major stratigraphic and chronological gap (ca. 300 years) between them. Impressed Ware at Sidari is associated with the full suite of domestic animals and other changes in lithic technology and typology (*Perlès 2001.49–50*). The identity of the inventors of Impressed Ware style remains elusive. Were they from the indigenous population, who perhaps acquired or invented new pottery making techniques during the several centuries when they were not occupying the site, or were these new immigrant agropastoralists from the southeast, who brought pottery with them? We doubt that there will be a satisfactory answer to this question any time soon. Rather, we think it is more productive to try to understand how and why Impressed Ware started to move.

The coastal distribution of Impressed Ware sites and their presence on most of the eastern Adriatic islands, including a number of isolated islets far from the mainland (*Bass 1998; Forenbaher 1999*), indicates clearly that maritime communication was the key ingredient of its dispersion. Seafaring was not necessarily a Neolithic invention. There is indirect evidence of pre-Neolithic (11th Millennium BC) seafaring from Franchthi Cave (*Perlès 2001.28, 35*), as well as the Mesolithic colonisation of Corsica and other Mediterranean islands during the early Holocene (*Costa et al. 2003*).

The radiocarbon dates indicate that Impressed Ware and domestic animals took less time to move almost 500 km up the Adriatic to the Middle Dalmatian islands than they took to move 35 km across the Strait of Corfu to Konispol Cave. The former pattern is compatible with the model of 'leapfrog maritime colonisation' by small seafaring communities (*Zilhão 1993.37, 50; Zvelebil 2001.5*), although the lack of dated open-air sites (permanent villages) associated with the earliest Impressed Ware in the southern Adriatic undermines the fit. We may have early Neolithic 'colonists' without evidence of their colonies. Without more information about the Late Mesolithic in the coastal region it is difficult to exclude an alternative hypothesis: that local Mesolithic foragers acquired pottery and other innovations, and then dispersed them by sailing up and down the Adriatic.

Beyond the coastal strip in the southern Adriatic and Albania, Impressed Ware and other innovations were introduced through contact between agricultural and hunter-gatherer groups. Radiocarbon dates suggest a piecemeal adoption of parts of the 'Neolithic package' at Konispol, Odmut, Crvena Stijena, and Zelena pećina, slightly after the initial spread of Impressed Ware up the Adriatic. Some of these sites are located in areas unsuitable for agriculture, in remote parts of the hinterland separated from the coast by high mountain ranges; others overlook valleys with good agricultural potential. Only at Konispol do we have detailed enough data to discuss the process of adoption of pottery and domestic animals. Russell (*1998.149*) suggests that cattle were relatively important in the transitional assemblages at Konispol and that these animals may have been provided to the hunter-gatherer inhabitants as bride-wealth. Cattle and other domestic animals may have also been important in feasts. Without further information about the social contexts of consumption and use of food and pottery, the process by which these novel resources were adopted by the Mesolithic hunter-gatherers remains vague. For the time being, a variant of Individual Frontier Mobility would appear to be the most likely process.

After 6000 BC, Impressed Ware made its way up the northern Adriatic, reaching southern Istria by ca. 5750 BC. Along the way, our Impressed Ware potters started to live in open-air sites that look like more permanent villages. Faunal assemblages, whether from caves or open-air sites, are dominated by domestic animals. Direct evidence about plant foods is scarce, although site locations show a preference for land suitable for agriculture. Although the evidence is patchy at best, we suggest that it is only at this time that we have the assembly of the entire 'Neolithic package'.

Why did the pace of pottery adoption change after 6000 BC? The northern Adriatic may have supported larger and more successful groups of native hunter-gatherers, who resisted the immigration of farmers. Some evidence for this model comes from the large number of Mesolithic sites at the head of the Adriatic, and the delay in the appearance of agriculture in the region. On the other hand, the relative population densities might have been reversed (relatively lower in the north and higher in the south), suggesting that social leveling mechanisms in relatively small indigenous populations in the northern Adriatic undermined the acquisition and spread of prestige items like pottery and domestic animals. Regardless of whether Impressed Ware was carried by migrating farmers or passed among resident hunter-gatherers, the density and social organization of Late Mesolithic people is key to our understanding of the process.

A two-stage model of dispersal

We are thus proposing a two-stage model for the dispersal of Impressed Ware, in which there is an initial stage of pioneer exploration followed by a later stage of colonization (*Fiedel & Anthony 2003*). The first stage occurs rapidly and is limited to the islands and the coastal strip of the southern Adriatic. Rather than establishing permanent settlements, these people may have made short-term, seasonal camps in caves and the open-air. They apparently brought domestic animals with them, and may have seeded islands with flocks in anticipation of future visits. The Impressed Ware 'pioneers' rapidly explored the southern Adriatic, establishing contacts with indigenous hunter-gatherer groups in the hinterland, and probably relying on these native groups as a source of information and perhaps marriage partners. The initial Impressed Ware occupations at Vela Spila and Gudnja may be evidence of these first 'scouts'.

During the second phase of Impressed Ware expansion, settled farmers became established. There was less reliance on native hunter-gatherers for information and other resources, and in any case, those that held on in the region had probably been decimated by the loss of personnel to farming, disease, through marriage, or conflict. Exceptions might have been the hinterland of Montenegro, where important elements of the foraging lifestyle continued into the Middle Neolithic (Crvena Stijena) or even Late Neolithic (Odmut). Farming eventually reached the head of the Adriatic about 5600 BC, now associated with Middle Neolithic Danilo/Vlaška pottery.

Conclusion

Archaeological evidence suggests that immigration played a major role in the introduction of farming into the eastern Adriatic. This is not to say that this was a one-sided affair in which indigenous foragers were passive recipients. It must have been a complex process that involved both the actual movement of people and the active participation of the local population. There is no reason to believe that this process unfolded along identical lines throughout the region. There is provocative evidence that the transition to farming occurred in a two-stage pro-

cess. An initial stage of very rapid dispersal, perhaps by exploratory parties along the coast in the southern Adriatic, was followed by a second stage, during which the eastern Adriatic littoral was probably colonized by enclave-forming farming communities. The hinterland, and perhaps also parts of the coast, remained an agricultural frontier zone for a while.

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Early Neolithic jar burials in southeast Europe: a comparative approach

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ABSTRACT – *A typical product of early farming symbolism, jar burial, appeared in the beginning of southeast European neolithization. Early jar burial development in south-east Europe displays two distinct chronological levels: an early Neolithic core area in the Struma and Vardar valleys and the western Rhodope, and later, late/final Neolithic and/or early Chalcolithic – depending on local terminology – manifestations 'scattered' in various places in the study area. It is the early chronological level of jar burial distribution that will be considered here in relation to the first expressions of these mortuary practices in Central Anatolia, in order to throw some light on the specifics of their origins and variability.*

IZVLEČEK – *Tipičen element zgodnjega simbolizma poljedelcev, pokop v posodi, se je pojavil na začetku procesa neolitizacije jugovzhodne Evrope. Zgodnji razvoj teh pokopov kaže dve kronološki stopnji: zgodnje neolitsko jedrno območje v dolinah rek Strume in Vardarja ter zahodnih Rodopih in mlajše, pozno/končno neolitske in/ali zgodnje bakrenodobne pokope – odvisno od terminologije, razpršene v regiji. V razpravi analiziramo najstarejše žarne grobove in jih v kontekstu izvora teh grobnih praks, primerjamo s pokopi v centralni Anatoliji.*

KEY WORDS – *jar burials; early chronological level; southeast Europe; Central Anatolia*

Introduction: grave pit interpretations

The ordinary pit is reasonably conceived as the single archetype of burial structure. It is obviously the simplest, but sufficiently definite form of fulfillment of the idea of disposing of human remains through burial, which developed after the original covering of the deceased on the ground with grass, tree branches or hides, and later with soil and/or stones. Many of those who have explored southeast European Neolithic burials believe that the grave pit and hence the very burial of the dead has not been paid special attention; they illustrate their case with examples of refuse pit usage (*Jovanović 1967.13; Garašanin1973.27; Brukner 1974*). It was even proposed that intramural burials had not belonged to local community members, but to their defeated enemies, and that the dead of the respective Neolithic community were buried in extramural cemeteries. In my opinion, the main reason for the wide circulation of this thesis in one form or another is the fact that most Neolithic burials lack grave goods and that the pits' backfill is the same soil of the cultural deposit, which contains various artifacts. Hence the seemingly reasonable conclusion that the dead were 'thrown away', but not buried.

Such an argument is unacceptable, especially if one considers the fact that, at least for the area of southeast Europe, it is based on the incorrect interpretation of grave pits as refuse pits. Certainly their backfill is often identical with that of refuse pits, and the difference between them is rather 'archaeologically elusive'. The presence of a great number of sherds and animal bones does not automatically transform pits into refuse pits, as is obvious, for in-

stance, from two 'ritual pits' from Parţa I (*Resch 1991*; see also the analysis of the so-called structured deposition in *Chapman 2000*).

Moreover, there is the case with the re-use of already existing pits, for instance pits left from clay digging, as at Ajmana in the Danube Gorges (*Stalio 1992.65–66*), and of silos, as at Nea Nikomedeia in western Macedonia (*Rodden 1962.286*). On the other hand, there are unquestionable examples of 'rejection' or 'isolation' of the deceased, as at Vaxevo in the Struma Valley, where the situation unambiguously demonstrated that the dead body had been thrown into the pit (*Cholakov 1991.231–232, Fig. 1; Chohadzhiev 2001.170–171, Fig. 10*). Quite instructive in this respect is burial 285 at Çatalhöyük, which is the only one outside the buildings. Anthropological analysis shows pathological changes suggesting that the deceased young man probably suffered all his life from a serious disease which was the cause of his external deformities (*Molleson et al. 1998*).

And last, but not least, the 'refuse pits' interpretations always fail to consider burials beneath house floors, which are especially valuable as arguments against these allegations. These burials' position does not allow one to suppose that they belong to 'rejected' individuals; neither are they limited to infants and children only in order to be explained as 'sacrifices', although it is not very clear either why these so-called sacrifices should be related to children. In this sense, it is worth remembering that the burials in the Anatolian Neolithic and early Chalcolithic are most often not interpreted as belonging to marginal members of the local communities, and they generally correspond to the southeast European burials, both culturally and formally.

The grave pit was considered in the same semantic context as the contracted position of the dead body. If the symbolic meaning of the body position is generally assumed as embryonic, it is completely reasonable to view the pit as the womb of the female divinity, even though this 'Mother-Goddessist' interpretation would probably be considered by many as outdated. The later megalithic tombs in northern Europe had similar significance; their entrance was viewed as a divine vagina, and the bringing of the dead body into the tomb imitated the act of impregnation (*Gräslund 1994.22–24*). Of course, burial structures of a semantically similar plan existed as early as the Starčevo period at Zlatara in Srem and at Vinča-Belo Brdo (*Vasić 1936.9–17; Leković 1985. 159–161*), and are a logical development from ordinary pits. It is clear that, as a whole, the mortuary rituals reproduced the mythological act of creation, and the burial features played a fundamental role in them.

Jar burials: early types and distribution

An additional argument here is the group of graves in southeast Europe where the human remains were buried in clay pots. This practice was common in the Levant, both in earlier and contemporary contexts. The clay pot itself was also considered as a womb, but this symbolic aspect had been secondarily stressed in burial contexts, as is the case with the later Alishar Hüyük, where two of the urns were modelled with conical 'breasts' (*Schmidt 1932.72*). In its symbolic aspect of container, the womb of the female divinity or the mother goddess, if one should use the convenient term, the pot – without respect to the material – played a significant role in many rituals, all the more so in historical times. One specific feature of the burial in clay pots in the Neolithic, which differentiates it from the evolution of this practice in later periods, is the re-use of vessels, which originally had a different function and had not been made especially for burial. The original purpose – both real and symbolic – of clay pots from Neolithic sites remains unknown, but the tradition of burying in silos can be traced back to the Levant. It is worth considering the burials at Ajmana and Nea Nikomedeia once again and especially the original purpose of the grave pits: the former was a pit left from clay digging, and the latter was an old silo. Certainly one should not belittle the expedient aspects of re-using pits but it is evident that there is a semantic similarity to the clay pot on the one hand, and to grain, on the other. The burial in a vessel/pit – which is a container/womb – obviously reproduced the mythological act of creation; it confirms again the symbolic relationship between grave/death/burial and grain/fertility/rebirth (*Bacvarov 2003.129–133*). In this sense, on a practical level, these clay pots were originally used as food containers, as cooking pots or for other purposes, and were later re-used in burials as death-containing vessels; on a symbolic level they were originally used as containers of culturally transformed or transforming matter, or matter prepared for transformation in the future, and were later re-used in burials as 'birth-giving' vessels. All these were different aspects of the same concept in the religio-mythological beliefs of early farmers.

Nevertheless, burials in clay pots do not constitute a homogenous group, but can be separated into

three different types, each with specific features. I will consider them here with respect to their origins and territorial distribution.

A total of four cases of individual formal inhumation in a clay pot – or typical jar burials – have been found in southeast Europe: two at Kovačevo in the Struma Valley, one at Rakitovo in the Rhodope and one at Anza in the Vardar Valley (*Lichardus-Itten et al. 2002.116, 127, Pl. 9, 1–2; 10, 1; Raduncheva et al. 2002.35, 150–151, obr. 24/2, 12; 81/3; Gimbutas 1976.397, Fig. 242, Pl. 47*). All four complexes date back to the early Neolithic: the first three burials belong to the Karanovo I culture, and the fourth belongs to the Kremenik-Anzabegovo culture. The burial from Rakitovo was found near the western wall of a house, beneath the floor, and the other three graves were discovered between houses. All vessels were pots, one of which – that from Kovačevo – had a clay lid. The globular pithos from Anza had four broken handles and a broken bottom, most probably intentionally. Grave goods were found only in the Rakitovo burial: a flint tool and lumps of red ochre. The skeletal remains belong to newborn or stillborn infants buried in a contracted position. Only one of the Kovačevo skeletons was explored in situ by an anthropologist and in this case the position was found to be contracted on the right side, with the head aligned to the north. It is worth mentioning that a total of seven infant or children burials were excavated at the same site, and only two of them, belonging to stillborn/newborn babies, were interred in clay pots, whereas the rest belong to children buried in ordinary pits. In one case the dead child was wrapped in a thick cover, probably a mat or possibly a sack.

As far as I am concerned, this practice had no parallels in the neighbouring areas, neither culturally nor chronologically. The closest analogies are three jar burials from Kösk Höyük and Pinarbasi-Bor in Central Anatolia, which were also found beneath house floors like the Rakitovo grave, and belong to the Anatolian late Neolithic/early Chalcolithic (*Yakar 1991. 192*). On the other hand, however, this tradition probably originated in the Levant, where it had already become quite common and was related, for instance, to the archaic Hassuna culture and the Tell Sotto culture. Six jar burials at the eponymous site at Tell Sotto and one burial at Tell Hazna II are especially instructive (*Bader 1989.132–135, Tab. 47/1–2; Munchaev et al. 1993.27–34*). The strong influence of Levantine traditions on the life and culture at Kösk Höyük, especially on mortuary practices, manifested itself in the local variant of the 'skull cult' which was observed at that Anatolian site. The earliest 'decorated' skulls of this kind were found at Jericho. The skull from Kösk Höyük, however, was found in Layer III, which resembles the late Neolithic at Çatalhöyük, whereas the skulls from Jericho are of a much earlier date.

The second type comprises only one Neolithic grave related to a secondary collective burial. It was discovered in Layer III at Tell Azmak in Thrace and belongs to the early Neolithic Karanovo I culture. The clay pot contained several skulls (the excavator does not give the exact number) as well as separate bones (*Georgiev 1966.9–10*). This find remains unique and could be related only to the secondary collective burials in ordinary pits, from Layer II and IV of Tell Karanovo, for instance (*Bacvarov 2000*).

This is not the case with the last type, known from as many as six sites in southeast Europe and related to cremation burial. A large clay pot containing the burnt bones of a child was found close to the oven in a house from the early Neolithic layer at Tell Azmak. The pot was very probably buried beneath the house floor, but this is not explicitly stated in the only source available: the ground plan of the house published in 1972 (*Georgiev 1972.17, Abb. 4*). This burial is not unique in the southeast European early Neolithic, although it is the only one found in Thrace. Cremation burials in clay pots were found in the late Starčevo layer at Vinča-Belo Brdo and at the Körös site of Gorza in the Tisza Valley (*Vasić 1936.182; Gazdapusztai 1957*). The burials from Vinča and Gorza formally correspond to the Azmak complex; the calcined bones were interred in clay pots.

Cremation was known as a ritual practice as early as the Upper Palaeolithic, but the bones were often only burnt superficially (*Binant 1991.145–146*). Such burials were also found at Epipaleolithic sites, although rather occasionally. However, it is possible that the separate burnt human bones were not recognized and collected together with the animal bones, as is the case with the Franchti cave, where skeletal remains of about thirty individuals were recovered after careful sieving of the soil and analysis of the animal bones (*Cullen 1995.274*). More numerous examples of cremation burials in pots come from the late Neolithic layers at Souphli Magoula and Plateia Magoula Zarkou in eastern Thessaly (*Gallis 1975; 1996a; 1996b*). At Souphli, besides the charred skeletal remains buried in round pits with grave goods and belonging to the early Neolithic Protoseskło culture,

seven pots containing charred bones were found to the south of the Magoula, belonging to the Tzangli-Larissa phase of the Dimini culture. The cemetery of Plateia was excavated at less than five hundred meters from the site; it contained more than seventy cremation burials in clay pots covered with other vessels, in one case a zoomorph. The grave pits were surrounded with stones, or in some cases the bottoms of the pits were covered with a layer of pebbles. Smaller vessels were buried as grave goods.

There are many different interpretations of the Neolithic cremation burials, ranging from purification to ways of releasing the spirit. Ina Wunn assumes that the burials from Souphli and Plateia are clear indicators of a belief in the existence of a soul which detaches from its earthly shell through cremation, thus facilitating its transformation into another existential form (*Wunn 2001.134–137*). I cannot agree with the idea that these practices were the result of the elaboration of concepts of an afterworld, because they appeared too early. It is rather that the cremation burial was considered in the same religio-mythological context as inhumation in a contracted position, but in an aspect more closely related to fire. This conclusion is supported by the fact that in most cases the cremated human remains were interred in clay pots, whose symbolic meaning has already been considered here. The position of the Azmak burial near the oven should be viewed in the same light.

Certain additional hints to the interpretation of the symbolism of cremation burials in clay pots are found in the fact that the complexes at Tell Azmak and Gorza are earlier, whereas the graves at Vinča, Souphli and Plateia are of later date. Moreover, the Azmak burial – and probably the burial from Gorza – was of a child, which perhaps relates it more closely to formal individual inhumations than to the typical late Neolithic cremation burials; it should be noted also that it was found beneath a house floor.

Instead of a conclusion: Late/Final Neolithic and Chalcolithic development

Jar burial continued to be practiced in the late/final Neolithic and the Chalcolithic of southeast Europe. Six more burials were found beneath house floors or outside houses. A new element here was the use of bowls to contain or cover the infants' bodies, while in the early Neolithic cases, only pots had been used. Such a burial of a neonate, covered by a deep, dark-burnished bowl with channelling was found at Tell Ezero in Upper Thrace and date back to the late Neolithic Karanovo III period (*Georgiev et al. 1979.46*). They are similar to the final Neolithic cases at the tells at Mandalo in northern Greece and Lerna in Argolis, where two more burials were uncovered under house floors, in an open undecorated bowl and a patterned beaker, respectively (*Caskey 1957.159*). However, the old tradition of burial in pots also survived in the same areas it had been practiced before, as is suggested by the infant burials at Polgár, site 7 (Alföld Linear Pottery Culture) in the Great Hungarian Plain, and in the Kouveleiki cave in Laconia, Greece (*Papathanassopoulos 1996*), as well as the burials at Rachmani in Thessaly (*Wace and Thompson 1912*).

Nine more jar burials were found in the cemeteries at Mórágy-Tűzkődomb (southern Transdanubia), Durankulak (Dobruja), and Kephala on the Cycladic island of Keos, which belong to the late Neolithic Lengyel culture, Hamangia III and the final Neolithic, respectively (*Zalai-Gaál 2002; Todorova 2002; Fowler 2004*).

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Further notes on Mesolithic-Neolithic contacts in the Iron Gates Region and the Central Balkans

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ABSTRACT – *Hunter-gatherer/farmer contact in the Iron Gates region is re-examined in view of recent archaeological research, and the social dynamics, population movements and interactions of small scale societies. Full, non-hostile interaction between hunter-gatherers and farmers in the Iron Gates region is proposed for the mid- 7th millennium calBC, followed by hunter-gatherer encapsulation at the end 7th millennium calBC. The lack of archaeological records on the Central Balkan Postglacial and Early Holocene hunter-gatherers is highlighted as a major obstacle to fully understanding cultural transformations, including the Neolithic transition, in this region.*

IZVLEČEK – *V luči sodobnih arheoloških raziskav smo ponovno preučili kontakt med lovci in nabiralci ter poljedelci na območju Železnih vrat in socialno dinamiko, populacijske premike ter interakcije majhnih družb. Predlagamo, da je med lovci in nabiralci ter poljedelci na območju Železnih vrat v sredini sedmega tisočletja calBC obstajala popolna, nesovražna interakcija, ki ji je sledila kapsulacija lovcev in nabiralcev na koncu sedmega tisočletja calBC. Poudarili smo, da je glavna ovira pri popolnemu razumevanju kulturnih transformacij, tudi neolitske tranzicije v tej regiji, pomanjkanje arheoloških zapisov o centralno balkanskih post glacialnih in zgodnje holocenskih lovcih in nabiralcih.*

KEY WORDS – *Balkans; Mesolithic; Neolithic; Lepenski Vir; hunter-gatherer/farmer; interaction; migration; landscape learning*

Introduction

The idea of the potential contact between hunter-gatherers and early food producers during the 7th and early 6th millennium calBC emerged because of the contemporaneity of the Central Balkan Early Neolithic sites with the Iron Gates Mesolithic, along with the occurrence of items and features traditionally related to the 'Neolithic package'[1] in Mesolithic contexts (*Garašanin and Radovanović 2001; Jovanović 1972; Kaczanowska and Kozłowski 2003; Pâunescu 1987; Radovanović 1996c; Voytek and Tringham 1989*).

Apart from the Danube Iron Gates Gorges, the existing archaeological record does not imply any straightforward evidence of contact between hunter-gatherers and early food producers elsewhere in this region. A few sites in the Morava valley, all of them Early Neolithic, may only indicate the possibility of such contact, since the time of their occupation overlaps with the time of the Late Mesolithic and Early Neolithic in the not so distant Danube Gorges. On these grounds, a patchy distribution of rare 'last hunter-gatherers' who co-existed with regional Early Neolithic groups has been proposed (*Chapman 1989; Radovanović 1996c; Tringham 2000; Voytek and Tringham 1989*). Confirmed contact of the Iron Gates Mesolithic with the Early Neolithic, based on the presence of various material culture elements assumed

1 In the Balkans, the classic 'Neolithic package' items and features, although marked by important regional variability, may include all or only some of the following: monochrome and/or painted pottery, fired clay objects, rectangular structures constructed from wattle-and-daub, macro-blade chipped stone industries, polished stone objects and grinding stones, domesticated plants and animals (sheep, goat, cattle, pig, wheat, barley, lentils, peas), intramural human burials in contracted position, etc.

to be a part of the 'Neolithic package', goes back at least to 6300 cal BC. It is unlikely that the demographics of the Central Balkans were marked at that time by a proportion of food-producing groups so large as to lead to the encapsulation of the remaining hunter-gatherers. The situation may more accurately be described as a mosaic of diverse hunter-gatherer and early food producing groups having settled different niches, or even sharing them to a certain extent. The early food producers were more probably surrounded by the hunter-gatherers at that time, than vice-versa. The beginning of this contact – preceding 6300 calBC – could be imagined with small 'pioneer' Neolithic groups who had entered this area, but were not able to begin pursuing their established mode of production, based on domesticated plant and animal exploitation, without co-operation with local hunter-gatherers (for a variety of reasons discussed below). This possibility cannot be ruled out only because the diagnostic 'Neolithic package' elements preceding 6300 calBC are absent from Iron Gates Mesolithic contexts. It should initially be explored by identifying changes in a number of different aspects of the IGM hunter-gatherers' material culture, and by investigating whether they could be a direct or an indirect result of that contact (see also *Radovanović 2006a; Tringham 2000.44*). The encapsulation of hunter-gatherers' may be probable only in the final stages of the Neolithic settlement of the Danube Gorges and elsewhere over several centuries following 5900 calBC, during the Middle Neolithic Starčevo. The goal of this paper is to discuss such contacts and their impact on different groups living in the area at that time.

Late Pleistocene and Early Holocene research bias in the Central Balkans

Regrettably, we still know very little about prehistoric hunter-gatherers in Central Balkan areas other than the Danube Gorges. Only in the past few years have a more intensive survey and test excavations targeting the Late Pleistocene sites in this region begun to yield very promising results (*Mihailović D. and Mihailović B. pers. com*), providing further evidence that the Central Balkans is not a Palaeolithic/Mesolithic void, as has been assumed (but see *Tringham 2000.32*) (Fig. 1). It is quite unlikely that the Late Palaeolithic and Early Mesolithic hunter-gatherers, or their Palaeolithic predecessors, who frequented the Danube Gorges were the only groups present in the region. It is even less likely, since the Balkan Peninsula was an important *refugium* for the European living world during the Ice Ages (*Kozłowski 1999, Mišić 1981; Taberlet and Cheddadi 2002; Tzedakis et al. 2000*), with no indication of living conditions worsening to such a degree as to force all hunter-gatherers to abandon the entire region at any time during the Pleistocene or later. Some of the evidence could indeed be missing due to the erosive and accumulative processes responsible for the destruction and deep burial of sediments containing a potential Pleistocene and Early Holocene archaeological record (*Dolukhanov 1979; Montet-White 1999*). However, recent research in Serbia indicates that such explanations are not applicable to the entire Central and/or Eastern Balkans.

Therefore, the scarcity of fully explored geological, palaeontological, and archaeological record from the Late Pleistocene and Early Holocene can be noted as the main cause of the inadequate knowledge of and, hence, questionable interpretations regarding the cultural change and transformations that took place during earlier prehistoric periods in the Central Balkans. No wonder that the scarcity of this record influenced so strongly, for example, some versions of the Neolithic demic diffusion model, which portray a relentless population 'wave' advancing from the Middle East over the Central Balkan 'void', circumventing only the Danube Gorges' coastal areas which were settled by the solitary hunter-gatherers.

Why is the Palaeolithic/Mesolithic evidence so scarce? The most important reason is the very low priority that Palaeolithic and Mesolithic explorations had in the archaeology of the Central Balkans (principally Serbia) during most of the 20th century. Prehistoric archaeology in Central and South-East Europe was, and to a great extent still is, practiced within the long tradition of the cultural-historical approach, with a significant penchant for the study of the Neolithic and later prehistoric periods. In contrast to neighbouring areas (Hungary, Romania and, much later, Bosnia and Herzegovina, Montenegro, Bulgaria, Greece, and Albania), the Pleistocene and Early Holocene hunter-gatherer settlements in Serbia were of only peripheral interest for most local scholars. The lack of systematic archaeological surveys and scarcity of regional quaternary studies was a recognized fact, but it did not initiate any substantial revision of the 'mainstream' agenda. The belief that the Central Balkans was devoid of human settlement during the Late Pleistocene and Early Holocene was, albeit illogically, reinforced. No wonder that the results of the survey and rescue excavations on the right banks of the Danube Gorges and downstream areas in the mid 1960s, which brought to light evi-

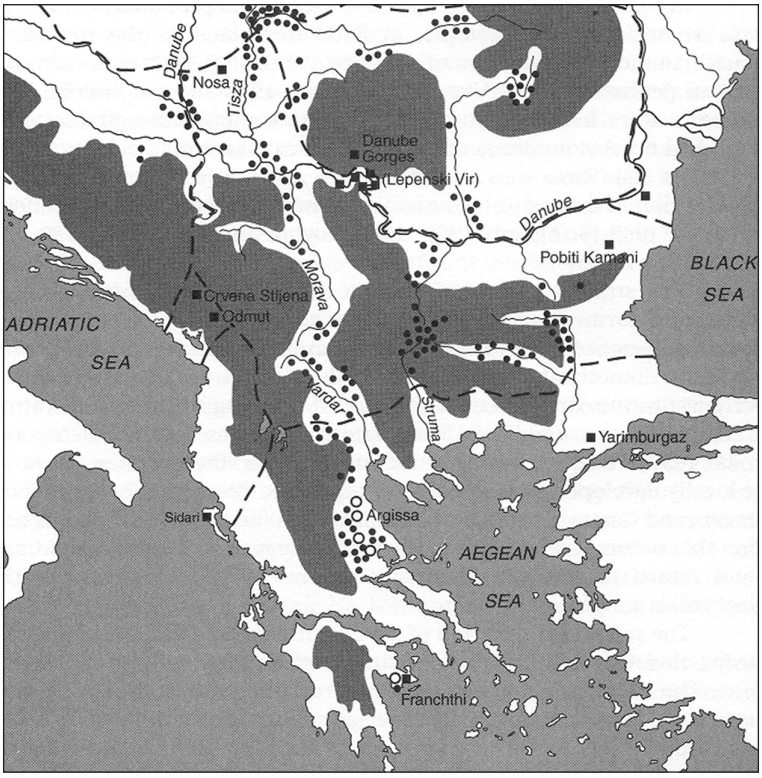


Fig. 1. Balkan Peninsula with locations of Mesolithic (■) and Early Neolithic sites (●○) (after* Tringham 2000*).

dence of Early and Late Mesolithic camp sites, came as a complete surprise.

It is true that the Childean perception of the Balkans as a 'bridge' and/or a 'buffer-zone' between the Near East and Europe influenced the research goals of scholars in both regions, in the past and today (*Kotsakis 2003.217; Tringham 2000.19–56*). A significant emphasis was on topics such as the origins of food production, metallurgy, social complexity, and the ensuing processes of their diffusion over the Balkans through population movements, acculturation and exchange, believed to be directly reflected in the spatial and temporal variability of material culture (especially pottery).

The study of hunter-gatherers and its potential in the Central and Southern Balkans

Similarly to the Central Balkans, the Palaeolithic and Mesolithic were understudied in Greece in comparison to other parts of Europe. This situation began to change in the 1970s, and Palaeolithic-Mesolithic research has steadily intensified ever since (for recent reviews see *Bailey et al. 1999; Galanidou and Perlès 2003*). However, some questions remained open, particularly in regard to the Post-glacial and Early Holocene human occupation that is of interest for our topic. While the distribution and density of Central Balkan Mesolithic settlements is still largely unknown, the Greek record shows an uneven geographical distribution, with hunter-gatherer sites in the Epirus, Argolid, and on the coasts. Other parts of the country, according to the results of extensive survey, were virtually uninhabited between 13 000 BP and the beginning of the Holocene (*Runnels 2003.128*). Kotsakis (*2001.66; 2003.218*), however, does not see this hiatus in occupation as a demographic reality, but rather as another preconception caused by insufficient research (especially evident after the discovery of the Mesolithic in the Theopetra cave in NW Thessaly), coupled with the archaeological invisibility of the sites situated on the now submerged coasts, or in locations buried under alluvium. Perlès (*2003.103*) concurs with Runnels that Greece was extensively surveyed, arguing that it was "sparsely populated during the Palaeolithic and Mesolithic", with the additional setback of the low visibility of Mesolithic open air sites (in contrast to caves) which were occupied for brief periods of time, thus leaving no substantial material record. She supposes that "if a local dynamic towards more complex and more sedentary societies had taken place, the settlements would have become all the more important and archaeologically visible...exemplified not only by the Near and Middle East with the Natufian and Quermezian settlements, but also, for instance the Iron Gates Mesolithic or Ertebølle complex."

Perlès' note on the subject of hunter-gatherers' shift to greater complexity and/or sedentism driven by 'local dynamics' may be a good opportunity to clarify the term 'hunter-gatherers', either simple, complex or sedentary.

In the early ethnographic literature, hunter-gatherer groups were portrayed as self-sufficient, practicing a pure foraging economy, timeless and stuck in a developmental *cul-de-sac*. They were marked by "*...little personal property and an egalitarian social system; sporadic gathering of the bands, and much mobility of individuals between bands; fluid organization involving no territorial rights; no food storage and no group strongly attached to a parti-*

cular area..." (*Rowley-Conwy 2001.40*). Deviations from this description such as territoriality, trade, social hierarchy, restricted mobility and/or sedentism, and other traits associated with greater complexity, were seen not as genuine behaviours, but as by-products of recent acculturation (*Bird-David 1995.17; Layton 2001.293*).

However, anthropological understanding of the term has been redefined over the past five decades, based both on the observations of hunter-gatherer variability in the modern ethnographic and ethno-historical record, and a diversity of analytical approaches marked by emphasis on one or another aspect of hunter-gatherer existence: economy, behavioural ecology, technology, society, or ideology. A variety of more refined classifications of hunter-gatherers resulted from this work, such as Binford's foragers or collectors, groups with residential or logistic mobility, or Woodburn's groups with immediate- or delayed-return. In terms of social organization they were commonly described as egalitarian and 'simple' or non-egalitarian and 'complex' – (for comprehensive reviews and discussions see papers in *Ingold, Riches and Woodburn 1995; Panter-Brick, Layton and Rowley-Conwy 2001*). These studies had a different impact on archaeologists and anthropologists, caused, among other things, by the different time-scale of their research. Socio-cultural anthropologists' synchronic approach led to a greater awareness of the hunter-gatherers' variability, which encompasses numerous culturally specific economic, technological, social, and ideological responses to local environmental and demographic conditions. The archaeologists' diachronic approach leaned towards progressivist assumptions about hunter-gatherers: that there is a trend from 'simple' to 'complex' groups, that a greater social complexity of hunter-gatherers automatically implies that it had to emerge from a prior simple form, such as the 'Original Affluent Society' described by Sahlins (*1972*), that a change toward complexity occurs slowly, leads to agriculture as its logical outcome, and that such change is irreversible. Yet, based both on the analyses of ethnographic and archaeological record, each of these assumptions was shown to be incorrect (*Rowley-Conwy 2001.44–52; 2004.86*). The above noted differences in approaches are certainly simplified, since not all archaeologists are progressivist, and those who are would not subscribe to all these common assumptions. In relation to my topic here, they may help understand the roots of a major disagreement among scholars about the relationship (or a lack of it) between the Iron Gates Mesolithic and Early Neolithic of the Central Balkans.

The main split between archaeologists interpreting the same evidence from the Danube Gorges occurred along the line which divides (often implicit) progressivist approaches from their alternatives, which were more concerned with hunter-gatherer responses to the local environmental and social conditions and their historical trajectories (for the history of research in the Danube Gorges area since the 1960s and the effects of these approaches on interpretation, see *Radovanović 1996a*).

Having argued for a non-progressivist, 'local dynamics' approach, Rowley-Conwy classifies the ethnographically observed varieties of hunter-gatherer groups into four types (*2001.42*):

"❶ the OAS [Sahlins' "Original Affluent Society" type]: groups with little or no logistic movement of resources or food storage, found mostly in tropical regions (e.g. the Aborigines); some occur in higher latitude areas, where resources are available throughout the year and people can move from one resource to the next, exploiting them in sequence without the need for much storage;
❷ logistic groups that do not defend territories, such as most Inuit;
❸ logistic groups that do defend territories – many of Woodburn's delayed return groups;
❹ sedentary groups who invariably defend territories and store resources, forming a continuation of type 3."

These types do not develop from one another following a path beginning with type 1 (i.e., 'simple', egalitarian, OAS, foragers, residentially mobile, immediate-return groups) and ending with type 4. All but type 1 can be defined as complex (i.e., non-egalitarian, collectors, logistically mobile or sedentary, delayed-return groups). Further discussion on type 1 will show that labelling it as 'simple' is yet again questionable.

In the complex, delayed-return small-scale societies (pastoral, agricultural and hunter-gatherer), "*the binding commitments and dependencies are most often those of kinship and affinity: we may find lineages, clans and other kinship groups (...) marriage alliances between groups (...) and other sorts of formal contractual bonds to which people are committed*" (*Woodburn 1995.34*).

In contrast to these, the social organization of groups with immediate-return systems (Rowley-Conwy's type 1) are marked by "*flexible social groupings, often*

changing their composition, individuals that have a choice whom they associate with in residence, in the food quest, in trade and exchange and in ritual contexts; people are not dependent on specific *other people, whether relationship of kinship or other relationships, stress sharing and mutuality, but do not involve long-term binding commitments of the sort that characterize delayed-return systems; distinctions – other than those between sexes – of wealth, power and status are systematically eliminated*" (*Woodburn 1995.34*). One among many other examples is the south Indian Nayaka's egalitarian hunter-gatherers' view of kinship, which "*was primarily made by recurring social actions of sharing and relating with, not by blood or by descent, not by biology or by myth or genealogy*", also a person is sensed as one "*with whom we share with*" (*Bird-David 1999.73*). The systematic elimination or discouraging of socially unacceptable behaviours in egalitarian hunter-gatherer groups implies a collective consensus, but it also implies social control and pressure to maintain it; but who is in control and where does the pressure come from? Since egalitarian groups "place enormous emphasis on creating and maintaining communal consensus", this often sparks "a kind of equally elaborate reaction formation" of "the extreme forms of symbolic violence"[2] (*Graeber 2004.25* and also *Clastres 1997*). The consensus is thus maintained by re-affirming internalized cultural tradition through various aspects of symbolic conflict (*Chamberlain 2006.42*). The qualification of theses societies as 'simple' does not make much sense, knowing that such symbolic means of control and pressure act in order to uphold the egalitarian system. Even if the symbolic means are 'imaginary' from the *etic* standpoint, they are not less real and powerful in the *emic* view. Along with various types of non-egalitarian hunter-gatherer societies, and "from the perspective of the flexibility, mobility and social equality", egalitarian hunter-gatherer society "may be the most remarkable and specialized social form that humans have ever evolved. It has no claim to be the original human condition" (*Rowley-Conwy 2001.65*).

Furthermore, ethnographically known egalitarian hunter-gatherers were not found in situations of 'pristine isolation', but in interaction with other groups (including ethnographers), with whom they co-operate through relationships of symbiosis, or dependence and subordination (*Layton 2001.299–302, 306; Pennigton 2001.178; Woodburn 1995.35*). The ethnographic record shows that many of these groups were versatile, switching between foraging and horticulturalist or herding modes of production to suit current conditions (*Layton 2001.303*). These oscillations between the 'genuine' simple hunter-gatherer mode and more complex ones underline the significant role of the local environmental and social dynamics that perpetuated them.

The ethnographic record also shows that egalitarian groups are not pre-existing cultural entities, but special alliances of individuals created in opposition to the internal social dynamics of their 'parental' group and/or to the external pressure of neighbours. This is why they are marked by great fluidity, establishing their 'kinship', in Bird-David's words "not by blood or by descent, not by biology or by myth or genealogy" (*l.c.*). Such observations are important for archaeologists, especially when they study prehistoric hunter-gatherers' interaction with other groups, either hunter-gatherers, food producers or both.

In this respect I agree with Perlès' comment above about the importance of local dynamics in the formation of prehistoric hunter-gatherer settlement patterns which directly determines the visibility of the archaeological record. The assumed low visibility of Mesolithic open-air sites in Greece may indeed be the consequence of greater hunter-gatherer mobility (type 1) at that time. Previous discussion also points to a fact that most of the ethnographically known egalitarian groups (i.e., residentially mobile or immediate-return groups) were, at the time anthropologists studied them, surrounded or encapsulated by other small- or large scale societies with whom they may have co-operated. The high mobility (and egalitarianism) of the Greek Mesolithic groups could therefore have been a result of the interaction with the neighbouring, complex (logistic) hunter-gatherer groups, but the settlements of such logistic groups have yet to be found (along the now submerged coasts or deep under the alluvium, according to Kotsakis). We have also seen that egalitarian groups could be formed through avoidance of co-operation,

2 Drawing these ideas about symbolic violence, which is reflected in these societies' cosmologies, myths and rituals, from P. Clastres, Graeber continues "*...there is a striking contrast between the cosmological content, which is nothing if not tumultuous, and social process, which is all about mediation, arriving at consensus. None of these societies are entirely egalitarian: there are always certain key forms of dominance, at least of men over women, elders over juniors. (...) It is hardly a coincidence that when larger, more systematically violent forms of domination do emerge, they draw on precisely these idioms of age and gender to justify themselves.*"

provided that the resources they foraged were available all-year round and distributed in niches different from those used by logistic, delay-return groups. In both cases, egalitarian, consensus based groups are created in response and opposition to surrounding groups. They cannot emerge and exist without 'the other'. Woodburn (*1995.63*) states that "oppositional egalitarian solidarity" may have been repeatedly "invented and re-invented" where "economic circumstances were appropriate" without the need to be triggered by outside pressure. One can also argue that the 'invention' of oppositional egalitarian solidarity may be a response to internal social pressure: social tensions growing inside the parental delayed-return group (which then becomes 'the other').

The low archaeological visibility of highly mobile hunter-gatherer groups in the Mesolithic in Greece may apply to the period when farming communities were established and attained greater population densities. Some local hunter-gatherer groups (egalitarian or otherwise) were then assimilated, while others could have remained encapsulated for some time, leaving a 'simple' mobile hunter-gatherer signature in the archaeological record.

The above discussion on hunter-gatherer variability based on the ethnographic record was interspersed with my comments on recent research in Greece. They served as a 'proxy' to better understand the circumstances of the early to mid-Holocene hunter-gatherer research in the Central Balkans and its potential. Apart from geographical proximity (although not a geographical resemblance), such an alternative was also chosen because of the historical similarities in the mainstream research agendas in both regions which resulted in a considerable dearth of studies of the prehistoric hunter-gatherer record. It not only delayed research of hunter-gatherer variability in this part of the world, but also impeded better understanding of the 'Neolithisation process' which for a long time was, and still is, the main focus of the regional archaeological explorations. This research was heavily biased toward only one side of the 'Neolithisation' coin: that of established food producing groups. This process cannot be known without a much better grasp of the local hunter-gatherers' way of life, settlement patterns, ways in which they interacted with other groups, long- and short-distance exchange networks and routes and, in relation to these, the effects of long- and short- distance (small or large scale) population movements; and last but not least, the effects of changing environmental conditions.

A brief reminder of the solitary Late Post-glacial and Holocene hunter-gatherer archaeological evidence until the time of contact with early food producers from the Central Balkans, i.e., the Danube Gorges now follows.

Late Post-glacial and Early-Mid Holocene in the Danube Gorges

The process by which settlement intensified in the Late Post-glacial and Early Holocene in the Danube Gorges is well documented, including the ongoing process of settlement and reinforcement of distinct local cultural identity markers observed in the standards of material culture production (*Radovanović 1996b*) (Fig. 2). The Iron Gates region witnessed extensive settlement in this period at the Climente II cave, the rock shelter at Cuina Turcului, and at the open air sites of Padina (layer A1) and the earliest occupation at Vlasac (*Kozłowski 1999; Radovanović 1981; 1996a*). While the caves and rock-shelter sites in the Iron Gates area of this period are marked by activities such as the specialized hunting of ibex (Cuina Turcului) or red deer and wild boar (Climente II), the open air camps at Padina A, Vlasac and probably a number of other sites, specialized in fishing. These sites were not all-year-round settlements, but locations belonging to a broader network of sites used by local hunter-gatherer groups. The full territorial extent and complexity of this network is still unknown.

The local hunter-gatherers' inclination of establishing and frequenting fishing camps along the Danube, both in the Iron Gates Gorges and downstream, continued to intensify in the Early Holocene through inter-group competition, sometimes resulting in hostile interactions (*Lourandos 1995.150; Radovanović 2006b; Roksandic et al. 2006*). These camps were regularly revisited, with the material culture record reflecting the presence of logistic, territorial and complex hunter-gatherer groups who established permanent structures and formal disposal areas at Padina, Vlasac, Proto-Lepenski Vir, Icoana, Hajdučka Vodenica, Schela Cladovei, Kula (*Radovanović 1996a*) (Figs. 3 and 4). The growing significance of aquatic resources in the subsistence of these communities was confirmed both by the predominance of fish in the faunal remains and palaeodietary analyses revealing a strong aquatic signature (*Bonsall et al. 1997*). A trend toward greater social complexity, permanence of settlements and the territoriality of coastal hunter-gatherers whose subsistence was based on aquatic resources (either from the sea, lakes or large

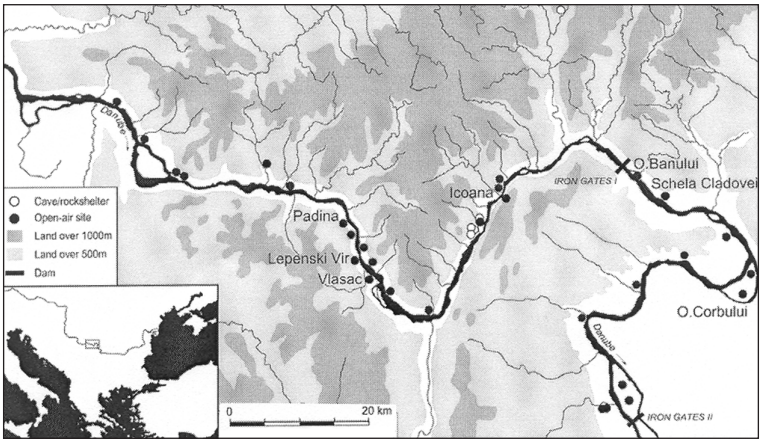


Fig. 2. Mesolithic sites in the Iron Gates Gorges (after* Radovanović 1996a*).

rivers) is a well explored phenomenon in archaeology and ethnography (for example, see *Palsson 1995.194* ff on the strong correlation between dependence on coastal resources and permanence of settlement).

However, there was a major shift from aquatic resources to mixed a terrestrial diet around the mid-7th millennium calBC (*Bonsall et al. 1997*). Several other lines of evidence also mark a considerable change in the Iron Gates Mesolithic community's way of life at that time. Studies of the material culture from the entire region imply a restriction of the size of territory settled by Iron Gates Mesolithic hunter-gatherers in this period, and the abandonment of the entire left bank and parts of the right bank of the Danube with downstream areas (for the abandonment of sites implied by stratigraphic gaps and discontinuities in traditional technologies see: *Antonović 2006; Radovanović 1996a; 1996c*). This assumption was supported by Bonsall and his collaborators' (*2000*) discussion on the lack of continuity in ^{14}C dates for the period between ca 6300–5900 calBC at Vlasac, Icoana, Ostrovul Banului, Ostrovul Corbului, and Schela Cladovei, and the later re-occupation of these locations at 5900 cal BC. Post 6300 calBC, massive site abandonment coincides with the establishment of a new series of permanent structures in only two (explored) settlements in the Upper Gorges: Padina B and Lepenski Vir I–II. Traditional forms of settlement organization, architectural elements and burial practice were modified, and new material, such as pottery and other artefacts of local Early Neolithic provenance was incorporated (*Garašanin and Radovanović 2001; Radovanović 1996c; 2000; 2006a*). There is evidence confirming continuity at the Lepenski Vir settlement between 6300 and 5900 calBC (*Bonsall et al. 2004*), and a continuity of the settlement at Padina has also been proposed (*Borić and Miracle 2004*).

The presence of new material culture elements has led archaeologists to assume the co-existence of Lepenski Vir and Padina communities with the regional Early Neolithic groups. Among the main elements indicating direct contact with Early Neolithic groups are diagnostic raw materials and technologies (see also different arguments, but the same general idea, in *Borić 1999; Jovanović 1987; Kaczanowska and Kozłowski 2003; Kozłowski 1982; Kozłowski and Kozłowski 1984; Pâunescu 1987; Radovanović 1996a; Voytek and Tringham 1989*). The question of the presence of pottery between 6300 calBC and 5700 calBC in the Iron Gates Mesolithic in the Upper Gorges has been explored (*Garašanin and Radovanović 2001; Radovanović 1996a*) in view of the stratigraphically secure evidence from Lepenski Vir phases LV I/2–3 and Padina B/I–III. In order to clarify which Neolithic group came into contact with the Mesolithic community at Lepenski Vir and Padina, this evidence was correlated with the Early Neolithic of the Central Balkans (see Tab. 2 in *Garašanin and Radovanović 2001*). A conclusion very similar to Srejović's (*1966b*) first interpretation of the Lepenski Vir stratigraphy was reached, that is: Lepenski Vir I represents phase I of the Starčevo culture in terms of pottery presence, while Lepenski Vir IIIa and IIIb correspond to Star-



Fig. 3. Sculptures from Lepenski Vir structures (Institute of Archaeology, Belgrade).

čevo IIa and Starčevo IIb respectively. Effectively, 'Proto-Starčevo' and Starčevo I would represent one and the same initial phase in the Starčevo cultural sequence, strongly marked by early elements of the Balkan-Anatolian complex of the Early Neolithic (Fig. 5).

The Danube Gorges will be reoccupied at a later date, after 5900 calBC. These settlements (apart from Padina and Lepenski Vir, where the Mesolithic 'cultural identity' markers still endured) were built according to 'classic' Neolithic standards: irregular dugout dwellings and/or above ground huts, with rectangular ground-plans furnished with circular hearth constructions, such as at Râzvrata II, Ostrovul Mare km. 873, Ostrovul Corbului II/hor.VII, Hajdučka Vodenica II, Donje Butorke, Ajmana, Pesak-Vajuga, Velesnica, Ušće kameničkog potoka, Knjepište, and Alibeg at the entrance of the Danube to the upper gorges (*Radovanović 1996c.43–44*).

Bonsall et al. (*2000*) hypothesized that the abandonment of a large number of the Iron Gates Mesolithic sites in the period 6300–5900 cal BC could have been triggered by the global climatic oscillation at 8250–7900 BP (cca 6300–5950 calBC). This event was marked by cooler and wetter conditions, and may have resulted in extensive periodical flooding of the Danube banks. In their view, the exception would be the settlement of Lepenski Vir, which the Iron Gates Mesolithic community probably regarded as a sacred site, and therefore chose not to abandon. The duration of this climatic oscillation corresponds to the construction of the Lepenski Vir I structures, with floors made of a heavy-duty mixture of limestone and sand unique in the whole Iron Gates area (Fig. 6). These sturdy floors have been interpreted as protection against the structures being washed away by flooding (see also *Chapman 2000.195*).

Borić and Miracle (*2004*) opposed this interpretation because of the lack of evidence of sediments that may correspond to floods. The palaeo-climatological record on the effects of the '8200 BP cold event' in South-Eastern Europe is still inconclusive. In contrast to North-western and Central Europe where a high-resolution record about this event was assembled, its magnitude and effects farther east in Eurasia are unknown (*Davis et al. 2003; Morrill and Jacobsen 2005; Veski, Seppa, and Ojala 2004*) Although the abandonment of the Iron Gates Mesolithic sites cannot be explained only in terms of climatic deterioration, some floods and their impact on local groups cannot be excluded. Srejović (*1966a*) observed 'a



Fig. 4. Early Mesolithic burial, from Proto-Lepenski Vir (Institute of Archaeology, Belgrade).

thin layer of brown loessic sand' at places between the LV I and LV II settlements, and supposed that the site could have been abandoned for some time. In my view, the lowermost parts of this site might have been abandoned: according to my 1996 phasing of LV I settlements, the latest phase of Lepenski Vir I (LV I/3, corresponding roughly to Srejović's phases LV Id–e) consists of somewhat overcrowded rows of houses located on a steep slope in the rear of the settlement (*Radovanović 1996a.Figs. 3.17, 3.22, 3.23 and especially 3.36*). It is therefore likely that the retreat of the entire settlement higher up the slope might have been related to an increased danger of flooding at the lower elevations. Therefore the structures in these elevated parts of the site could have avoided periodical flooding. A similar trend of 'retreat up the slope' of the chronologically latest houses has also been observed at Padina, another Mesolithic site that continued to be used over a considerable time during the VI millennium calBC (*Radovanović 1996a.Fig. 3.5*).

Contacts and transitions

The internal relationships within a small-scale society that constitute their social organization are often separated in anthropological literature (for analytical purposes) from external relationships with neighbours, traders, newcomers, etc. This external relationship is usually termed 'contact' (for a critique of this analytical division see *Bird-David 1995.17*), 'coexistence' and 'interaction' that ranges from the sym-

<table>
<tr><th>LV
settlement
phases</th><th>LV
pottery
phases</th><th>AMS dates</th><th>EN dispersal
and landscape
learning in IGM</th><th>EN Balkan-
Anatolian
complex</th><th>EN Carpatho-
Danubian
complex</th></tr>
<tr><td>LV I/1</td><td>?</td><td>?</td><td rowspan="3">Pioneer colonization; rapid dispersal and landscape learning. Full non-hostile interaction withresident population. Abandonment of the Mesolithic Lepenski Vir by 5800 BC</td><td>Anzabegovo Ia
Proto-Sesklo</td><td></td></tr>
<tr><td>LV I/2
LV I/3–</td><td>LV IIIa1</td><td>Between
6380-6200 BC
and 6080-5970 BC</td><td>Anzabegovo Ib</td><td>Starčevo I</td></tr>
<tr><td>LV II</td><td>LV IIIa2</td><td>At or after
6010-5810 BC</td><td>Anzabegovo Ic
Gura Baciului</td><td>Starčevo IIa</td></tr>
<tr><td>LV IIIb</td><td>LV IIIb</td><td>At or before
5720-5550 BC</td><td>Abandonment of Lepenski Vir after 5550 BC</td><td>Anzabegovo II</td><td>Starčevo IIb</td></tr>
</table>

Fig. 5. Correlations of AMS calendar dates from Lepenski Vir with the Early Neolithic periodization of the Central Balkans (adapted after* Garašanin and Radovanović 2001 *and* Bonsall et al.2004*).

biosis to dependence and subordination of one group to another (*Layton 2001.295–301*).

The following discussion focuses on contact between hunter-gatherers and farmers. Although it is another analytical division that may be criticized (we only need to remember the above-noted oscillations in the production mode of 'egalitarian' small-scale societies), Rowley-Conwy (*2004.97*) stated that the hunter-gatherer:farmer dichotomy is analytically and empirically valid. He compared three phases (availability, substitution, consolidation) of the model of transition to agriculture (*Zvelebil and Rowley-Conwy 1986*) to the results of Hunn and Williams' (*1982*) study of the economic practices of 200 ethnographically known small-scale societies. Zvelebil and Rowley-Conwy's *availability* phase predicts that a small-scale society depends on less than 5% of agricultural products in their diet; the *substitution* phase would include 5%–50%, and the *consolidation* phase more than 50%. Hunn and Williams' study has shown that in ethnographically known small-scale societies, agricultural products contribute either less than 5% to the diet (these are hunter-gatherers, corresponding to Zvelebil and Rowley-Conwy's *availability* phase) or more than 45% (agriculturalists, corresponding to the *consolidation* phase). Statistically negligible percentage reflected 5%–50% participation of agricultural products (*substitution* phase), implying that this phase is unstable and probably of very short duration, and would probably be difficult to detect in archaeological record. According to these data the small-scale societies would consist of either hunter-gatherers or farmers, not likely to linger in the intermediate substitution phase (*Rowley-Conwy 2004.97*). This brings us to the topic of current palaeo-dietary studies in the Iron Gates Mesolithic



Fig. 6. Lepenski Vir I structures (Institute of Archaeology, Belgrade).

A new and larger series of radio-carbon measurements of the remaining and still datable archaeological record from the Iron Gates Mesolithic sites has been vital for further clarification of the duration, continuities and actual contemporaneity of particular settlements. The combination of dating human bones with the use of δ–^{13}C and δ–^{15}N dietary analyses has produced a powerful (although not entirely conclusive) tool for the understanding of burial record, deposition processes and habitat in the area (*Bonsall et al. 2006*).

According to the initial study of Bonsall et al. (*1997*), there was a shift from a considerable intake of aquatic resources to a broad-spectrum diet, with emphasis on terrestrial resources, based upon the values of

$\delta^{13}C$ and $\delta^{15}N$ in the collagen extracted from human bones from the sites of Lepenski Vir, Vlasac and Schela Cladovei. Another explanation was offered, relying upon Schulting's model (*1998*), emphasizing a shift from a marine/aquatic to a mixed diet, with a considerable intake of freshwater fish. It was pointed out (*Radovanović 2000*) that regardless of the differences between these two models, they both imply that a significant dietary change took place in the Iron Gates Gorges after the mid-VII millennium cal BC and, for the convenience, the diets were marked as 'Early' (before the dietary shift at the mid-VII millennium cal BC) and 'Late' (after the dietary shift).

In further discussion on the stable isotopes and food resources in the Iron Gates area, Bonsall et al. (*2000*) rejected the suggestion that anadromous fish (which may contribute to the "marine aquatic" signature) could be a source of the high $\delta^{15}N$ values in some Mesolithic skeletons – which were higher than those expected for a diet based on freshwater fish only – "because there was no corresponding enrichment in $\delta^{13}C$ values, and because average $\delta^{15}N$ and $\delta^{13}C$ for Mesolithic adults in Schela Cladovei (where there is abundant evidence for Mesolithic exploitation of sturgeon) appeared very similar to those of their counterparts at Lepenski Vir and Vlasac where no sturgeon remains were identified..." Part of this argument would be contested by a later report stating that sturgeon remains were identified in the faunal assemblage collected from and/or beneath Lepenski Vir house floors, apparently missed in the course of S. Bökönyi's initial analysis of this material in 1960s (*Borić et al. 2004*). Nevertheless, this new information does not substantially affect the argument of Bonsall and collaborators, since the Danube *Acipenseridae* were in fact freshwater fish until 5600 calBC, when the Black Sea became a marine environment after rejoining the waters of the Mediterranean (*Bonsall et al. 2000; Ryan et al. 1997*). On the basis of stable isotope analyses Bonsall and collaborators proposed palaeo-dietary groupings of the skeletal remains from Lepenski Vir, Vlasac and Schela Cladovei into two periods – Mesolithic and Neolithic – the former marked by high $\delta^{15}N$ values, and the latter with these values depleted. These data were then imposed on Srejović's (*1969; 1972*) phasing of occupation at these two sites. However, after the new AMS dates were correlated to Srejović' phases LV Ia–d, LV IIIa1–a2 and LV IIIb, they appeared to be inconsistent both with the phasing and the known radiometric measurements of the charcoal samples from Lepenski Vir structures. A problem emerged, since the AMS dates from bone samples seemed to be older than the radio-carbon measurements of charcoal samples from the concurrent contexts.

Cook et al. (*2001; 2002*) succeeded in overcoming this problem, having found that the AMS dates from the bone collagen have to be corrected for a freshwater reservoir effect (FWR), based on the premise that "human diet may have included material from a reservoir that differed in ^{14}C specific activity from the contemporary atmosphere". The AMS dates of individual human bones were corrected for the corresponding FWR, and this procedure resulted in a series of radio-carbon dates that were, at this time, more satisfactorily correlated with known ^{14}C dates obtained from charcoal samples at Lepenski Vir and other sites. Nevertheless, the problems of the inconsistency of human burial dates with those of the house phases at Lepenski Vir remained (*Bonsall et al. 2006; Radovanović 2006b*) (Fig. 7).

Further analyses of the stable isotope signatures from the Iron Gates Mesolithic ensued. Grupe et al. (*2003*) provided additional information about stable isotope signatures from Lepenski Vir and Vlasac, noting that the "younger human finds at Lepenski Vir are not only morphologically totally different from the older finds, but tend at the same time to have the lowest $\delta^{15}N$ values". Similarly to Bonsall et al. (*2000*), their analysis implies a diachronic change in palaeo-dietary habits at this site. Bonsall et al. (*2000; 2002*) maintain that the "younger" sample has a strong "terrestrial" isotopic profile, based on the increase of $\delta^{13}C$ in the isotopic signature, which corresponds to cattle rather than to deer. It remained less clear why they refer to this type of signature as the signature of domestic cattle only (see also *Grupe et al. 2003*). Bonsall et al. (*2000*) provided two possible scenarios for the palaeo-dietary change in the Iron Gates Mesolithic: either the adoption of a food producing economy, or exchange for agricultural products with neighbouring farmers (see also *Tringham 2000; Voytek and Tringham 1989*).

Other scenarios proposed that a decrease in the importance of fish as a staple food resource was triggered by contact with first farmers (*Radovanović 1996a; 1997*), or excluded the possibility of a diet based on agricultural products, since the lack of domesticated faunal remains at Lepenski Vir does not support such a possibility, along with the fact that the Danube Gorges are quite unsuitable for agriculture (*Borić et al. 2004*). These two scenarios imply that the local hunter-gatherers switched to the mixed broad spectrum diet (based on hunting and fishing)

Lepenski Vir phases	Ranges of FWR corrected and calibrated AMS dates	Number of occurrences
Proto-Lepenski Vir	9320–9190 BC 8310–8180 BC	2
Lepenski Vir I/1		none
Lepenski Vir I/2–3	6380–6200 BC 6080–5970 BC	12
Lepenski Vir II Lepenski Vir IIIb	6010–5810 BC 5720–5550 BC	5

Fig. 7. The AMS dates and stable isotope evidence from a new series of 14 samples from the site of Lepenski Vir (*Bonsall et al. 2004*; with more detail in* Bonsall et al. in press*), together with five earlier measurements from this site (*Bonsall et al. 1997*). It is important to note that AMS dates in this table represent the occurrence of dated human bone samples originating from the Lepenski Vir settlement contexts, but they do not necessarily date these contexts (see also* Bonsall et al. 2006*).

at the time of contact with the Early Neolithic. I have earlier (*Radovanović 1996a.314; 1997*) attempted to explain the contradiction between the faunal record in the post 6300 calBC Lepenski Vir (reflecting the significance of *K*-selected resources and the ensuing greater mobility of hunter-gatherers) and the perpetuation of settlement's permanency and symbolic displays (in spite of the diminished importance of *r*-selected resources i.e, fish) in terms of the local Mesolithic population's social and ideological resistance to contact with Early Neolithic groups.

I will here add yet another potential scenario that does take into account an intake of domestic food resources (as proposed by *Bonsall et al. 2000*) by the individuals interred at Lepenski Vir after 6300 calBC. These individuals could in fact have been affiliated to the early farming communities who lived in areas outside the Danube Gorges, at least during the past 10 years of their lives. The settlement of Lepenski Vir is usually, and with very good reason, taken to be quite dissimilar to other sites in the Danube Gorges, because it is the only site with substantial durable structures containing sculptures and other symbolic artefacts, a record of complex burial procedures, a strong demographic bias of burials in favour of males, along with a large number of newborns and infants beneath the trapezoid structure floors. Archaeologists have never viewed it as just another fishing camp, but as a probable aggregation site that may have witnessed intense ritual activities[3] since its Early Mesolithic (Proto-Lepenski Vir) phase, and which continued to play an important social and ritual role in the lives of local communities in later periods, both during and after the above-noted abandonment of sites on the left Danube bank and the Lower Gorges. According to this third scenario, if the structure of faunal remains at Lepenski Vir contradicts the palaeo-dietary signature of the individuals buried at this same site, it is clear that Lepenski Vir could not have been a hunter-gatherer residential site, since it does not reflect the everyday subsistence activities of the group who used it.

The question, therefore, is not if Mesolithic hunter-gatherers interacted with the Early Neolithic groups, but how were these groups affected by this interaction. Do Lepenski Vir settlements I and II reflect the availability phase (a hunter-gatherer diet, based on the faunal remains and a palaeo-dietary signature interpreted as wild resource intake), or consolidation phase (farmer's diet, based on the palaeo-dietary signature interpreted as domestic resource intake) in terms of Zvelebil and Rowley-Conwy's agricultural transition model.

Before exploring these scenarios further, let us first revisit briefly the concept of migration, since it has had an important role in archaeological interpretations of the Meso/Neolithic transition in South-east Europe.

Migrations and landscape learning

Anthony's (*1990*) comprehensive review of this concept describes the causes for migration in terms of *push* (economic and/or social tension in the home region) and *pull* (attraction in the destination region) factors. He distinguishes long and short distance migrations with the likelihood of a *long-distance migration* to occur "much more rapidly among societies with focal economies, since they were likely to deplete critical resources within a given unit

3 Ritual performances at residential and aggregation camps in the ethnographic record involve visits by supernatural beings who appear through trance and dance, or make their voices heard, for example 'shaking tent ritual' among the Cree, the !Kung 'medicine dance', the Hadza's 'sacred epeme dance, the Batek 'fruit season's singing session' and the Palyan and Pandaram 'spirit possesion'. These ritual performances may be held as frequently as weekly among the !Kung, monthly among the Hadza, and "whenever need arises" among the Pandaram, and they could include up to one third of the community (*Bird-David 1999.78*).

area more rapidly than societies practising diffuse or broad-spectrum subsistence strategies..." i.e., among farmers, and "given the proper mix of home negatives, destination positives, and low transport cost, focally adapted farmers might be considered *more* likely to migrate long distances than broad spectrum hunter-gatherers... Local moves would have only subtle effects on material culture, and would therefore be difficult but not impossible." (*ibid. 901*) *Short-distance* migration will consist of slow gradual moves and is generally distinctive for hunter-gatherers.

The migration process begins with movements of a few people ('scouts'), often along known, previously used routes in long-distance exchanges. Such small groups are goal-oriented, since migration is unlikely if there is no information about the destination region. Scout movements can be rapid (*leap-frog* migration), reaching quickly and deep into the new lands, and they are archaeologically detectable as 'islands', separated by less desirable (either settled or unsettled) territory.

A secondary flow (*chain* or *stream migration*) of larger groups will follow, "which is quite different in goal orientation and composition from the initial migrant group" (*Anthony 1990.902*), moving along the known route and establishing the 'residential' phase of more substantial land use (*Runnels 2003.126–127*). Migrants will move along *mega-patches*, such as easily traceable geographic features, rivers, linear mountain chains, clear ecological zones, i.e. landscapes more easily internalized into a cognitive map (*Kelly 2003.54*). This brings us to an explanation of the concept of *landscape learning*, which describes the consistent process of developing knowledge about a new environment. It is a "social response to situations in which there is both a lack of knowledge of the distribution of natural resources in a region and a lack of access to previously acquired knowledge about that distribution" (*Rockman 2003.12*), which is precisely the situation that the pioneer colonizers had to confront.

Drawing upon Rockman (*2003*), Meltzer (*2003*) offers a model that takes the factor of new landscape learning and its speed, curve and mode, as an important part of colonizing success, which may contribute significantly to our understanding of the process of settling in unfamiliar environments. He proposed a basic division: landscape learning with no resident population, and landscape learning with a resident population. Since there was a resident population in the Balkans, I will note only the part of his model regarding the modalities of interaction between the resident population and the colonizers: no interaction; limited or hostile interaction; and full (non-hostile) interaction. In all cases the newcomers would have to learn about the environment from landscape cues and the indigenous population. The mode of learning would have been copying in the case of 'no interaction', and tutorial in cases of 'limited' and 'full interaction'. However, the speed of learning is greatest and the learning curve steepest only in the case of full and non-hostile interaction.

Landscape learning is slow, and includes not only building personal experience, but also incorporating those of preceding generations. Its slow rate stands in contrast to the fast pioneer colonization (or rapid directional dispersal) model established for the Early Neolithic colonization of Southeast Europe (*Perlès 2003; Zvelebil 2001*). This model is supported by a number of recent studies of ancient and modern DNA (*Bentley, Chikhi, and Price 2003.63; Haak et al. 2005.1017; Richards 2003.159*) and the latest series of the Final Mesolithic and Early Neolithic radio-carbon dates from the Central Balkans (*Bonsall et al. 2004; Borić and Miracle 2004; Whittle et al. 2002*). Kelly (*2003.54*) explains, when discussing the fast rate of colonization process that "...people are not able to learn landscapes, since learning requires personal experience that is gathered from an early age and that is encoded in folklore that requires some time depth in development" and adds "that this means, coincidentally, that the nature of the adaptation brought with a colonizing population will have a strong influence over the initial choices made." Since the new environment cannot be learned quickly, migrants need to rely upon a more generalized knowledge, choosing to settle areas ecologically and topographically similar to those in their homeland or, in the absence of these, in areas with less than optimal conditions for their traditional mode of production.

The colonizers' choice of particular ecological niches is detectable in the archaeological record, since they preferred to settle in the flood plains where they could practice agriculture optimally, in Thessaly, for example, and later in the Pannonian basin (*van Andel and Runnels 1995.481*). A preference for such niches is reflected in the establishment of long-term settlements. It cannot be explained only in terms of topographical, hydrographical, and ecological conditions and how well they seemed to fit the migrants' expectations. Such choices of niches may also imply an awareness of the fixed inter-group bounda-

ries separating farmers from the surrounding niches exploited by the local hunter-gatherers. In the Thessalian Early Neolithic, for example, such boundaries are reflected in a deliberate avoidance of exploitation of the wild resources, local lithic raw materials and use of caves and rock-shelters, which is interpreted as an implication of a possible cultural prohibition (*Perlès 2001.5; 2003.106;* see also *Thomas 2003.69*). Discussing the faunal record from the Balkan Early Neolithic sites south of the Morava/Vardar watershed and Sredna Gora mountains in Bulgaria, Tringham (*2000.25*) also notes that wild food resources in the local rich micro- and macro-environment were under-utilized, but she wonders if it was "through ignorance or through resistance to venturing far in space or concept into the unknown." Both scenarios are viable, since the niche separation could initially have been the result of 'non-interaction' or 'limited interaction", or, basically a hostile interaction with local hunter-gatherers. A slow pace of landscape learning is therefore implicated ('a resistance to venturing in space'). The encapsulation of the local hunter-gatherers at a time when a greater population density in the Early Neolithic of Southern Balkans was reached, may have led to the introduction of such 'cultural prohibitions', and this brings to mind similarities with more recent examples of the hunter-gatherer/farmer social interaction from the ethnographic record (*Woodburn 1995.37–40*)[4].

However, following Meltzer's model, learning a new landscape may also have been a fairly rapid process, due to a completely non-hostile interaction with the local population. In the case of the Central Balkans and the Iron Gates region, one can easily recognize the archaeological signature of the initial Neolithic as a 'rapid directional dispersal', including the Meso/Neolithic 'mix' that occurred in the Lepenski Vir settlements.

The very first Early Neolithic settlers in the Central Balkans were individuals or smaller groups that actually needed the support of the indigenous hunter-gatherers in order to gain crucial information about a variety of factors such as the local topography, short-term seasonal climatic, hydrographic and ecological fluctuations, long-term changes in the availability of resources and the likelihood of catastrophic events – information that otherwise has to be learned over several generations. As stated at the beginning of this paper, we know almost nothing about these hunter-gatherers outside the Iron Gates region. However, we can see that the archaeological signature of the Early Neolithic settlements in the Central Balkans stands in contrast to those in the South. The settlements are short-term, tactical, and 'opportunistic', and there is no clear 'niche separation' (local lithic raw materials are used along with exotic ones; caves and rock-shelters were utilized; wild game exploitation is practiced), in contrast to the above discussed Thessalian and Bulgarian record (*Tringham 2000.25*).

In the Danube Gorges case, learning about the new landscape may have required learning *from* the resident population and *within the framework of the resident population's tradition* – understood here as the totality of "the socially and culturally defined normative rules for the transmission of knowledge and practical skill from one generation to another" (*Zvelebil 2001.1*). The archaeological signature of the Meso-Neolithic contact in the Danube Gorges, for example, implies that encounters with the local Mesolithic population were not marked by conflict, quite in contrast to the local inter-group or inter-personal violence during the Early Mesolithic reported at Vlasac and Schela Cladovei (*Boroneanţ 1973; Roksandic et al. 2006*). Ensuring this support necessitates very close social links with a resident group, including exchange and inter-marriage. Regardless of their knowledge of plant cultivation and stock breeding from their homeland (and in spite of bringing some or all of the 'Neolithic package'), the newcomers could not have been self-sufficient, either economically or socially, for some time in the novel and unfamiliar surroundings (*Tringham 2000.49, Zvelebil and Lillie 2000.64–65*). In this respect I agree with Tringham (*ibid. 47*) that the (Mesolithic) "fora-

4 Such cultural prohibitions targeted at the hunter-gatherers are conceivable in the circumstances of their encapsulation. Woodburn (*1995.34, 40*) notes that "*...nomadic hunting and gathering as a way of life does offer so many patterned contrasts to the cherished values of successful farmers that it is readily represented as alien and unintelligible; for farmers, it simply cannot be a 'real' coherent way of life at all and must be a bastardized form*." These cultural prohibitions would justify a farming community's pressure on the hunter-gatherers, which may include some or all the following: "*attempts to kill or injure them or to coerce them using violence; to classify them as inferiors and to treat them as such; to seize and entice them (especially their women and children) to work as slaves, servants or clients; to dispossess them of their land or the natural resources of their land; to seize their artefacts, or wild resources they have harvested; to divert them from working to meet their own needs into working to obtain furs, ivory, honey, meat, or other goods required by outsiders; to proselytize them and incorporate them, often in subsidiary roles, into outsider religious and ritual systems*."

gers in the Danube Gorges would have been the more dynamic partners in that interaction", because "they had greater access to exchange relations with agriculturalists, along with ceremonial paraphernalia and social complexity that such status might imply."

The post-6000 calBC farmers and stock-breeders in the Morava and Middle Danube valley would actually represent a part of the "secondary flow", a further north-westerly move of the south-east European agricultural frontier (*van Andel and Runnels 1995; Zvelebil 2001; Zvelebil and Lillie 2000*). This possibility has been supported by the recent radio-carbon dating for a number of these settlements, along with the palaeoecological evidence (*Whittle et al. 2002; Willis and Bennett 1994*). The groups spinning off that population were those that re-occupied the Iron Gates Gorges, establishing classic Starčevo-type settlements in the previously abandoned locations (Vlasac, Schela Cladovei etc.) and in locations that were still in use, enduring since the mid 7th millennium calBC, at Lepenski Vir and Padina.

Conclusion

The Mesolithic-Neolithic contact – preceding 6300 calBC – in the Danube Gorges was initiated by small 'pioneer' Neolithic groups. They were not self-sufficient economically and socially upon their arrival, and in order to subsist, had to co-operate with the resident population within the local framework of cultural traditions. Their 'signature' in the Iron gates Mesolithic include some elements of the Early Neolithic 'package', but may also be seen in some other aspects of the Late Mesolithic archaeological record (reflected in modifications of architectural standards and burial procedures). Based on the Early Neolithic record in the Central Balkans, a similar scenario of non-hostile interaction with local population may be expected. During this still unclear process of the early interaction between hunter-gatherers and farmers or stock-breeders around 6300 calBC, the Iron Gates Mesolithic sites were abandoned, except for Lepenski Vir and Padina, either as a result of climatic deterioration, increasing colonizers' pressure, or both. These factors did not allow Mesolithic hunter-gatherers to continue the intensive exploitation of aquatic resources. Since the intensification of aquatic resources and more permanent settlement among coastal hunter-gatherer groups is primarily triggered by inter-group competition, the abandonment of almost all fishing camps implies that this kind of competition ceased. The palaeo-dietary signature of this population confirms that aquatic sources ceased to be a staple food resource. These Late Mesolithic hunter-gatherers switched to a more mobile way of life, implied by the *K*-selected species in the faunal record. However, they continued to use the only two remaining locations – Lepenski Vir and Padina – probably as seasonal fishing camps and aggregation sites. On the one hand, the interaction with Neolithic groups was non-hostile and fully cooperative. On the other, the perpetuation of these locations' use and symbolic displays in material culture probably reflect the above described 'symbolic conflict', especially at Lepenski Vir. In spite of the diminished importance of *r*-selected species (i.e., fish), this situation is interpreted in terms of the local Mesolithic population's ideological, but not economic and social, resistance to contact with the Early Neolithic groups. According to another scenario, the mixed terrestrial signature in the palaeo-dietary record of the Lepenski Vir population is interpreted in terms of subsistence based on domestic food resources (but then, this population can no longer be a hunter-gatherer population).

The end of the cold and wet climatic oscillation at 5900 calBC corresponds to a more substantial Neolithic settlement of the Central Balkans, including the Iron Gates and neighbouring areas, as indicated by the increasing number of recorded Middle Neolithic archaeological sites. This secondary flow would correspond to larger farming population moving and settling in the Central Balkans, establishing longer-term settlements and more extensive land-use in the Morava and the middle Danube basin. The Danube Gorges sites were re-occupied, but this time by Neolithic groups displaying a full range of the 'Neolithic package' elements. The increase in Neolithic population density (which included the second wave of 'colonizers', descendants of early colonizers and local residents, and the assimilated groups of local hunter-gatherers) outside of the Danube Gorges, probably triggered the encapsulation of the remaining hunter-gatherers in the Upper Gorge. They continued for some time to re-affirm their cultural traditions by maintaining and revisiting the long-established Lepenski Vir and Padina aggregation camps, until in the mid-6th millennium when they were finally abandoned – but the surrounding Middle Neolithic settlements in the Danube Gorges were soon to be abandoned too. In their discussion on the Iron Gates Mesolithic, Fiedel and Anthony (*2003*) captured very well a probable reason for such development: "...the Neolithic farmers were less concerned with securing a good local fishing place than with winning control of this nexus of indigenous social

and ideological resistance. Once they accomplished their goal, they had little further interest in this agriculturally marginal area".

Recent studies in the Meso/Neolithic transition based on, for example, genetic models (*Barbujani and Chikhi 2006*), population dynamics (*Davison et al. 2006*), and radio-carbon data (*Gkiasta et al. 2003. 48*) were not discussed here at great length. They all emphasize the 'overall process' and 'continent-wide patterns' which could not, so far, contribute substantially to a topic that attempted to explore local social (and demographic) dynamics, which we have seen to be of the outmost importance in the understanding of any kind of 'transition'.

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Eastern, Central and Western Hungary – variations of Neolithisation models

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ABSTRACT – *Until recent times, the Carpathian Basin was regarded as a uniform zone of neolithization. In the last few years it has become clear that at least three different types of transitions can be distinguished in the Eastern Plain (Alföld) region: one in the Jászság area with authentic Mesolithic sites, one in the northern, one in the northeastern fringes of the Körös distribution area, and a further one in the southern part of the Danube–Tisza Interfluve where the impact of the formative Vinča culture must also be reckoned with. All regions differ from each other, concerning the contacts with Mesolithic population and the phases of neolithisation. Regarding Transdanubia, the picture becomes even more complex. The transition to the Neolithic obviously differed in each region: in the Drava valley where the Starčevo presence was very intensive, in the marshland around Lake Balaton, in the Rába valley lying close to the Alpine foreland, in the northern Transdanubian Danube valley and in the Little Hungarian Plain. Rejecting the simplifying model the assumption of a mosaic-like series of variations in the neolithisation process is offered. The process of Neolithisation is thus is far from being unified in the various regions. This short study tries to seek different models of neolithisation behind the differences.*

IZVLEČEK – *Do nedavnega so Karpatski bazen smatrali za enotno področje neolitizacije. V zadnjih nekaj letih pa je postalo jasno, da lahko na področju Vzhodne ravnice (Alföld) ločimo vsaj tri različne tipe tranzicije: prvega na področju Jászság, s prvotnimi mezolitskimi najdišči, drugega na severnem in tretjega na severovzhodnem obrobju področja Körös, še enega pa na južnem delu Donavskotiškega porečja, kjer je potrebno računati tudi z vplivom kulture Vinča. Regije se v procesu neolitizacije med seboj razlikujejo tudi v odnosih med mezolitskimi in neolitskimi populacijami. V Transdanubiji je ta podoba še bolj kompleksna. Tu je neolitizacije v vsaki regiji potekala drugače: v Dravski dolini, kjer je bila močno navzoča kultura Starčevo, na močvirnatem področju okrog Balatonskega jezera, v dolini Rabe, ki leži blizu alpskega predgorja, v severni Transdanubijski donavski dolini in na Mali madžarski ravnini. V članku zavrnemo poenostavljen model neolitizacije in ponudimo domnevo o mozaični seriji regionalnih procesov neolitizacije.*

KEY WORDS – *Carpathian Basin; Neolithic transition; Körös, Starčevo; early and developed LBK groups*

The Pre-Neolithic period in the Great Hungarian Plain (Alföld)

In Hungary, there is only one region where a settlement niche, a series of authentic Mesolithic sites, has been found, researched and proceeded. This is the Jászság area, east of the Danube (Fig. 1) Here, two phases were distinguished by the excavator, Kertész: besides the older Mesolithic Jászberény phase, a settlement of the latest period was also identified at Jásztelek. (*Kertész 1994a; 1994b*). The environmental and historical reconstruction of this phase has given basic new information about the phase immediately preceding the Neolithic (*Kertész-Sümegi 1999; Sümegi 2003*).

The north-eastern part of the Alföld (Fig. 2) shows a fairly different picture from the mid-northern fringes, at least in the present state of research. The catchments of the rivers Berettyó, Sebes and Fekete Körös form a complex, articulated landscape frequently dotted with marshes and swamps. Although stone artifacts of the Late Mesolithic – preceding the times of permanent settlements – are known from as far as Western Romania, no archaeological evidence of any settlements has been found. The palaeo-environmental analysis, however, was able to show up some evidence for pre-Neolithic clearing and forest burning activity from around 8400 cal BC, paths in the woodland e.g. in the Bátorliget marsh region as well as near the village of Csaroda in a marshy area, the 'Nyíres láp' (*Sümegi 2003.21–22, Fig. 1; Sümegi-Gulyás 2004.Ch. 3.8: Pollen and charcoal analysis*). Around 8400 calBC *Tilia* lost its dominace and *Quercus* became more typical (*Willis et al. 1995*), indicating closed forestation due to a milder climate with more precipitation. Dates for the mollusk fauna allow similar inferences (*Sümegi 2003.21*). Given space for sunlight, the growth of berries and especially hazelnut in the bushy-shrubby undergrowth were enhanced. Favorable changes in the landscape were further intensified by small-scale bush clearing, as findings from several European localities have indicated (*Gronenborn 1999; Zvelebil 1986; 2000*). Pre-Neolithic "Tardenoisien" groups of people may have only temporarily settled in small homesteads, and moved on with the shifts of the seasons accompanied by the migration of wild herds along the constantly shifting riverbeds. Maxim (*1999.27–30, 221–222*) thus concluded from her examination of the lithics from Transylvania and the Partium area that the river valleys and the upland areas must have been inhabited by a local population before the first farmers reached this region. Paul regarded the indigenous contribution important enough to speak of a "Prăcriş" culture, based on analogies with the Balkans (*Paul 1995.62–67*).

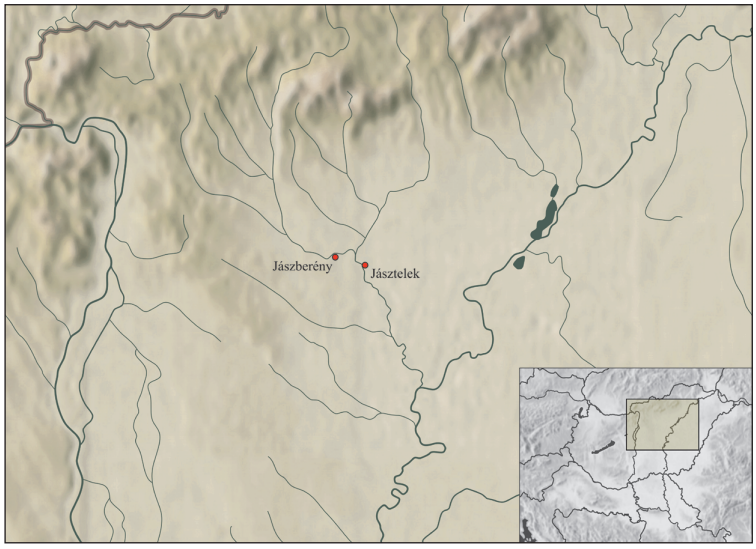


Fig. 1. The Northern part of the Duna-Tisza interfluve area (The Jászság), with sites mentioned.

The north-eastern part of the Alföld underwent significant transformations at the turn of the 7–6th Millennium BC. From this time onwards there was a decrease in the ratio of tree pollen in the profiles. This refers to a drop in woodlands, accompanied by a wide-scale extension of furrow-weeds, signifying human activities in the landscape (*Willis et al. 1995; Gál–Juhász–Sümegi 2006*). Besides forest clearings, traces of forming "hunters' paths" in the woodland, as well as hints of foddering animals with vegetation can also be observed in the region (*Sümegi 1998; 1999*). Quite obviously, and as radiocarbon dates of archeological finds testify, this was a time when the first immigrants from South-East Europe settled on the waterlogged soils stretching between the rivers Szamos and Berettyó. The flint assemblage from the pre-Neolithic site at Tarpa-Márki Tanya can be considered as

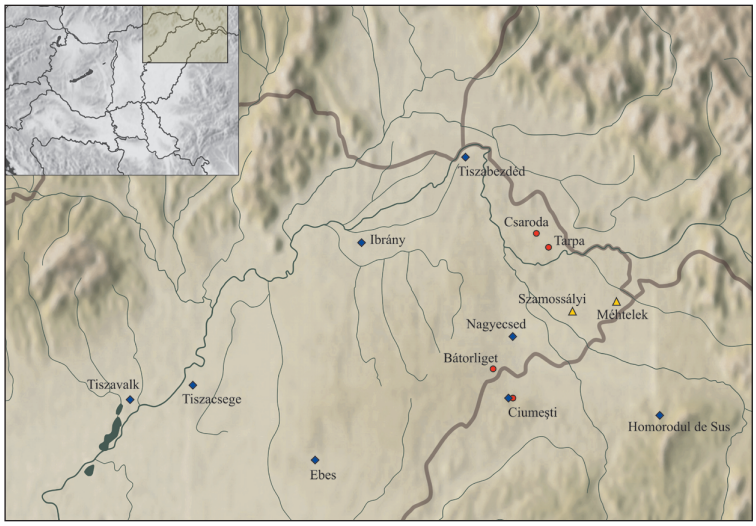


Fig. 2. The North-Eastern part of the Alföld and the adjacent Érmellék region in Werstern Romania. a) preneolithic sites; b) Körös-Criş sites; c) Early Alföld LBK (Szatmár II) sites.

archaeological evidence completing the scientific results (*Kertész 1994b*).

The process of Neolithisation in regions of the northern Great Hungarian Plain (Alföld)

Studying the main characteristics of Neolithic distribution in the Balkan area, several archaeological traces point to the inference that the Neolithic infiltration into Moldavia through the Banat, and the Olt valley, and Transylvania took a different path than the variant advancing westward from the Mid-Balkans, via the mouth of the Morava River. It seems that the Alföld region has much in common with the eastern type of Neolithic transition.

In recent decades, contradictory opinions have emerged about the Alföld Neolithisation. First, it was generally accepted that there were no people living in the area in the late Mesolithic; thus the first farmers arrived in a "vacuum" (*Gábori 1981*). In 1982 Makkay came up with an entirely new idea. He ascribed the peculiar northern frontier of the Körös and Starčevo cultures in the Carpathian Basin that contradict any natural geographical obstacles, to the hostile behaviour of a local forager population (*Makkay 1982. 23*). In the late 80's the discovery of a real Mesolithic niche (mentioned above) in the Jászság area between the Danube and the Tisza created the impression that Makkay was generally right in his postulating an indigenous population, although at that time he was not able to bolster his idea with any arguments. It is also possible that this population was not equally distributed in each Alföld region, not to speak of the different activity in contacting the newcomers. Up until now the Jászság is the only region where the presence of this Mesolithic population could be proven.

Concerning the early Neolithic development of Eastern Hungary, research was intensive in the mid-20th century, so that the first reports and evaluating studies appered in 1976 and thereafter (*Kalicz, Makkay 1977; Raczky 1988; Kurucz 1989; Nagy 1998*). Many decades ago, Kalicz and Makkay had already noted that the sites of the old 'Szatmár group' in North-Eastern Hungary at Nagyecsed, Tiszabezdéd, Tiszavalk, Tiszacsege, Ebes, Ibrány and Ciumeşti (Csomaköz) in the Berettyó and Szamos valley, in the Érmellék area and in the Upper Tisza region can hardly be understood without assuming intensive contacts with Transylvania (*Kalicz, Makkay 1972. 78; 1977; Makkay 1982*). At some sites (e.g. Nagyecsed-Péterzug, Tiszabezdéd-Servápa), Körös elements were more dominant than the Linear Pottery traits in the early Alföld LBK (Szatmár II) assemblages (*Kalicz, Makkay 1977.20*). Based on these features, Kalicz and Makkay assigned these sites to their 'Szatmár I' group,[1] together with the easternmost-lying Méhtelek, and close to it, the Romanian Homorodul de Sus (Felsőhomoród) (*Kalicz, Makkay 1972.92; 1977.22*). Following his excavation of the Kőtelek-Huszársarok site, Raczky noted that the assemblages of the Szatmár II group "contained many formal and ornamental elements whose origins could only be explained through the Transylvanian branch of the Körös culture" (i.e. the Criş culture) (*Raczky 1983; 1986.31; 1988.27*). Thus the idea was raised that the Szatmár II group as the earliest phase of the Alföld LBK would go back to the contact between late formations of the early Neolithic: the Körös in the Alföld and the Criş culture arriving from the East.

This hypothesis was then reinforced by analyses of smaller regions, such as Nyírség in North-Eastern Hungary (*Kurucz 1989; Starnini 1994*). Early Alföld Linear Pottery sites are lacking between this area and westwards to Hortobágy. Kurucz noted that the finds from the early sites on the Szatmár plain (up to the Szamossályi site) differed from the assemblages in more westerly areas to the extent that "any genetic relations between the two seem very doubtful" (*Kurucz 1989.15*). The later development in this region definitely confirms this observation. In the Middle Neolithic, this is the sole region occupied by the "Esztár–Szamos region Painted Pottery group", which is the only painted sub-group of the immense LBK culture.

Between North-western Jászság and the North-Eastern part of the Alföld, in the Upper Tisza region, there is a contact area between the lowland and the Mátra and Bükk Mountains extends. (Fig. 3) Here, the strong genetic relation between the early Alföld LBK settlements and the Körös culture can be seen.

Domboróczki came to the conclusion that the LBK formulation i.e. the Neolithic transition in this area took place with practically no participation of groups other than late Körös (*Domboróczki 2001; 2005*). Domboróczki completed his observations by hypothesising that local forager tribes that might have lived on the edge of the Alföld most probably withdrew to the mountains, and it was only in a later

1 This nomination is now out of use.

phase of the East Hungarian Neolithic that these groups began to merge with LBK: namely, their traces would be observed in the Tiszadob and Szilmeg groups of the developed LBK (*Domboróczki 2003*). Again, this inference could be reinforced by the anthropological analysis of some graves belonging to these groups (*Zoffmann 2000*). In connection with these ideas, it is to be noted that the original northern border of the Körös distribution along the Szolnok – River Berettyó line seems to collapse: new Körös sites are found north of this region, even in the Upper Tisza area; moreover, most recently one site, obviously connected with obsidian mining, was detected at the foot of the Tokaj Mountains.[2] Again, this is data that seem to bolster Domboróczki's postulations.

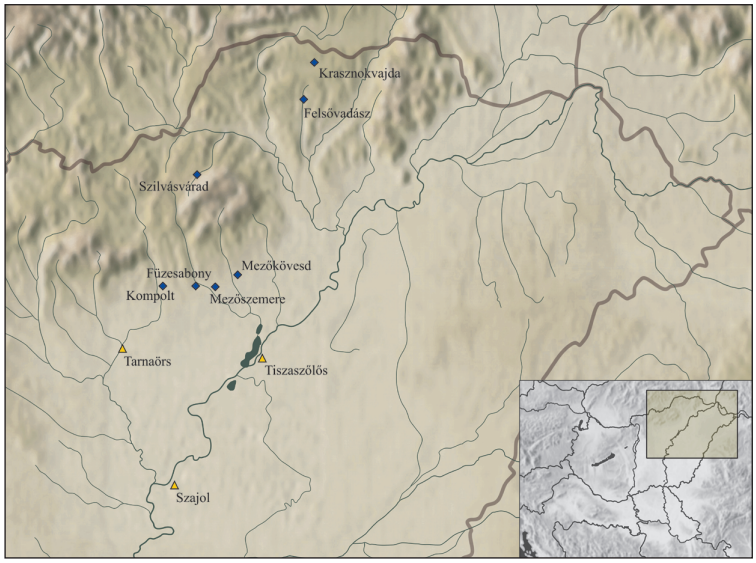


Fig. 3. The Northern part of the Alföld with the adjacent Bükk, Mátra mountains. a) Körös sites; b) Early Alföld LBK (Szatmár II) sites.

The later Alföld LBK groups, the Tiszadob, Szilmeg and also the Bükk formations set out from the Northern Mountains. The location of their possible local Mesolithic roots is a highly relevant assumption, which claims good arguments. Before drawing any conclusion on this question, however, some fields should be considered in detail. Such questions are signs of isolated development in pottery types and decoration. Some decorative features seem to be alien to the LBK heritage, while other new features can also be found in southern Alföld groups, like the Szakálhát, thus making their isolated highland origins questionable. Besides the basic studies and report already mentioned (*Kalicz, Makkay 1977; Kurucz 1989; Nagy 1998; 2006*), the proceedings of some further new sites along the M3 motorway, such as at Füzesabony, Mezőszemere, Mezőkövesd and Kompolt, have yielded some complementary information (*Domboróczki 1997; 2003; Kalicz, Koós 1997a; 1997b; 2000; Bánffy, Biró, Vaday 1997; Bánffy 1999*). For the earliest and developed LBK phase, however, real highland sites are also known (*Csengeri 2003; 2004; Bánffy 2000a*). The other relevant point is the exchange system which is seen as the basis for contacts between the Alföld and the assumed highland population. On this question the research work by Bácskay and Biró are essential, shedding new light on the raw material, provenance and the typological features of chipped stone implements within the LBK groups. (*Bácskay 1976; 1982; Bácskay, Biró 1983; 1987*).

A further link with the Körös roots of Alföld LBK in this region is the development of cult objects. In recent excavations of the northern Alföld, plenty of peculiar animal figurines and those depicting fabulous creatures (centaurs) have come to light (Füzesabony: *Domboróczki 1996; 1997*; Mezőkövesd: *Kalicz, Koós 1997a; 1997b*). These early LBK finds can be directly traced back to the Körös culture (*Domboróczki 2003.39*). This view seems to be completed by earlier cross-cultural cultic depictions, such as bull figurines or four-legged altarpieces, that had already been considered to have lived on as Körös influences on the Alföld LBK (*Kutzián 1944; Kalicz, Raczky 1981*). The famous flat figurines from Méhtelek also seem to confirm the connections between the south-east European type figurative art and the early Alföld LBK, where flat, close to rectangular figurines also occur. It can be assumed that the survival of cult object types may also involve the survival of certain elements in the ritual tradition and cult life.

Further important indications of characterising different ways within the Alföld development can be found when reviewing architectural traditions. The Early Neolithic houses of South-East Europe were small buildings. They were usually constructed on a square, rather than a rectangular ground plan, and they lacked an internal post structure, thus sugges-

2 I thank Pál Raczky's kind oral communication here. János Dani, archaeologist to the Déri Múzeum Debrecen also reported about a northernmost lying Körös site.

ting a light roof. Clay was used more abundantly than wood (*Lenneis 1997; 2000*). The spaces outside the houses were at least equally important as the undivided intramural interior spaces, which rarely contained a hearth. East of the Tisza River, the Körös communities followed exactly this South-East European tradition in house construction. Although it has been claimed that the Körös houses actually represent the earliest, central section of Linear Pottery houses (*Meier-Arendt 1989*), I have found no evidence to confirm this. The Szajol-Felsőföld type houses or those from the north (Krasznokvajda) differ both in their form and in their orientation from the north-oriented and heavy wood long houses of the Central European LBK (*Raczky 1977; Horváth 1989; Losits 1980*).

Besides architecture, pottery, physical anthropological analyses and similarities in cult objects, there is one more set new results which make a direct Körös impact on the formulation of Alföld LBK groups very probable: this is new information on absolute chronology. The new dates for the latest Körös and early Alföld LBK (Szatmár II) period show a definite overlap (*Whittle et al. 2002; Domboróczki 2003*), thus making direct contacts possible in this part of Eastern Hungary.

In sum: on the Northern fringes of the Alföld there are three regions where the phases of the Neolithic transition have been cursorily examined. In the northwestern part: at Jászság, there is direct evidence for late Mesolithic groups, but contact with the Körös culture has remained hypothetical as yet. In the Upper Tisza region, where the Alföld meets the Mátra and Bükk Mountains, traces of a dynamic Körös expansion have been observed. According to recent data, no considerable Mesolithic participation formed the early Neolithic in this region. The forager groups may have withdrawn into the highlands, contacting LBK groups only in their developed phases – a working hypothesis which requires further research. On the North-Eastern fringe of the Alföld, the existence of a Mesolithic population could be partly shown by data from the natural sciences (i.e. by anthropogenic impacts), and partly by flint assemblages from different sites. Direct contact with early Neolithic tribes is probable, yet this still lacks direct evidence. In this case, the earliest Neolithic impact consisted much more of the eastern, Criş branch of Körös culture, rather than its Alföld variant. According to recent research, the three areas mentioned here constitute three variants of the Neolithisation process.

Preneolithic Period in Transdanubia (Figure 4.)

In case the existence of any pre-Neolithic (i.e. late Mesolithic) hunter-gatherer groups are assumed in Transdanubia, then these groups definitely had to face wholly new ecological circumstances in the mid-centuries of the 6th Millennium BC. In some periods, Lake Balaton split into two or three smaller lakes, with clear, cold water; when the climate turned warmer and wetter, natural dams were breached and even the northern Tapolca Basin and valleys south of the lake also became part of the lake. During these periods, the lake flooded the north to south valleys, to its south down to the Kapos River, occasionally as far as the Drava valley (*Cserny 1999*). At these times the Sárrét bog, somewhat east of Lake Balaton became a one-meter-deep lake (*Juhász, Sümegi, Zatykó 2006, in press; Bánffy, Juhász, Sümegi, in press*). The water level of the lake was fairly low at the end of the Mesolithic, rising significantly around 5500–5400 calBC. The wetter climate and the rise in the water level meant that lake shore inhabitants were forced to move away from the lowest stream shores and river terraces, and to follow the growing water level along the shores of Lake Balaton (see also: *Juhász, Sümegi, Zatykó 2006, in press*). Despite the lack of well researched Mesolithic sites in the region, their presence in Transdanubia is partly reflected by some evidence. Such a hint is the registration of pre-

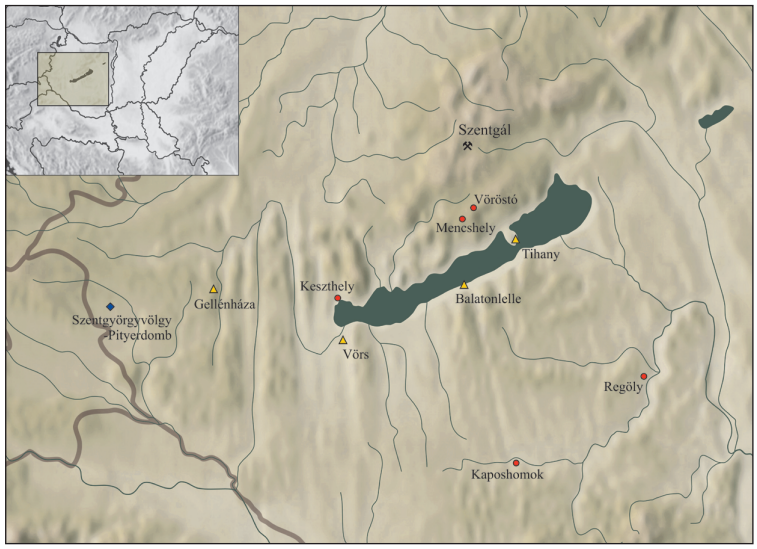


Fig. 4. The Balaton region in Transdanubia. a) preneolithic sites; b) Starčevo sites; c) earliest LBK site, d) prehistoric flint mine.

Neolithic forest burning. Traces of this activity were observed at Szentgyörgyvölgy, near the Pityerdomb site. The soil samples taken from the waterlogged, marshy banks of the Szentgyörgy stream flowing by the site indicated intentional forest burning around 8771 BP (7936–7821 cal BC) (*Cserny, Nagy-Bodor 2006*). The burnt organic matter and the low level of erosion in the area suggest that forest burning was repeated fairly often, about every 15–30 years. This phenomenon is also shown in pollen data (*Medzihradszky 2001; Füzes 1989; Zólyomi 1980; Nagy-Bodor 1988; Juhász 2002*). The pollen profiles for the Balaton Basin and the marshland of the Little Balaton region indicate that there was a sudden increase of hazel in the mid-6th century BC, and that over one-half, 55 per cent of the ligneous species, was hazel around 5600 calBC, i.e. in the period immediately preceding the LBK (*Juhász 2002*, see also *Juhász, Sümegi, Zatykó 2006, in press*). Botanical analyses have shown that south-western Transdanubia was a hazel refugium during the last glaciation, and that it spread to other parts of the Carpathian Basin from this area. Still, the sudden, large-scale expansion of the species can hardly be explained without assuming active human manipulation of the environment (*Bánffy, Juhász, Sümegi in press*). It seems likely that the growth of hazel was encouraged by forest clearance, by the creation of small clearings where this warmth-loving species yielding storable fruit with a high nutritional value could thrive. A comparison of the frequencies of hazel and cereals in the pollen diagrams is most instructive: the two are inversely proportional. The increase of cereal pollens is accompanied by a decline of hazel in the sediments. As a further hint of a Mesolithic presence, there was a pre-Neolithic boat find near Keszthely, which was no doubt used when the shoreline ran in that area, presumably still in the Mesolithic (*Bakay, Kalicz, Sági 1966.76*). As evidence closer to archaeology, microlithic trapezes and other types of the late Mesolithic tool-kit, collected during field surveys, have long been known from Transdanubia. Their dating, based on their typological traits, has never been challenged (*Mészáros 1948; Pusztai 1957; Dobosi 1972; Biró 1991*). Most recently, a thorough excavation was begun at the Regöly Mesolithic site, south of Lake Balaton. The preliminary results have yielded a great amount of stratified lithic instruments, although intact settlement features have not been found yet (*Eichmann, Kertész, Marton, in press*). The Kapos valley and the Vázsony basin, lying north of Lake Balaton near the Szentgál mine, are especially rich in finds of this type. The stone tools examined to date were almost all made from red radiolarite from the Bakony Mountains. Most recently, a new project has the task of investigating some especially promising sites south of Lake Balaton, and to clarify the late Mesolithic-Starčevo interaction and LBK cultural development by excavation.[3]

The process of Neolithisation in Western Transdanubia

Recent research into the Neolithic of Western Transdanubia and the findings of three micro-regional research projects made it more than probable that western Transdanubia and the Balaton region were part of a frontier zone in the mid-6th millennium BC, the setting of the long interaction between indigenous hunter-gatherer groups and immigrant Starčevo communities from the south.

The probably already existing late Mesolithic horticulture (see above) was expanded with the cultivation of domestic plants after contact with Starčevo groups (*Berzsényi, Dálnoki 2006*), and indigenous people also began to copy the immigrants' vessels. The result of the interaction between the two groups was the emergence of a genetically mixed population that soon colonized northern Transdanubia along the Marcal, Rába and Danube valleys, and later migrated farther along the Danube to eastern Austria, south-western Slovakia, southern Moravia and the heartland of Central Europe, where they played an active role in the transplantation of a sedentary, food-producing lifestyle.

Adaptation to the changed circumstances was both an option and a bitter necessity for each. The adaptation to the cool and wet Alpine-Atlantic climate of Transdanubia, with is heavy snows in winter, must have posed a serious challenge to the Balkan immigrants. Pityerdomb, Andráshida, and perhaps Brunn II near Vienna, finds from which are rooted in the Starčevo tradition, indicate that they were capable of adapting (*Bánffy 2004; Simon 2002; Stadler 2005*). On the other hand, a few Starčevo groups also settled in the marshland around Lake Balaton and on islets in the marshland, in an environment that meant a similar challenge for farmers of southern origin. The settlements at Gellénháza, Vörs-Máriaasszonysziget, Balatonlelle, and Tihany-Apáti re-

3 The Kapos and Koppány valleys in southern Transdanubia are the primary targeted areas. Participators in the program (2006–2009): E. Bánffy, T. Marton, K. Oross, R. Kustár.

flect this different type of adaptation (*Simon 1994; 1996; Kalicz, Virág, Biró 1998; Kalicz, Biró, Virág 2002; Regenye 2006, in press; Biró 2006*).

It follows from the rise of the Balaton water level that the one-time late Mesolithic settlements along the lakeshore are now all submerged. A closer look at the location of the plentiful early Neolithic sites around the lake reveals that they lie directly along the changed shoreline of the period, when the water level was higher than the present one, in the marshland or on islets in the marshland (Fig. 5). This settlement pattern broadly corresponds to the Mesolithic one. These settlements all lay in close proximity to the water, in areas that were unsuited to agriculture. It is therefore possible that the majority of the settlements lying directly on the shore in the marshland had in fact been occupied by adapting Mesolithic hunter-fisher communities and those smaller groups of Balkan immigrants chose to settle in this area under their influence. If this was the case, it also implies that relations between the Starčevo groups and the indigenous population were essentially peaceful.

In spite of the fact that the settlements lay in an environment that was unsuited to cultivation, macrobotanical finds from the earliest phase indicate a surprising variety of species. As to the samples from Pityerdomb, the number of remains was low for each species, never exceeding twenty specimens (*Berzsényi, Dálnoki 2006*). The surprising variety (einkorn, spelt, common wheat, barley and edible goosefoot), but low number of cereal grains would suggest that the extent of cultivation in western Transdanubia and the Balaton region did not exceed that of Mesolithic horticulture – the range of plants cultivated and tended in the open areas between the houses and in the narrow zone along the shore was simply broadened with the species adopted from the Starčevo communities, together with the art of cultivation. Thus, in the formative Neolithic phase, domesticated plants may not yet have become the basis of subsistence; instead, they seem to have been a complementary source.

Mesolithic impact may well be assumed in early architecture. In the northern and western Starčevo distribution, new features appear which already form a link to LBK buildings. In spite of the lack of houses on the Starčevo sites in Transdanubia, the presence of burnt daub fragments suggest that these communities lived in small- or medium-size houses (*Kalicz 1993.87*).

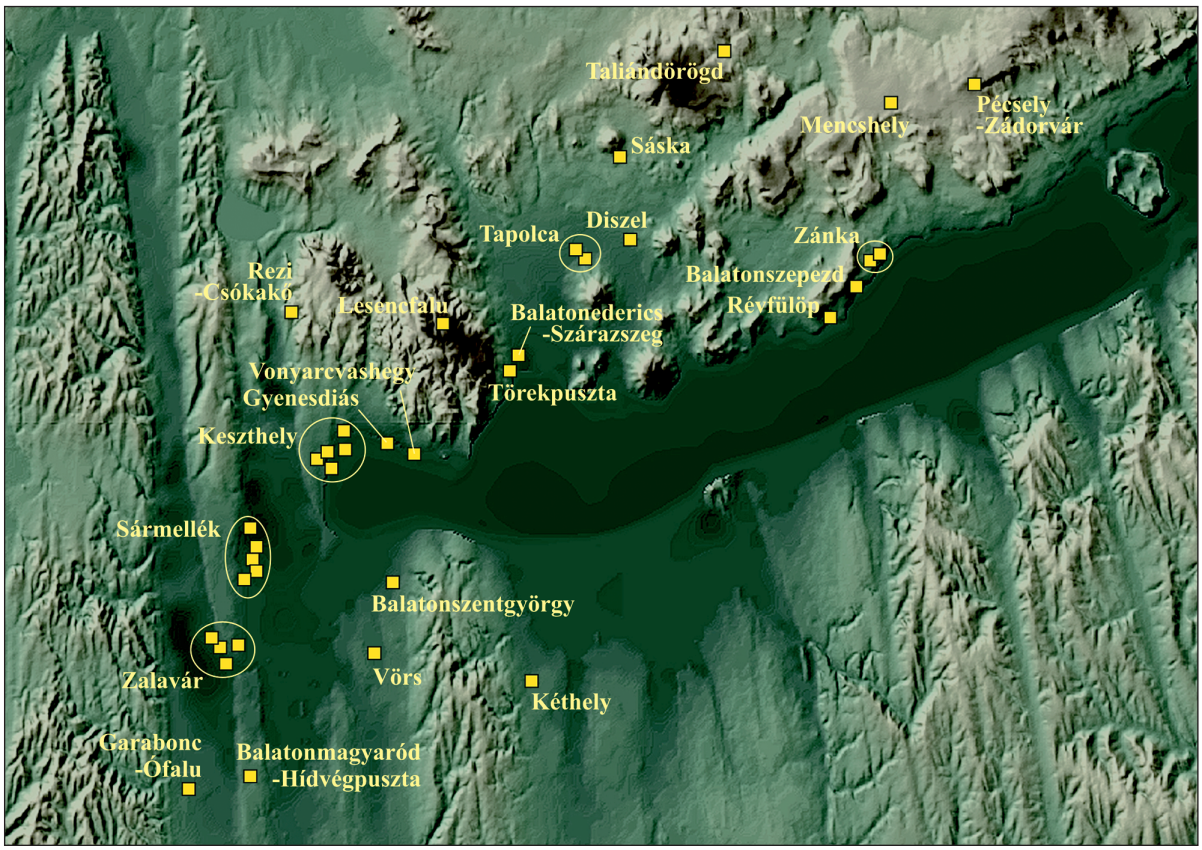


Fig. 5. The Western Balaton region (satellite photo) indicating the ancient shorelines and the earliest LBK sites along.

In the earliest phase, early Central European LBK houses were single roomed, with a southern and northern part added at some later date. Extramural activates were performed in pits, many of which had some sort of protective roofing, especially in the northern part. These phenomena can primarily be explained by the climate, with cultural traditions playing a secondary role only. It would appear that the central section of the Central European Linear Pottery houses evolved first. Timber played an increasingly important role in the construction of these buildings. The size of the two houses excavated at Szentgyörgyvölgy-Pityerdomb (*Bánffy 2000b; 2004*), the combined use of timber and clay, and the northern orientation appear to have been adopted from the pre-Linear Pottery period. The long pits flanking the longitudinal walls are first documented at this site. We may therefore assume that both Mesolithic and Starčevo influences played a role in the emergence of Linear Pottery houses, as did the environment and climate.

Contacts can also be analysed by examining early pottery in Transdanubia. Significant differences can be noted between the pottery assemblages from the late Starčevo settlements in western Transdanubia and the Balaton region, and those from southern Transdanubian and more southerly sites. This difference, reflected in the finds from Szentgyörgyvölgy-Pityerdomb and a number of other settlements, can most likely be attributed to the cultural impact of indigenous hunter-gatherer groups (*Simon 1996; 2002; Bánffy 2004*).

The examination and interpretation of cult finds leads to a similar conclusion (*Bánffy 2005*). The appearance of the cult objects of the South-East European Neolithic in transitional assemblages, such as the one from Pityerdomb, and, later, of their copies, again indicates some form of interaction between the two populations. There was no trace of the rich diversity of the Early Neolithic statuary of the Balkans either at Pityerdomb. This would suggest that some of the cult paraphernalia were adopted and used by the formative Linear Pottery communities, while others were discarded. Neither can we reject the possibility that certain elements of the cult inventory were adopted or copied for prestige reasons, as in the case of other Neolithic innovations, perhaps as the reflection of an incipient social ranking in these indigenous communities. It is my belief that the local copies of cult objects and the drastic decline in statuary can be explained by the cultural impact of indigenous hunter-gatherer groups in the mixed population forming the early Linear Pottery communities.

The survival of the Mesolithic lifestyle in the transitional period can also be traced in the chipped stone inventory. The rich lithic assemblage found near Vöröstó and Mencshely, two Linear Pottery sites in the Vázsony basin by the northern shore of Lake Balaton, is in the late Mesolithic Tardenoisien microlithic tradition. A closer examination of the stone artefacts reveal traces of sickle gloss on a few samples. There are two possible explanations: the sickle gloss can be attributed to their use in Mesolithic horticulture, or the lithics came from an early Linear Pottery settlement preceding the occupation in the classical phase (*Biró 2001; 2002b*). An interesting observation is that the disappearance of this tool-kit coincided with changes in settlement patterns and subsistence at the beginning of the developed Transdanubian LBK, the Keszthely phase – the very period when the occupants of the Transdanubian settlements began to use the more simple range of tools generally characterizing Linear Pottery cultures, restricted to sickle blades and a few other types (*Biró 1991; 2001; 2002a; 2002b*).

The indigenous Mesolithic groups were clearly part of the mobile hunter-fisher-gatherer population whose stone tools and other remains have been found in the Vázsony basin in the Balaton Uplands, in the Little Balaton region, and in the Szentgyörgyvölgy area. The interaction between the two populations probably meant that the two distinct lifestyles and sets of values acted as a stimulus, while their mutual reliance on each other no doubt contributed to minimalizing conflicts, promoting peaceful co-existence, or even the joint occupation of settlements.

This long-running process of gradual change suggests that the statement that the so-called "Neolithic revolution" i.e. the radical change in subsistence did not happen in the initial phases of the West Transdanubian Neolithic, but one phase later. In Transdanubia the major change in lifestyles and subsistence patterns occurred not at the beginning of the Neolithic, as earlier believed, but some three or four generations later.

The problems of Neolithisation in Eastern and Northern Transdanubia (Figure 6)

Among the fairly intensive LBK sites from County Fejér, North-Eastern Transdanubia (*Makkay 1970; 1978*), the fairly intensive presence of only the deve-

loped phases can be confirmed. Among these, the Bicske site is the only exception dated to the older phase. It was named as the eponymous site for the older Transdanubian LBK by Makkay. However, it seems that it may not represent the initial, oldest phase of the culture (*Bánffy, Oross in press*). There are several regions in Transdanubia where both the oldest, Sármellék-Pityerdomb typed pottery, and also the slightly later Bicske typed pottery, are present. First, the possibility had to be maintained that this phenomenon may well be treated as a geographical difference, since there has not been abundant data for assuming the opposite. In north-eastern Transdanubia, for decades the Bicske typed material had been the only representative of the old LBK, before a new site was excavated in by Kalicz-Schreiber and Kalicz (*Kalicz-Schreiber, Kalicz 1992; Kalicz, Kalicz-Schreiber 2002*). Budapest-Aranyhegyi Road, lying in the marshy plain of the Danube bank in Aquincum, northern Buda. It was dated to the older LBK phase. Interestingly enough, older LBK sites did not grow with time and increasing research intensity. The topographic description of the region of Esztergom and Dorog (north-west of Budapest) contains no hints of LBK sherds that could be dated to the older phase (*Horváth, Kelemen, Torma 1979*). As we shall see, along the northern banks of the river i.e. in South-western Slovakia, the situation is the same. Pavúk himself was unable to present sites of this type either along the Danube, or in the Csallóköz area on his most recent, 1994 map (*Pavúk 1994.147*). The reason for this hiatus remains enigmatic. The contacts of the Linear Pottery sites in the Burgenland and Lower Austria with Transdanubia suggest that the main route of migration led through the Danube valley. It is to be hoped that future investigations will resolve this issue.

In connection with these observations, Pavuk's hypothesis of Neolithisation in South-western Slovakia is worth mentioning. These views, essentially unchanged for long decades,[4] can be rejected on the basis of the following arguments. While accepting J. Lichardus' earlier "proto-Linienbandkeramik" theory (*Lichardus 1972*), Pavúk made two claims (*Pavúk 1962; 1972; 1980a; 1980b; 1994*). The first of these was that Linear Pottery society and lifestyle developed in south-eastern Slovakia. The other, the more bizarre aspect of his thesis, concerned the date of the emergence of Linear Pottery. Pavúk dissociated Linear Pottery development from the cultural and ethnic influence of the Balkans, both in the Great Hungarian Plain and in Transdanubia, the latter being the more interesting of the two areas, owing to its proximity to Slovakia. In his opinion, the transition and the first use of pottery were not only entirely independent of the Körös-Starčevo culture and its possible effects on the Nitra Basin, but actually began much earlier than the generally accepted late Starčevo period, namely, in the period corresponding to the early/classic Starčevo phase. Pavúk attributed the undeniable similarities between late Starčevo and Linear Pottery to the later, southern expansion of groups from the Nitra Basin, during the course of which the Linear Pottery groups interacted with the Starčevo communities of the Spiraloid B phase in Transdanubia. He distinguished four sub-phases in the early Linear Pottery phase of western Slovakia – the Nitra, the Hurbanovo, the Bíňa and the Milanovce phases – in order to demonstrate the complexity and long duration of the process (*Pavúk 1980a.40–47*). This categorization is uncertain and controversial, to say the least, since it is based exclusively on the manufacturing technique and the (rather rare) ornamental motifs of the pottery. Only at Bíňa were fine, biconical wares found; the pottery from the other sites is dominated by thick-walled household pottery.

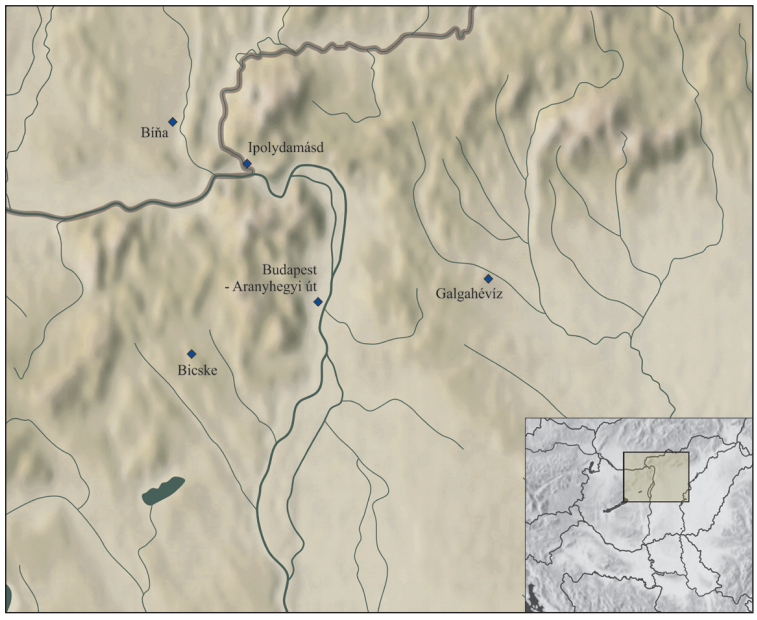


Fig. 6. North-Eastern Transdanubia with the adjacent Gödöllő hills and Jászság region to the east with early LBK sites mentioned.

4 Most recently in Zvelebil M., Lukes A. (eds.), *LBK dialogues.* Oxford 2004.

It is very difficult, if not downright impossible to set up a finer typological classification and to distinguish chronological horizons on the basis of coarse pottery, a handful of mostly surface finds.[5] Most of the pottery in question was admittedly recovered from smaller soundings and a handful of pits uncovered during small-scale excavations; very few represent closed assemblages and the "Hurbanovo phase" is exclusively based on a few surface finds. The Nitra type pottery can best be linked to the early Linear Pottery in the Balaton region; indeed: the absence fine wares and ornamentation can also be observed in assemblages of the type found in several sites, e.g. Sármellék, Révfülöp, Balatonszepezd, Tapolca-Plébániakert (*Bánffy 2004.334–344*). The Nitra Basin groups were unlikely to have invented pottery making on their own; a more likely possibility is that they adopted this innovation together with other elements of the Neolithic package from groups on the fringes of the Starčevo distribution, or rather from those groups born from the (intermarriage) mixing of southern immigrants and indigenous groups. It would seem that as a result of the cultural influences affecting Transdanubia, the indigenous groups inhabiting the northern part of the Little Hungarian Plain, too, tried their hand at pottery making.

In a recent study, Petrasch (*2001*) examined the problem of the Linear Pottery 'homeland' from a demographically. According to his estimates, northern Transdanubia, south-west Slovakia, the Burgenland and Lower Austria, could at the most have had a population of five thousand at the dawn of the Neolithic. Petrasch concluded that this region was more probably the first stop in the Linear Pottery expansion, rather than its point of departure. He also noted that Linear Pottery probably evolved in the Zala and Bakony region and the southern part of the area around Lake Fertő, i.e. western Transdanubia (*Petrasch 2001.17*).

Most recently, it occurred also east of the Danube that assemblages very similar to those from Budapest-Aranyhegyi Road have been found. Apart from very dense settelment in the developed LBK phases, the site at Galgahévíz contained pottery fragments of the oldest LBK phase (*Kalicz, Kalicz-Schreiber 2002.29–30*). Similarly, the oldest LBK vessel profile comes from Ipolydamásd, unfortunately a surface find (*Torma 1993.111, site 9/4 and Pl. 1*). Even with the help of these scattered finds it is not possible to answer questions about Neolithisation in north-east Transdanubia. These data, on the contrary, raise some new questions about the hypothetical contacts of Transdanubian LBK and the Late Mesolithic/Early Neolithic of the Jászság area, and also possible connections to the Szatmár II group, i.e. the earliest LBK in the Mátra-Bükk fringes of the Alföld.

When contrasting this peculiar phenomenon to the intensive Körös occupation of the Southern part of the Duna-Tisza heartland, which suddenly stopped south of the Jászság, a very new model of various Neolithisation types start to form. Certainly, much more data will be necessary even to make the questions more adequate, not to speak of the answers.

The possible causes of the differences

The first and most adequate answer for the different modes of Neolithic transition, in other words, Neolithisation models within a rather small geographical area, could be found in the different ratios and communication with local tribes (Fig. 7). There are two regions, the Drava Valley and the fringes of the Alföld at the Bükk-Mátra Mountains, where intensive Southern immigration dominated over the possible indigenous population, whose participation in the Neolithic package was weak. The Jászság area represents the other pole, according to our present knowledge. Here the indigenous groups are clearly present, but it seems that the real Körös sites, as well as transitional settlements that could represent contacts between the groups of different subsistence, are scarcely present. We found two regions: Western Transdanubia, including Lake Balaton and the north-eastern edge of the Alföld (the Nyírség), where it is highly probable that indigenous foragers came into contact with Starčevo groups in the first case, and Criş groups, in the second case. There are no real ideas as yet about the Neolithisation process in the north-eastern Transdanubian and the Budapest area, including the problem that the sporadic earliest Transdanubian (Central European) LBK sites are geographically very close to the Jászság, but this only compounds the problem. The second type of answer should be sought in the ecological barrier hypothesis (*Sümegi, Kertész 2001, Sümegi, Kertész, Hertelendi 2002*). In spite of the total misunderstanding valuations of this idea (*Makkay 2003.34–37*), this hy-

5 In contrast to the few dozen sherds categorized by Pavúk, Ottó Trogmayer examined tens of thousands of pottery fragments and was still unable to establish the internal chronology of the Körös culture (*Trogmayer 1968*). The lack of an internal chronology for the Körös culture is one of the great debts of Hungarian prehistoric research. M. Cladders' analyses of Linear Pottery wares yielded a similar result: in her opinion the differences can be traced to regional, rather than chronological differences (*Cladders 1995*).

pothesis about a Central European Agro-Ecological Barrier (CEB AEB) is not a frontier dividing the two groups of different subsistence modes from each other. On the contrary, this barrier means that the climatic situation would make the migration of Balkan farmers increasingly slower, until reaching an area in which for some species of the Neolithic package, including floral and faunal elements, it became hard or impossible to survive. Such species could be e.g. caprinae (sheep and goat) in the Western Transdanubian Atlantic climate, where in the wet winters, with high and long-lasting snow; short-legged animals would sink into the snow, dying before the spring of pneumonia and other disease. This all means that people who migrated from the South would have had to stop or move north or west much more slowly than earlier. This is the negative impulse. The ecological barrier also has a positive impact on the Neolithisation process. This lies in the longer time spent in one area, thus making it possible for small indigenous to come into closer personal, cultural and exchange contacts with the newcomers. A typical area for this longer-lasting process is the Balaton region, where co-existence is shown by several direct and indirect archeological and other evidence (*Bánffy 2000b; 2004; 2005*).

A further, significant difference in the Neolithic transition can be observed between the two major regions, the Transdanubian and the East Hungarian, Alföld area. This difference can be more easily observed when examining their persistence in the Middle Neolithic, which was caused by divergent modes of Neolithisation. During the whole life of the LBK, the distribution area remained roughly the same in the East, with no extension during the developed phases: from the Tisza to the Körös River regions and the Partium. The process in Transdanubia was just the opposite. Within a few generations, 80–120 years, the Transdanubian early LBK groups, i.e. a genetic and cultural mixture of indigenous foragers and Balkan farmers, had occupied a vast area covering a major part of Europe between the Paris Basin and south-east Poland. There must be diverse strategies hidden behind these major differences.

The eastern group chose an inceasingly intense settlement pattern, and agriculture that led to the formations of real tell settlements. This process must have happened together with an intensifying social stratification, hereditary social ranking, the intensive development of symbols and ritual life, and practically with the formation of a pre-urban society very similar to the Near Eastern model. Not unimportantly, it shows considerably more complexity than the economy of the previous periods. Agriculture, stock breeding played the main role, and, according to the social rank that must have been formulated by the Late Neolithic, all these activities must have been organised to a formerly unknown level.

The Alföld Linear pottery groups had every opportunity to exploit their rich soils and they were also in a position to develop intensive exchange relationships with their eastern neighbours. In other words, they were able to keep their settlements flourishing without migrations. This could be a prime reason for intensive internal expansion and social development without any changes in the Alföld distribution area. Thus, the Alföld region may have had the function of a "central site" from the Middle to the Late Neolithic. Nevertheless, this process seems to have had an end in its gestation stage (*Bánffy 2002*). The uppermost layers on numerous tell settlements show clearly how the mounds were abandoned at the dawn of the Copper Age (roughly around 4400 BC).

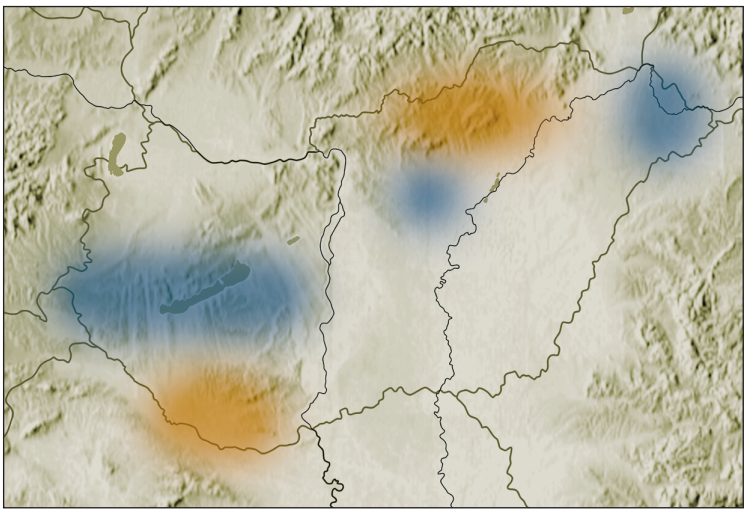


Fig. 7. Key areas of studying the neolithic transition within Hungary. Regions marked in yellow: stronger Körös/Starčevo impact; regions marked in blue: stronger Pre-Neolithic impact.

In Transdanubia, the keys to finding a reason behind the rapid distribution of the Western LBK are probably long-distance exchange and cultural contact. The causes behind the expansion and the survival of the contact networks may have been based on similar reasons, but the position of Transdanubia was determined by the lack of the Alföld conditions on the one

hand, some pressing contingencies and waves of migration on the other.

The expansion into the heartland of Central Europe was so rapid that it left no typological differences in the archaeological record (*Quitta 1960; 1971*), nor can the successive phases be pinpointed with radiocarbon dates (*Gläser 1991; Lenneis, Stadler, Windl 1996; Bánffy, Oross in press*). One obvious explanation was to invoke rapid population growth for this swift expansion, based on the examples from the ancient Near East. In his quoted study on the demographic data for the Early Neolithic, Petrasch shattered any illusions about this theory, arguing that early LBK population growth could have been no more than 0.1 per cent (*Petrasch 2001.18*).

Another probable explanation is offered by Anthony, when he writes of some positive triggers for migration, such as low population density, fertile soil, proximity to water, good climate etc. (*Anthony 1992. 898*). 'Push' forces, such as over-population or climatic deterioration, can be rejected in the case of the LBK expansion. In contrast, there is evidence for each of the "pull" forces. If exchange relations can also be created and maintained, an area of this type usually attracts settlers. "Migration is a social strategy" (*Anthony 1997.22*). Justifying this idea, the evidence for communication and contact networks between Transdanubia and the regions to its northwest can be reflected e.g. in the presence of Szentgál radiolarite in Moravia, and in Germany, being only modest indications of these networks in the archaeological records. Since there had to be a mutual interest forming the basis of these contact relations, the prehistorian would search for something the early Transdanubian farmers could be in need of, since north of Bosnia there is no source of salt in the whole region (*Tasić 2000.39*). This is not to say that the commodity in return may not have been salt. This idea occurs when examining the Bad Nauheim-Niedermörlen settlement north of Frankfurt/Main (*Schade-Lindig 2002a; 2002b*). The finds from this site reflected surprisingly strong ties with Transdanubia. Bad Nauheim lies in an area rich in salt. Saile argues for the early Neolithic exploitation of salt mines in Westphalia and Lower Saxony (*Saile 2001. 150–151*). It is therefore possible that this easily transportable and valuable commodity, essential to diet, for food preservation, and for animal husbandry, was exchanged for various articles from the Danube valley.

One could certainly object that the rich salt area at Hallstatt near Salzburg in the Upper Austrian region lies much closer. However, the distribution of Early Neolithic sites indicates that the migration route led along the northern Danube bank, through the Munich basin to southwest Germany. In this way, the salt mines in Hallstatt were unknown and can thus be rejected as a possible source. LBK communities of Transdanubia sought to acquire salt from regions with which they were familiar, in part as a result of their pre-Neolithic contacts, and in part from the knowledge acquired during their primary migrations – in other words, from the northwest. This probably enhanced the importance of the Wetterau and Aldenhoven region.

In spite of the many differences, some similarity can also be noted between Neolithization in Transdanubia and the Upper Tisza region. It has been repeatedly noted that riverside settlements in the area between the Great Hungarian Plain and the mountainous region to its north acted as a kind of 'marketplace' for the interaction: the possible co-existence and mixing of groups with different lifestyles during different periods of the Neolithic and the Copper Age in Hungary (*Kalicz 1994; Raczky et al. 1994; Bánffy 1999*). In this respect the northern Alföld fringes resemble western Transdanubia and the Balaton region, where interaction between different groups was stimulated by the trade in Szentgál radiolarite. In the Northern Mountain Range, the most valuable raw materials were limnoquartzite from the Mátra Mountains and obsidian from Tokaj. The stone tools found on early Alföld Linear Pottery sites and also on Körös sites were predominantly manufactured from these two rocks (*Kalicz-Makkay 1976.23; Starnini 1994; 2000; 2001; Biró 2001; 2002b; Maxim 1999*). If we accept the Mesolithic presence in the mountains, it is not to exclude the possibility that these precious raw material sources were controlled by these groups both in Transdanubia and in the Northern Mountain Range, and that the main cause and incentive for the interaction was the trade in these lithics. The indigenous groups presumably received Neolithic technologies in exchange for the lithic raw material in the Great Hungarian Plain, too, similarly to the situation assumed for Transdanubia.

In this sketch of the Mesolithic-Neolithic transition and early Neolithic formations, which appeared so differently in small regions within Eastern and Western Hungary, it seems that working hypotheses with question marks are more numerous than answers. Nevertheless, beforehand there were hardly any questions put. This stage is, in my opinion, a step forward that reflects the present state of research.

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Transformations in East-Central Europe from 6000 to 3000 BC: local vs. foreign patterns

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ABSTRACT – *In the sixth, fifth and fourth millennium BC, in the basins of the Vistula and the Oder, extremely complex economic, social and ideological transformations took place. They consisted in the emergence and expansion of new systems of circulating information ('communicative communities'). The majority of these were connected with the Neolithic. The process involved a constant clash between foreign and local patterns. The latter, over time, prevailed. Hence the ultimate dominance of Neolithic communicative communities in the eastern part of Central Europe around the middle of the fourth millennium was essentially a local development. Nonetheless, a considerable portion of the territory continued to remain outside their influence. Therefore, throughout the three millennia, Mesolithic communicative communities not only gradually merged with or evolved into Neolithic ones. They also embraced such transformations, mainly concerning the material culture and ideology, which were completely independent from the advances of the Neolithic, or could have been competitive in relation to them.*

IZVLEČEK – *V šestem, petem in četrtem tisočletju BC so se ob Visli in Odri dogajale izjemno kompleksne ekonomske, socialne in ideološke spremembe. Vključevale so pojav in širjenje novih sistemov distribucije informacij ('skupnosti, ki komunicirajo'). Večina jih je bila povezanih z neolitikom. Proces je vključeval stalna nasprotja med tujimi in lokalnimi vzorci. Slednji so sčasoma prevladali. Zato je bila dokončna nadvlada neolitskih 'skupnosti, ki komunicirajo' v vzhodnem delu srednje Evrope okoli sredine četrtega tisočletja v bistvu lokalni razvoj. Vendar je ostal velik del omenjenega teritorija še naprej izven njihovega vpliva. Zato se mezolitske 'skupnosti, ki komunicirajo' skozi tri tisočletja niso le postopoma zlile z neolitskimi ali razvile v njih. Vključevale so tudi transformacije materialne kulture in ideologije, ki so bile popolnoma neodvisne od neolitskega napredka ali so mu bile celo konkurenčne.*

KEY WORDS – *East-Central Europe; Late Mesolithic; Neolithic; Neolithisation; foreign and local patterns*

Introduction

The topic of this paper is the transformations that took place in the eastern part of Central Europe between 6000 and 3000 BC. My general thesis is that foreign influences and foreign systems in circulating information that were certainly present during that period caused indigenous reactions leading to the creation of such systems at the local level which consisted of indigenous elements, as well as selected external ones. I took the liberty of calling these systems, both foreign and local, 'communicative communities' (*Verkehrsgemeinschaft*), using the term applied by a Polish philologist Ludwik Zabrocki (*1963*), whose work focused on German historical and geographical dialectology. It must be strongly stressed that his term is not, or in any case does not have to be, equivalent to a linguistic community.

"*It is not necessary for a communicative community to have at its disposal only one medium of communication. A communicative community may use various media of communication, that is various languages. (...) every linguistic community is or was also a communicative community, but not every communicative community is a linguistic community*."

(*Zabrocki 1963.27–28* translated by M. Kapera)

It appears that a communicative community may embrace a number, large or small, of linguistic communities. Basically, Zabrocki's approach pertained to the dimension of language, which is obviously connected with the fact that the quoted study discussed exclusively philological matters. However, it is my conviction that it is worthwhile transplanting the term 'communicative community' to other, non-linguistic fields (*Parczewski 2000*), although it remains debatable whether it should be actually linked with the traditional notion of archaeological culture. Such a correlation is problematic even due to the meanings embedded in material culture (*Hodder 1992.12–14; 1995.16; Tilley 1999; Thomas 1996. 59*). Yet this term should refer to the above mentioned system of circulating information, and strictly speaking to those parts of it whose meanings were understood and approved of (or perhaps also imposed on) particular people. It is to be concluded then that the term 'system of circulating information' is a more general one and, in a sense, more comprehensive than the term 'communicative community': thanks to circulating information, members of a community may become aware of things and behaviours which are not understood by them, the hidden meaning of which cannot be grasped by them. So, let me emphasise once again, a 'communicative community' would include this part of the system of circulating information that is understood and approved of, even subconsciously, as metaphorical meanings have to be taken into account, as well[1]. Usually the nature of the problem is concealed from us, and a given communicative community embraces a multitude of phenomena and meanings of various kinds. In the discussed period of time and area, there may have been very many such communities, not entirely overlapping from the point of view of chorology and chronology.

I will also argue that the communicative communities present in East-Central Europe between 6000 and 3000 BC, and that we can distinguish on the basis of the remains of their material culture, were not identical with genetic populations nor did they coincide with linguistic populations.

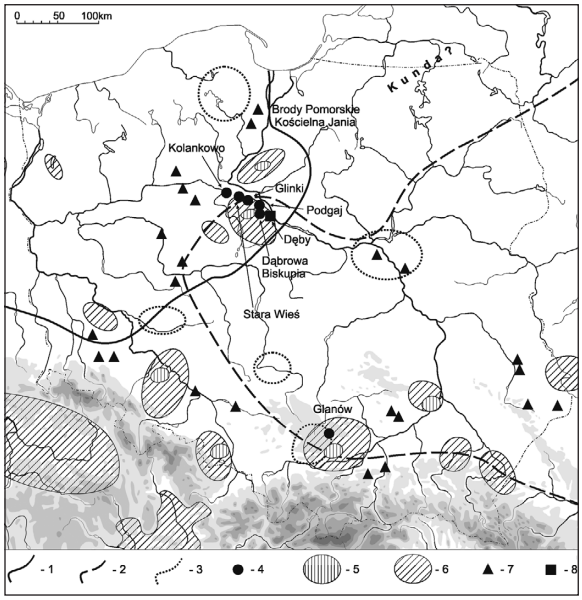


Fig. 1. East-Central Europe from 6000 to 4800 BC. 1 – post-Maglemosian units, 2 – Janisławice Culture, 3 – the latest Komornica Culture, 4 – selected late Mesolithic sites, 5 – early phase of the Linear Band Pottery Culture (LBK), 6 – maximal extent of the concentrations of LBK sites, 7 – selected, single sites of the LBK, 8 – site of Dęby 29.

From 6000 to 4800 BC

There are perhaps hundreds of Mesolithic sites, especially in northern and central Poland, that can be dated to the sixth millennium BC. They are grouped into two main division: the so-called Janisławice Culture and post-Maglemosian Complex (Fig. 1), comprising several smaller archaeological groupings. There are also relics of an older Duvensee archaeological tradition, which in Poland was distinguished as Komornica Culture (*Galiński 2002; Kobusiewicz 1999; Kozłowski 1989; Kozłowski, Kozłowski 1986*).

Whereas Neolithisation is the most important aspect here, one should also briefly mention the site of Dęby 29, in the region of Kuyavia (Fig. 1), which caused much controversy (*Domańska 1989; 1990; 1998*). In the fossil soil, under sand cover, numerous flints were found, as well as roughly two thousand animal bones. Among them, Lasota-Moskalewska

1 Of course it is an open question whether such term is the most accurate, and reflects the essence of the problem. One can come across a variety of similar terms which in my view have approximately the same connotations: 'interaction sphere' (*Caldwell,* after *Tabaczyński 2000.260*), 'interpretative community' (*Mamzer 2004.120-4*), 'homologous lineages' (*Shennan 2000.833*), 'system of circulating cultural information' (*Czebreszuk 2001.15*), 'communication systems' (*Raczky, Anders 2003.171*).

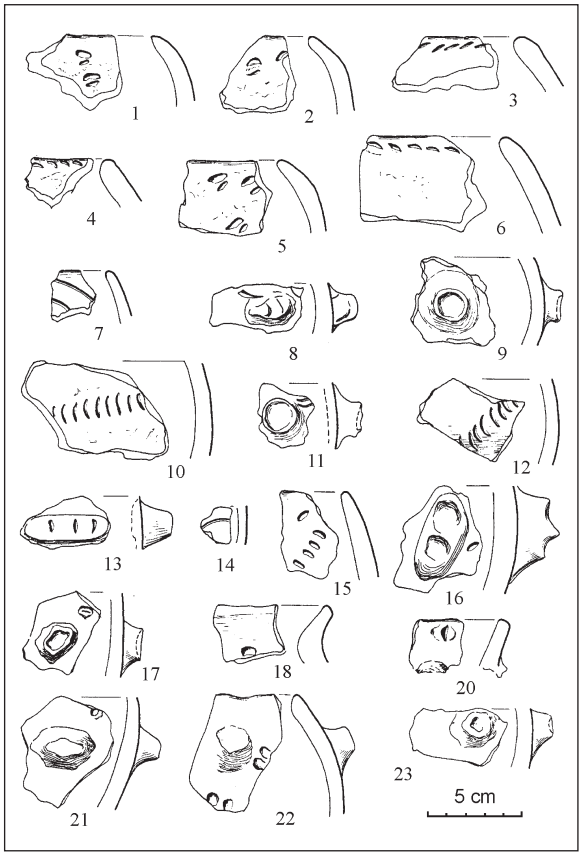


***Fig. 2. LBK-like pottery from the site of Podgaj 11 (Kuyavia, district Aleksandrów Kujawski); after* Czerniak 1994.**

(*1998*) identified several tens as bones of domesticated animals. However, the site findings aroused an extremely lively discussion. Opponents argued that there was no proof of homogeneity of the fossil soil, and consequently, the bones of domesticates may have been an admixture from the humic soil. Besides, there were also some doubts as to whether the bones were actually from domesticated animals (*Czerniak 1994.8–10; Kozłowski 1991; 1998; Niesiołowska-Śreniowska 1998b*). To sum up, I would say that the site even to date is still open to interpretation. At the same time, it provides a good example of the serious problems involved in the homogeneity of sand sites.

The first Neolithic sites in Poland (of Linear Band Pottery Culture, i.e. LBK) can be dated back to the beginning of the second half of the sixth millennium BC (*Bogucki 2000; 2001; 2003; Czerniak 1994; Kulczycka-Leciejewiczowa 1988; 2000*). They appear in southern Poland, as well as in the lowlands of Kuyavia and the Chełmno Land (Fig. 1). It is my belief, perhaps somewhat old-fashioned, that their appearance was a result of direct migrations by LBK farmers from the south, mainly from Moravia. From 54/53 centuries BC onwards, there was a considerable increase in the number of the LBK sites and of the LBK territorial range; however, the most of the sites were still concentrated within enclaves. All these enclaves comprise the most fertile soils. Certainly, there are also single sites of the LBK outside these enclaves, which reflect a relatively frequent penetration of less fertile areas in mountain, upland and lowland zones (Fig. 1). Very interesting in this respect are the recently discovered sites of this culture in Eastern Pomerania (*Bojarski et al. 2001.56; Bokiniec et al. 2003.36; 2004.30; Paner et al. 2003*), e. g. Brody Pomorskie and Kościelna Jania (*Paner 2001.40; Paner et al. 2004.25*), because they belong to the northernmost sites of the LBK.

Equally interesting seem to be sites of the Podgaj 32 type that contain Mesolithic-like flint tools and LBK pottery, but only its coarse variety (Fig. 2) (*Czerniak 1994.54–58; Domańska 2003*). These sites are located on sands, yet on the outskirts of a central Kuyavian patch of black soils (Fig. 1). Generally speaking, in this case two interpretations are applicable: i) this was a Mesolithic group, with selected LBK pottery; ii) this was an LBK group, with Mesolithic flints. Consequently, I am of the opinion that in the case of Podgaj 32 sites, we are dealing with a

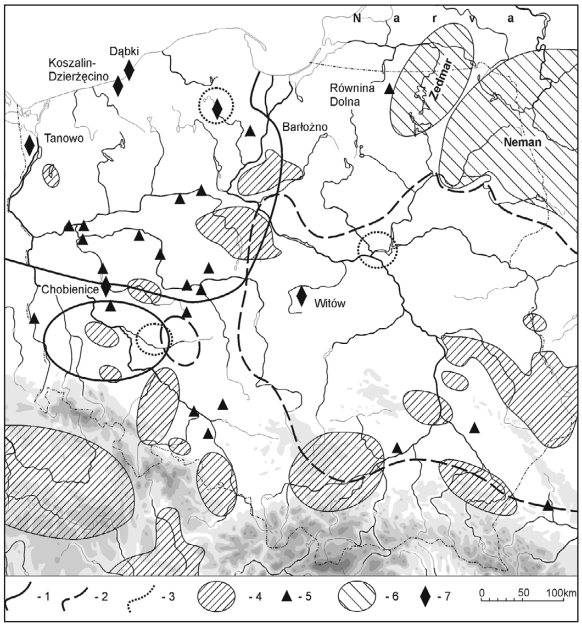


Fig. 3. East-Central Europe from 4800 to 4000 BC. 1 – post-Maglemosian units, 2 – Janisławice Culture, 3 – the latest Komornica Culture, 4 – concentrations of post-LBK (Stroke Band Pottery Culture) and Lengyel-Polgar sites, 5 – selected, single sites of the post-LBK and Lengyel-Polgar complexes, 6 – para-Neolithic units, 7 – single sites with para-Neolithic pottery.

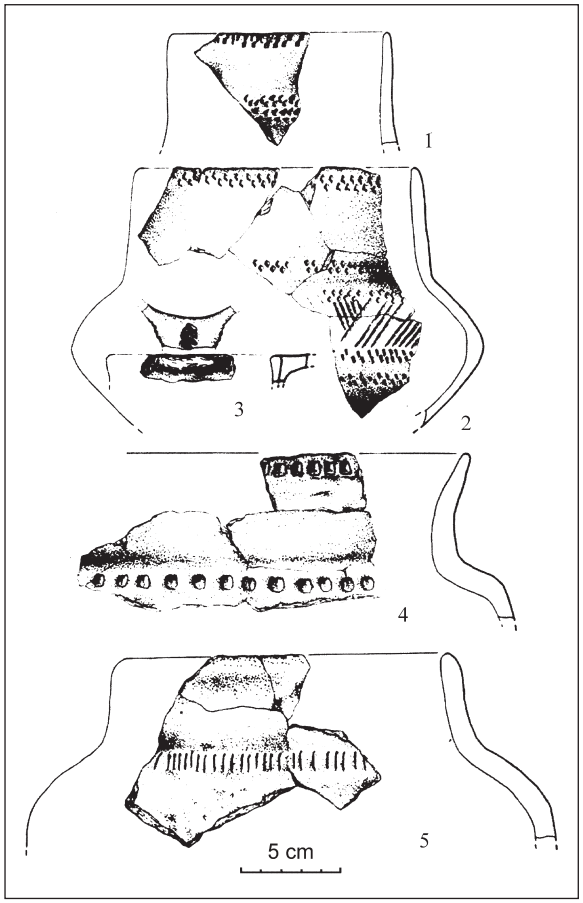


***Fig. 4. Post-LBK (?) pottery from the site of Równina Dolna (Warmia and Masuria, district Kętrzyn); after* Rybicka, Wysocki 2004.**

mixture of some foreign and local elements, irrespective of which interpretation is more probable.

Moreover, I would like to underline that there are a large number of Mesolithic sites that can be dated to the period between 5500 and 4800 BC (*Bagniewski 1979; 1987; 1996; 1999; 2000; Kozłowski 1989; Kobusiewicz 1999*), some of them either right within LBK enclaves or on their outskirts, like in the region of Kuyavia (Fig. 1) (*Domańska 2003*). One site of this kind is a recently excavated one at Glanów (*Pazdur et al. 2005; Zając 2001*): a very large, multi-period settlement, actually located close to an LBK settlement area. The late Mesolithic phase of the settlement partly overlapped with the LBK.

From 4800 to 4000 BC

When the LBK disappeared, the situation still remained bi-modal (Fig. 3). We have the same Mesolithic units, namely post-Maglemosian groups, including the so-called Bóbr group in Lower Silesia, Janisławice Culture, and the remnants of Komornica Culture (*Bagniewski 1998; 2001; Kobusiewicz 1999; Kozłowski 1989*). As regards Neolithic units, in theory, we have Stroke Band Pottery Culture in the aforementioned enclaves in western Poland and the Lengyel-Polgar Complex in south-eastern Poland. However, in practice, we observe very distinct stroke elements in the latter groups, as well as Lengyel-Polgar elements in a Stroke Band context (*Czerniak 1994; Kaczanowska et al. 1986; Kaczanowska, Kozłowski 1994; Kadrow, Zakościelna 2000; Kamieńska, Kozłowski 1990; Kirkowski 1994; Kozłowski 2004; Kulczycka-Leciejewiczowa 2002; Prus 1977*). These phenomena sometimes lead to terminological disorientation. One of the suggested solutions to this problem was the term 'Late Band Pottery Culture', introduced and used by pre-historians of the Poznań school of Neolithic archaeology (*Czerniak 1980; 1994*). This term refers to lowland, post-LBK Neolithic communities, although the main reason it was introduced was a belief in the direct con-

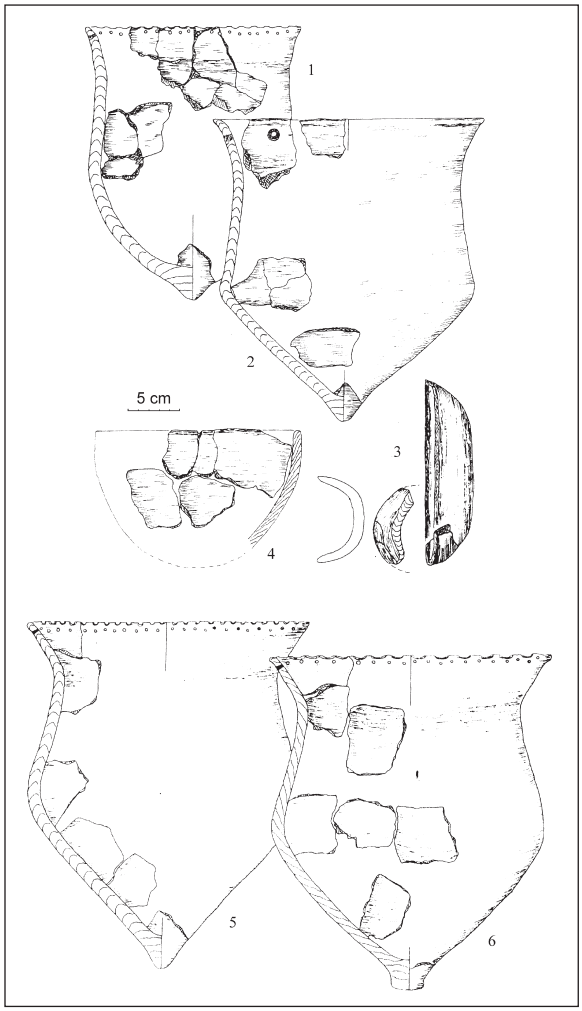


***Fig. 5. Para-Neolithic pottery from the site of Tanowo 3 (Western Pomerania, district Police; after* Gali ński 1992.**

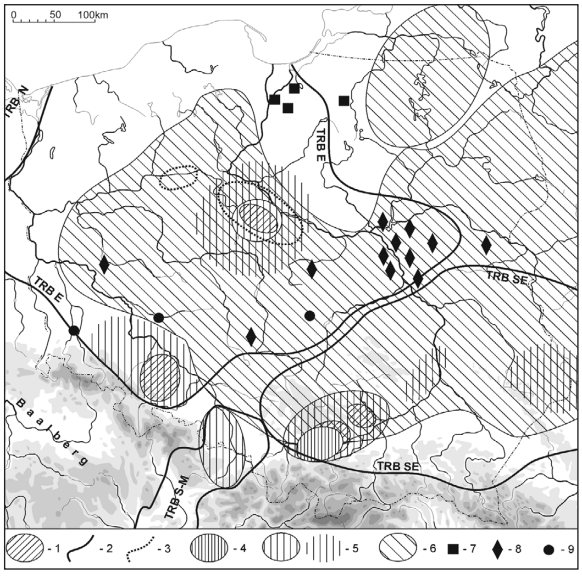


Fig. 6. East-Central Europe from 4000 to 3000 BC. 1 – the latest Lengyel-Polgar groups, 2 – Eastern (TRB E), South-Eastern (SE TRB) and Silesian-Moravian (TRB S-M) groups of the Funnel Beaker Culture, 3 – initial stages of the Globular Amphorae Culture, 4 – Baden Culture, 5 – regions of the strong and weak Baden influences on later TRB, 6 – para-Neolithic units (Zedmar and Neman), 7 – para-Neolithic Comb Pottery Culture, 8 – selected sites with early Linin pottery, 9 – the latest Mesolithic sites, without pottery.

tinuity of the LBK and post-LBK developments in this zone. Luckily, after ca. 4500 BC, the situation becomes clearer, because Stroke Band Pottery ceased to exist, replaced by the Lengyel-Polgar. There are also single Neolithic, post-LBK sites outside early Neolithic enclaves (*Bagniewski 2002; Bojarski et al. 2001.55; Felczak 1998; 2005; Jankowska 1999; 2001*). Of particular interest in this case are the recently discovered northernmost sites at Barłożno (*Paner 2001.38–42; Paner et al. 2004.22–24*) and Równina Dolna (Fig. 4) (*Rybicka, Rzepecki 2001; Rybicka, Wysocki 2004*).

Most probably, in this period there appeared also groupings that can be included in the para-Neolithic formation, i.e. foraging populations that produced and used their own, unique pottery. They generally knew agriculture, but did not apply it in practice in any greater measure (*Dolukhanov et al. 2005; Rimantiene 1992; Werbart 1998; Zvelebil 1993*). Referring to the "Polish" para-Neolithic in the fifth millennium, we can speak of the early stages of Neman Culture and Zedmar Culture (Fig. 3) (*Gumiński 1998; 1999a; 2003b; Józwiak 2003; Kempisty 1986; Kempisty, Sulgostowska 1991; Kempisty, Więckowska 1983*).

There are also single Mesolithic sites with pottery outside the scope of the aforementioned units dated to the period under consideration. Four of them (Dąbki, Koszalin-Dzierżęcino, Tanowo, Chobienice) contain pottery (Fig. 5) that is similar to the pottery of Ertebølle Culture (*Galiński 1987; 1988; 1992; Ilkiewicz 1989; 1997; Kabaciński 2001; Kobusiewicz, Kabaciński 1998*); therefore they are very often considered as the south-easternmost sites of this culture. As a matter of fact, they belong to Ertebølle Culture only as regards ceramics. The flint assemblages are of purely local, that is post-Maglemosian, type (*ibid.*). So, overall, we can again notice here a blend of local and foreign elements.

From 4000 to 3000 BC

After ca. 4000 BC the situation changed significantly (Fig. 6). The Lengyel-Polgar tradition was gradually vanishing, whereas a new Neolithic unit had appeared: Funnel Beaker Culture (i.e. TRB) (*Burchard et al. 1991; Czerniak et al. 1990; Midgley 1992; 2002*). This unit is the first Neolithic phenomenon that was

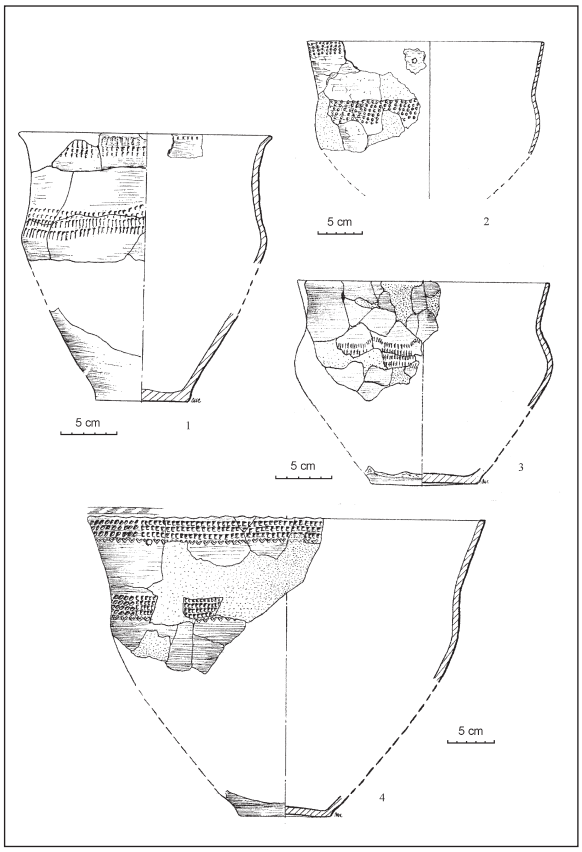


Fig. 7. Early Linin pottery (with TRB traits), from the territory of Masovia; after* Kempisty 1972.1 – *Dąbrowa (district Wołomin), 2 – Wiązowna (district Otwock), 3 – Grzegorzewo (district Wołomin), 4 – Działy Czarnowskie (district Wołomin).

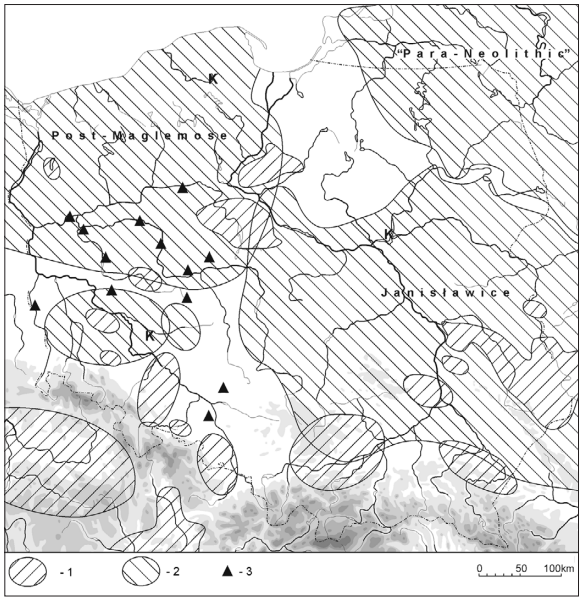


Fig. 8. East-Central Europe from 6000 to 4000 BC; flint perspective. 1 – Early Neolithic flint industry (LBK, SBK and early Lengyel-Polgar), 2 – Late Mesolithic type of flint industry (late Mesolithic and para-Neolithic), 3 – selected, single Early Neolithic sites, K – the latest sites of the Komornica Culture.

present literally everywhere, and not only within small enclaves (*Kruk 1980; Kruk, Milisauskas 1999; Nowak 1993; 2001; Pelisiak 2003; Rybicka 2004*). Therefore, we can consider the spread of this culture as the second stage of Neolithisation of East-Central Europe.

There are also differences between the spatial layout of the LBK, post-LBK and TRB in the aforementioned enclaves of early Neolithic settlement. Relatively few LBK and Lengyel-Polgar sites tend to be concentrated in clusters. As to TRB sites, there are much more of them, usually scattered throughout the area (*Czerniak 1994; Kruk et al. 1996; Milisauskas, Kruk 1984; Sosnowski 1994*).

The genesis of the TRB is one of the most disputed and controversial issues in European prehistory (*Bogucki 1996; 1998; Czerniak 1994; Czerniak, Kośko 1993; Domańska 1995; Galiński 1991; Gebauer 1995; Jankowska, Wiślański 1991; Jennbert 1998; Keeley 1992; Kukawka 1997; Price 1996; Price, Gebauer, Keely 1995; Rzepecki 2004; Sherratt 1990; Whittle 1996.204–10; Wiślański 1979; Zvelebil 2001; Zvelebil, Dolukhanov 1991*). Although many Polish archaeologists would surely argue against this statement, I think that we should seek the roots of 'Polish' TRB pottery outside, in Schleswig-Holstein and the area of the lower Elbe. This does not imply north-western migration, but a very extensive and relatively quick spread of a new ceramic fashion among both farming and foraging populations in East-Central Europe. Certainly, with time, 'Polish' TRB pottery acquired more and more unique features, as compared to pottery from the areas of primary origin. Thus the TRB in Poland, in its entirety, is in fact a combination of foreign patterns, as well as many local traditions in pottery-making.

At about 4500 BC, the last Lengyel-Polgar groups disappeared, but a new southern factor emerged, Baden Culture (Fig. 6). It was probably a result of direct migration from south-western Slovakia to Little Poland (the region of Kraków) (*Zastawny 1999; 2000*). Again, an intense process occurred through which Baden pottery stylistics were adopted by some TRB populations. This blend was very strong in western Little Poland (*Kruk, Milisauskas 1983; 1990; 1999),* Upper Silesia *(Bukowska-Gedigowa 1980*) and Kuyavia (*Kośko 1989; Wiślański 1979.194–197*), and it is noticeable in some other regions, albeit in a weaker form.

The mid-fourth millennium BC was also, in my opinion, the starting point of the next pottery style of local origin, that is Globular Amphorae Culture, although, according to Marzena Szmyt (*1996*), its beginnings are even earlier.

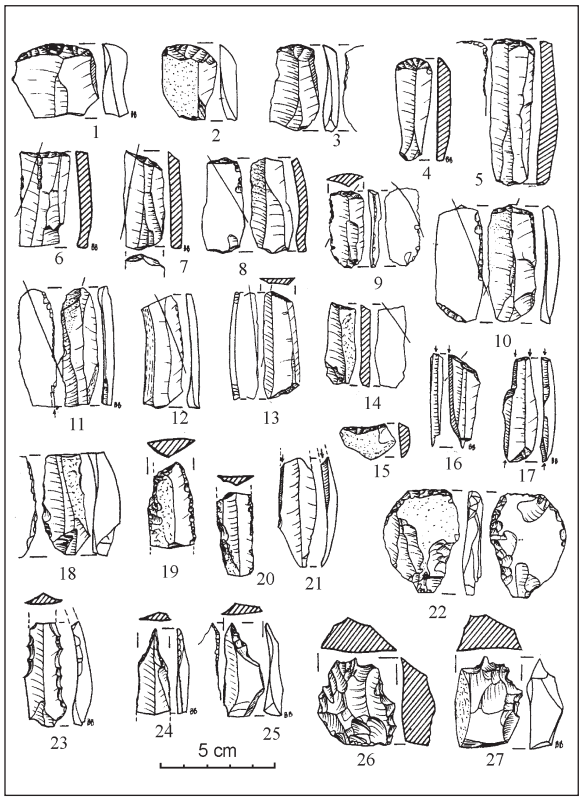


***Fig. 9. Flint tools of the LBK; after* Balcer 1983.**

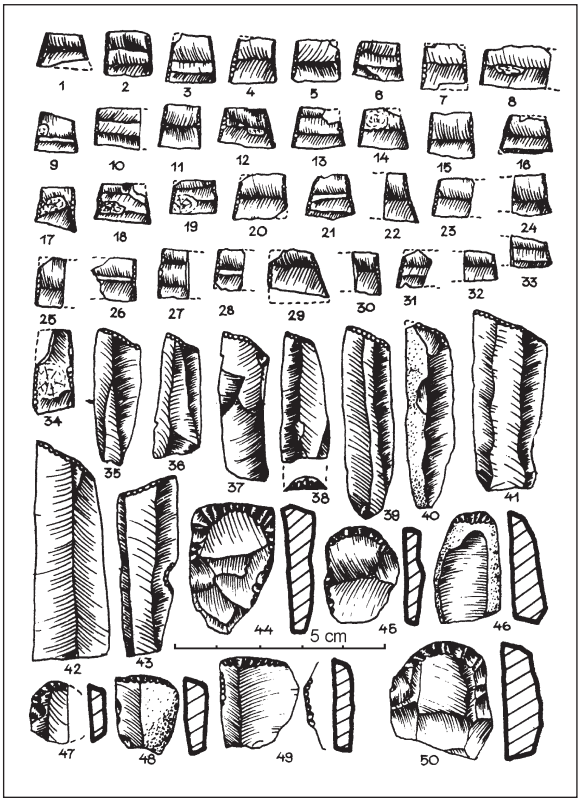


***Fig. 10. Late Mesolithic flint tools from Dąbrowa Krępnica (Lower Silesia, district Bolesławiec); after* Bagniewski 1982.**

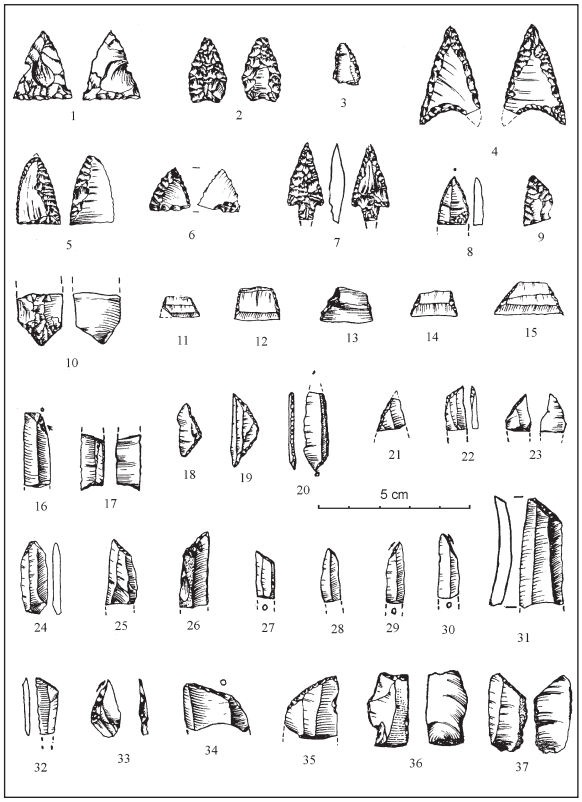


***Fig. 11. Late Mesolithic (with para-Neolithic elements) flint tools from Sośnia (Podlasie, district Grajewo); after* Kempisty, Więckowska 1983.**

Another fascinating phenomenon is the widespread presence of para-Neolithic pottery in the basins of the Vistula and the Oder (Fig. 6). It is connected mainly with Neman Culture and Zedmar Culture and, to some extent, with Comb Pottery Culture (*Cyrek 1990; Cyrek et al. 1985; Galiński 1991; Gumiński 1998; 1999a; 1999b; 2003a; 2003b; Józwiak 2003; Kempisty 1986; Kempisty, Sulgostowska 1991; Kempisty, Więckowska 1983; Kobusiewicz, Kabaciński 1993*). In my opinion, pottery of this kind was taken by local Mesolithic communities from their eastern foraging neighbours and incorporated into their information system. Traces of possible eastern migrations can be seen only on the north-eastern fringes of today's Poland. To make the picture of the fourth millennium BC complete, it must be added that some Mesolithic sites that do not include pottery are radiocarbon-dated to that period (Fig. 6) (*Bagniewski 1982; 1990; Niesiołowska-Śreniowska 1990; 1998a*).

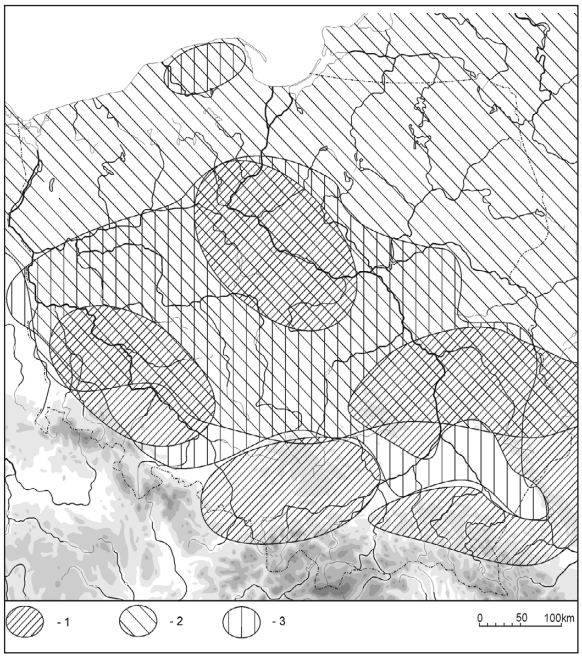


Fig. 12. East-Central Europe from 4000 to 3000 BC; flint perspective. 1 – 'macrolithic' Middle Neolithic flint industry (late Lengyel-Polgar and part of the TRB), 2 – 'Late Mesolithic' type of flint industry (the latest Mesolithic, para-Neolithic, and part of the TRB), 3 – Middle Neolithic flint industry based on local raw materials (part of the TRB).

However, this is not the end of the story of mergers. There is also para-Neolithic pottery that contains some Neolithic, Funnel Beaker features, and perhaps also Globular Amphorae features (Figs. 6, 7). In Poland, pottery of this kind is respectively defined as

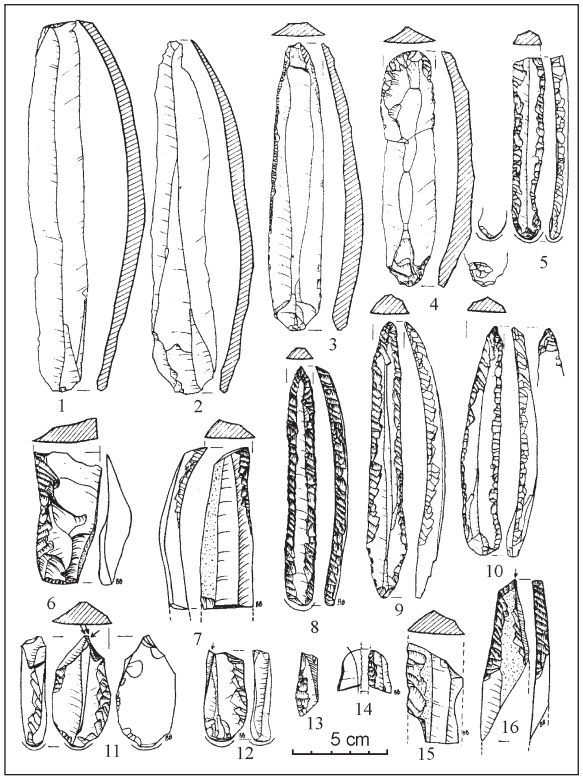


***Fig. 13. Late Lengyel-Polgar flint tools;* after Balcer 1983.**

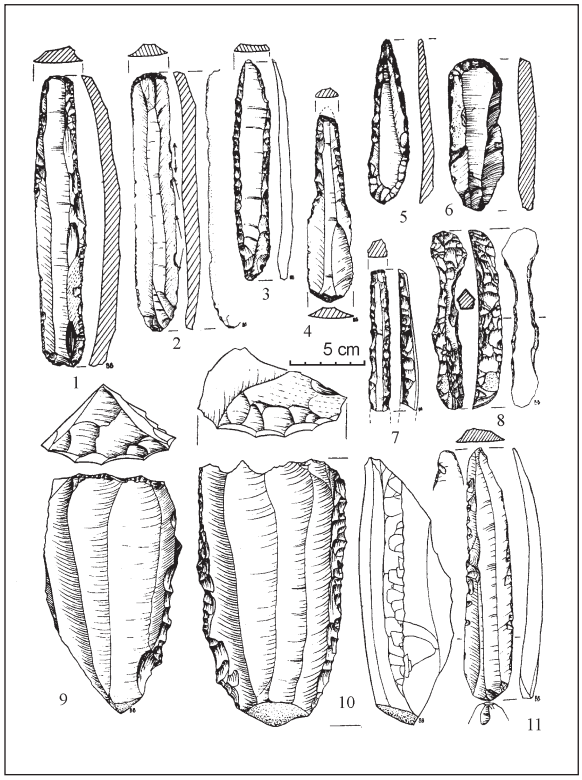


***Fig. 14. Macrolithic flint tools and cores of the TRB; after* Balcer 1983.**

Linin types A and B, according to Elżbieta Kempisty (*1986*). In fact, the pottery of Zedmar Culture also displays distinct Neolithic characteristics, as claimed by Witold Gumiński (*1999b; 2003b*).

Flint perspective

The previously presented transformations referred to traditional archaeological units; they were distinguished mainly on the basis of pottery in the Neolithic, and of flints in the Mesolithic. So, in my view, an inconsistency occurs here: flints did not dematerialize in the Neolithic period. Quite the contrary, flint working still flourished. Let us look then at the discussed period solely from a generalized flint perspective. The picture is different.

First of all, we have early Neolithic industry that joins LBK and early post-LBK units (Fig. 8), which Bogdan Balcer calls 'mediolithic' (*Balcer 1983; 1988*). This kind of industry is based on medium-sized blades, with end-scrapers, truncations, and borers as main tools (Fig. 9). On the other hand, in point of fact, there is only one important late Mesolithic industry with a highly unified character, with just a few regional modifications (Fig. 8). It contains primarily trapezes, long truncations, end-scrapers and side-scrapers as the main tool types (Fig. 10). Actually

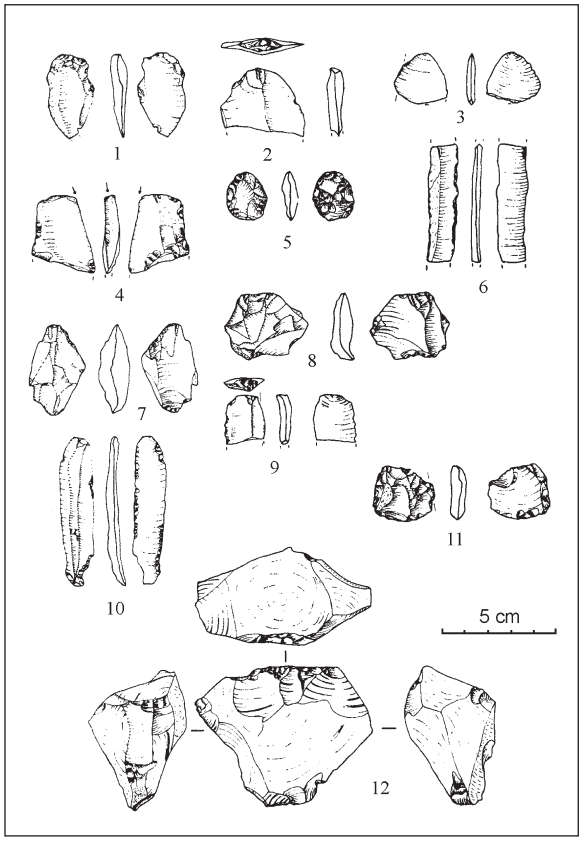


***Fig. 15. Flint industry based on local raw materials from site of the TRB at Kawczyce (Little Poland, district Busko-Zdrój); after* Nowak 1994.**

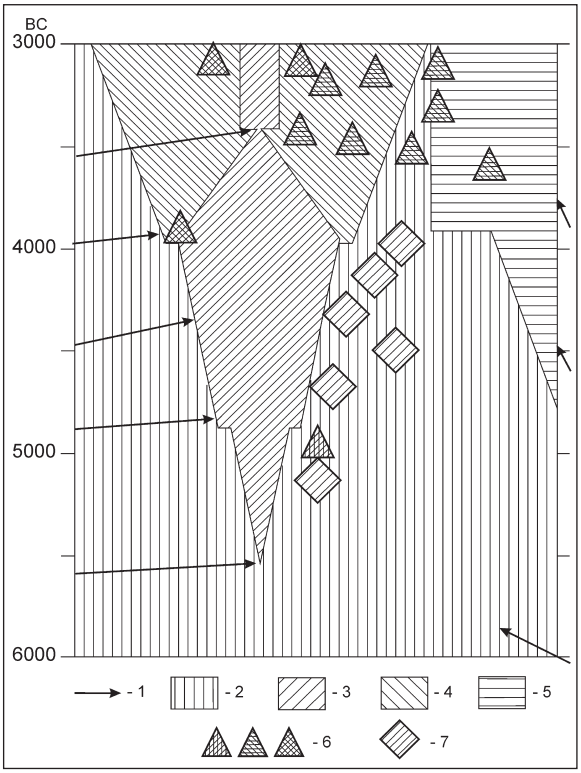


Fig. 16. Schematic view of the 'communicative communities' development in East-Central Europe from 6000 to 3000 BC. 1 – foreign migrations and stimuli, 2 – 'Mesolithic communicative community', 3 – 'Foreign Neolithic communicative community', 4 – 'Local Neolithic communicative community', 5 – 'Para-Neolithic communicative community', 6 – amalgamation of the elements of different 'communicative communities', 7 – 'Foreign Neolithic communicative community' outside its compact area.

para-Neolithic flints in Poland are of the same kind, with only some specific tools, such as several types of points and some specific retouch techniques (Fig. 11).

As to the Neolithic, the most important change took place in the middle of the fifth millennium BC as a result of contacts with Cucuteni-Trypole Culture (Fig. 12). Macrolithic industries, based on very long blades made of the best raw materials (Figs. 13, 14), appeared within later Lengyel-Polgar communities and this continued within the TRB (*Budziszewski 2000; Balcer 1983; 1988; Małecka-Kukawka 1992; Zakościelna 1996; 2000*). However, this type of industry did not amount to the entire TRB Culture. Northern groups used late Mesolithic flints, just like para-Neolithic and the last Mesolithic groups (Fig. 12) (*Domańska 1995; Jankowska 1990*). To make the matter more complicated, we can discern a third type of flint manufacturing connected with some TRB groups. This industry is in a sense a little primitive. It is based mainly on local raw materials; it uses splintered technique very frequently, so the blade blanks are mostly small and irregular (*Jankowska 1980; Nowak 1994; Świderski, Wierzbicki 1995; Wierzbicki 1992; 1999*). I am not sure how we should label this kind of industry; the description 'based on local raw materials' seems to be the best solution at the moment.

Conclusion

'Communicative communities' were units where information circulated without serious obstacles, and where the information package was accepted and understood consciously or even unconsciously. I think that in the period under discussion it is possible to discern at least four such units (Fig. 16).

The first should be called Mesolithic. The second I would call 'foreign Neolithic'; it appeared in the mid-sixth millennium, then gained in significance a little, but in the fourth millennium it declined considerably. The third is 'local Neolithic', which for me embraces most of the TRB. In my view, this community was the main local response to earlier foreign impul-

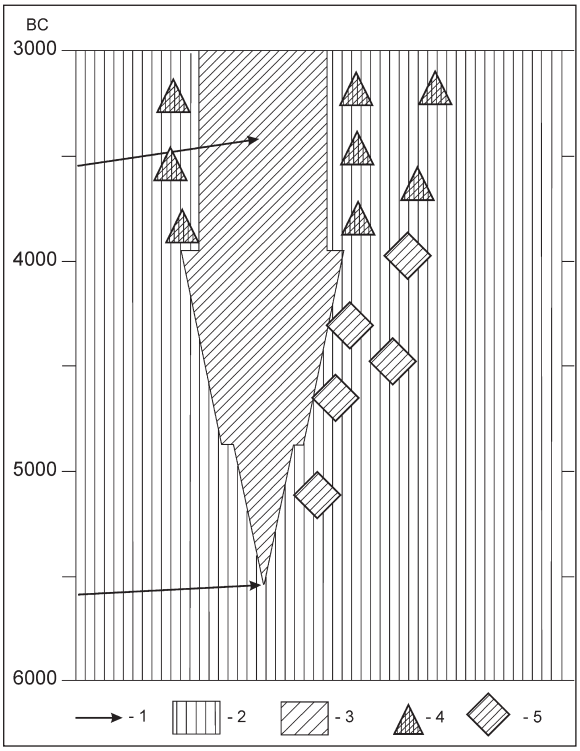


Fig. 17. Schematic view of the genetic development in East-Central Europe from 6000 to 3000 BC. 1 – foreign migrations, 2 – 'local' genetic pool, 3 – 'foreign' genetic pool, 4 – amalgamation of the genetic pools, 7 – 'foreign' genetic pool outside its compact area.

ses; so we can describe it not only as a second stage of Neolithisation, but also as its 'northern' version. Importantly, this was not the only version of 'northern' Neolithisation; there was also an alternative form, the para-Neolithic. It was also a reaction to foreign influences, but of a different kind: para-Neolithic groups used elements that did not originate in Neolithic agro-pastoral communities, but in foraging, east European ones, which mentally were perhaps much closer to 'our' foragers.

However, this picture does not correspond with the gene pools in the territories under discussion. Taking into account, *inter alia*, much less varied flint industries that I regard more resistant to the quick changes in fashion which are visible in pottery, I think that there were only two general genetic units (Fig. 17). From the very beginning of the Mesolithic, there existed a local gene pool. In the mid-sixth millennium, as a result of migration, a foreign one appeared, and grew in later periods, but never became predominant. In archaeological terms, this can be connected with the LBK, SBK, Lengyel-Polgar and with part of the TRB.

To proceed one step further, let us consider the linguistic situation (Fig. 18). The linguistic variety did not exactly mirror the genetic variety, i.e. the two basic gene pools. If we accept Marek Zvelebil's hypothesis about Creolisation (*Zvelebil 1995*), the range of influence of foreign languages must have been greater than the extent of the foreign gene pool. Strictly speaking, I would perceive the majority of TRB groups as affected by the Creolisation process.

Finally, it must be underlined that the date of 3000 BC is not the absolute time limit for the existence of foraging people in Polish territories. Their existence in the region ended owing to equally complicated transformations in the third millennium BC, and during the early Bronze Age.

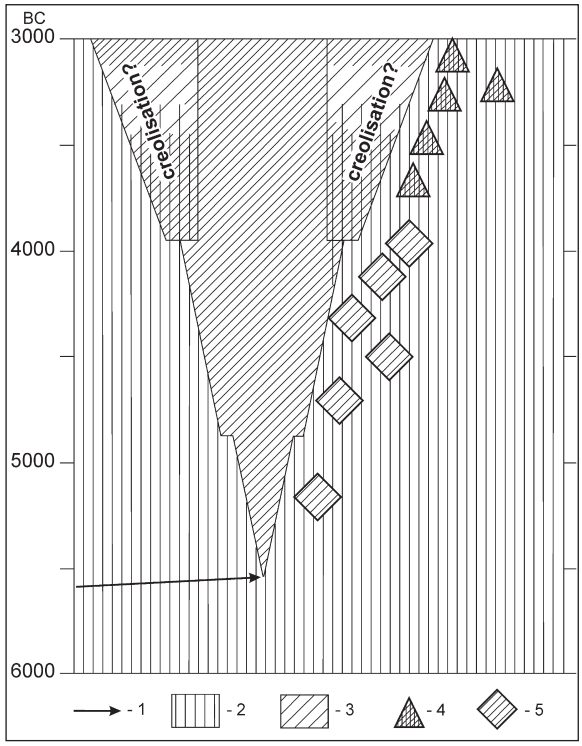


Fig. 18. Schematic view of the language development in East-Central Europe from 6000 to 3000 BC. 1 – foreign migrations, 2 – 'local' languages, 3 – 'foreign' languages (Indo-European ?), 4 – amalgamation of different languages, 7 – 'foreign' languages outside its compact area.

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The domestication of human birth

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ABSTRACT – *Observations of the burial places of newborns at the prehistoric site at Lepenski Vir (Serbia) revealed the possibility that deliveries took place inside houses that were heated. Warm houses provided a thermally stable environment which, in turn, could solve the problem of thermo-regulation, that is critical for the survival of babies. In this study it is shown that the creation of these good conditions for giving birth could have been an important step in human evolution that could have led to a demographic expansion.*

IZVLEČEK – *Opazovanja prostorov s pokopi novorojenčkov na prazgodovinskem najdišču Lepenski Vir (Srbija), so pokazala možnost, da se je rojevanje dogajalo znotraj ogrevanih hiš. Ogrevane hiše so zagotavljale termalno stabilno okolje, kar je morda rešilo problem termoregulacije, ki je odločilen za preživetje otrok. V tej študiji prikažemo, da je lahko ustvarjanje dobrih pogojev za rojevanje pomemben korak v človeški evoluciji in je lahko pripeljal do demografske ekspanzije.*

KEY WORDS – *Lepenski Vir; human birth; thermo-regulation; domestication*

Introduction

During the entire evolution of humans, the process of giving birth has been a key factor in their survival. The low human population that existed up to the Neolithic indicates that living conditions were very hard and that Palaeolithic populations were capable of maintaining only simple reproduction, without significant population growth. The way of life during the Palaeolithic age, cold climate, and high daily fluctuation of air temperature were detrimental to giving birth and for taking care of newborns. With the Neolithic came the first demographic expansion, but it is still not well understood what caused it. In this study, we attempt to show that it may have been caused by improved conditions of parturition.

It is well established that in the past and the present, different cultures have created good conditions for giving birth and for neo-natal care (*Cressy 1997; Jordan 1993; Priya 1991*). Thus, there are no reasons to believe that during the prehistoric period, humans had a different approach to these important aspects of their life. However, little attention has been paid in the archeological literature to this problem (*Beausang 2000.69–70*), and hence there is no developed methodology for investigating it. Recent studies by O'Donnell could be very helpful in finding material proof for establishing such a methodology (*O'Donnell 2003; 2004.165*). Her investigation of various aspects of parturition show that it always includes: 1) thermal regulation to ensure the viability of the newborn infant; 2) a defined spatial location; 3) support and companionship; 4) mobility, in order for the mother to negotiate the process; 5) attention to the pre- and post-natal environment; and 6) ritual and symbolism in the psychological negotiation of the process.

In this study, we consider thermal regulation and the defined spatial location as key factors for successful birth and neo-natal care. Our working hypothesis is that developments in early houses, as the defined spatial location for birthing, brought about dramatic improvements in the conditions for birth and child-care because one of the functions of those hou-

ses appears to have been that they served as places where women gave birth and where babies and infants were cared for. Our analysis was based on data obtained from the archaeological site at Lepenski Vir, located in the Danube Gorges (Serbia), with the Mesolithic phase at around 7500 Cal BC and the Early Neolithic phase at 6300–5500 Cal BC (*Bonsall et al. 2000; Borić 2002; Cook et al. 2002*). We provide two sets of evidence that indicate that the prehistoric women in the Danube Gorges had good conditions for giving birth, and could have enjoyed reproductive success – first, that those women gave birth inside houses that have been discovered at Lepenski Vir and other archaeological sites in the Danube Gorges; second, that those houses were heated and thus could have provided favourable conditions, including thermoregulation, for survival of newborns.

'**Maternity ward**'

The only reliable piece of evidence that a birth had taken place at a given prehistoric site is the skeleton of a newborn baby found at the location (Fig. 1). After the lifting of house floors in 1970, 41 infant skeletons were found at Lepenski Vir (Figs. 2 and 3) (*Borić and Stefanović 2004; Stefanović and Borić in press*). The largest number of skeletons (28) were aged from 38 to 40 gestational weeks (babies at the age of birth) (Fig. 4). Six skeletons were of slightly younger, and can be explained as premature. The remainder were somewhat older, i.e., newborns that lived a few weeks or months. DNA-based sex identifications of 33 sampled newborn skeletons show that 19 of the newborns were males and 14 were females (*Čuljković et al. in press*). The pattern concerning the newborn burials is that all of them were placed exclusively in the rear of the houses (in 19 houses). Burial pits were either cut through the limestone floors or dug immediately off the floor edge, often between the construction stones surrounding the floor. Taken together, these pieces of evidence suggest that births took place inside these houses. The possibility that women gave birth outside the house and that children who did not survive were taken back and buried inside the house does not seem tenable. For example, it was found that some children who were buried inside the house had survived several months after birth. Thus, the presence of child skeletons under the floors of the houses indicates that the birth took place in the house, and that babies that survived their birth continued to live in those houses. In other words, at Lepenski Vir, the houses served as 'maternity wards' and the birth event became domesticated.

Heated Houses, Thermo-regulation and Baby Care

In each of the houses examined, there were hearths in the centres of the houses, of more or less rectangular shape, constructed from limestone slabs placed vertically (Fig. 5). According to Radovanović, hearths are the "most conspicuous architectural feature" of the Danube Gorges (*Radovanović 1996*). Is there any connection between hearths and babies? We be-

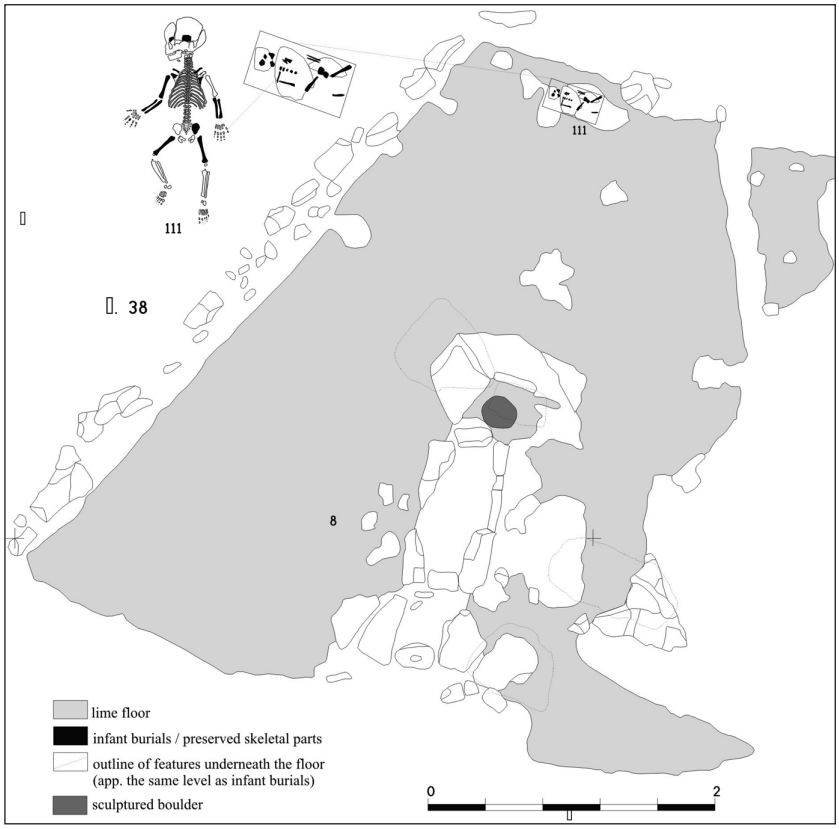


Fig. 1. House No. 38 from Lepenski Vir with a rectangular hearth inside and with newborn burial No. 111. The burial was placed in a pit that was cut through the lime floor. The skeleton belongs to a newborn girl (38–40 gestational weeks), found on her back, (supine) with legs splayed outwards, in a S–N orientation (after* Stefanović and Borić in press.Fig. 5*).



Fig. 2. Grave 98, newborn-girl (35–37 gestational weeks) House No. 19. The skeleton is flexed on the left side in a NW–SE orientation (photo: Department of Archaeology, Faculty of Philosophy, University of Belgrade).

lieve there is, and it is highly significant. A hearth means heat, and a hearth in the house means a warm house, which is essential for survival of newborn babies. There have been no studies or analyses that could show how the houses in the Danube Gorges were heated, or what room temperature could be achieved in them.

Interestingly, however, in many of the houses, burned limestone blocks were found, while no other evidence of fire, such as tar or ash, was present. This suggests that the stone blocks were heated outside of the houses and then brought inside and placed in the rectangular hearths as a source of heat. To show plausibility of the idea that the limestone blocks could provide heat to the houses, we carried out basic heat transfer calculations. We estimate that hot limestone blocks heated to 100 °C could raise the room temperature from 10 °C to a comfortable 20–30 °C (see Appendix). This, as we explain below, was sufficient to prevent and offset hypothermia among newborns. It is noteworthy that the system for heating houses described above was more probably used at older sites, such as Vlasac. At more recent sites, such as Lepenski Vir, the heating system appears more advanced. Houses had a rectangular hearth in the centre, with an approach platform, and an outdoor fireplace connected with the hearth through a funnel-like hole, suggesting some kind of 'central heating system' (Fig. 5).

One of the most critical features in the survival of newborns is temperature regulation. Even today, thermo-regulation is one of the most important and challenging aspects of the neonatal care (*Weber on-line*). The transition from the intra-uterine to the extra-uterine environment is accompanied by a substantial temperature change that compromises the baby's thermo-regulatory abilities. If the delivery does not take place in a warm and thermally stable environment, during the first 10–20 minutes following birth the newborn may lose enough heat for its body temperature to fall by 2–4 °C , with even greater falls in the ensuing period if proper care is not given (*Adamsons and Towell 1965; Dahm and James 1972; Smales and Kime 1978*). Consequently, the baby will develop hypothermia, i.e., a body temperature below normal. If the neonate's body temperature is less than 36.5 °C, it enters a state of cold stress, a condition that results in many complications and often causes death (*Neonatal Thermo-regulation Guidelines for Practice 1997; Ellis et al. 1996*). Although today we know of about twenty symptoms of cold stress (*Thermal protection and/or management of neonatal hypothermia and hyperthermia on-line*), the first of them, when the body is cold to the touch, was certainly something that prehistoric peoples had often experienced; and they knew that it could be altered by warming up. It is well known that for a baby to survive hypothermia, it has to be warmed up such that in addition to



Fig. 3. Grave 103, newborn-boy (38–40 gestational weeks), House No. 19. The skeleton is on his back (supine), with contracted legs in S–N orientation (photo: Department of Archaeology, Faculty of Philosophy, University of Belgrade).



Fig. 4. A skeleton of a newborn-boy (38–40 gestational weeks), Grave 114, House No. 36. The estimated gestational age of infants from Lepenski Vir was made according to the maximal length of both/either femur and/or humerus which give precision of ± 2 weeks. (photo: Paleoanthropological collection, Faculty of Philosophy, University of Belgrade).

skin-to-skin contact, it has to be in a room with an air temperature from 25 °C (in the case of mild hypothermia) up to 38 °C (in the case of intensive hypothermia (*Thermal protection of the newborn: a practical guide on-line, Silverman et al. 1958; Johanson et al. 1992*).

Such conditions could be hardly achieved during the prehistoric period, especially when babies were born in the open. It is very likely that prehistoric people used skin-to-skin contact to warm up their babies. This method is effective only if babies stay close to their mothers' bodies throughout the day, and if the air temperature does not fall below 25 °C (*Karlsson 1996; Färdig 1980; Acolet et al. 1989; Christensson et al. 1992; Singh et al. 1992*). Since women from Lepenski Vir gave birth and took care of their newborns inside houses that were heated, deliveries took place in a thermally stable environment which, in turn, led to a higher rate of survival of newborns. In addition to providing favourable thermal conditions, these prehistoric houses offered some other advantages for giving birth. For example, they were of small dimensions (from 5.5 to 28 m^2) (*Radovanović 1996*), and could be easily illuminated from inside, a condition that is very important for delivering babies (e.g., for severing the umbilical cord, and for cleaning the baby and the mother immediately after the delivery). Since, like other primates, humans usually give birth at night, delivering a baby in a lighted house could make it easier for the mother and those who attended her during delivery. There are also important psychological advantages to giving birth in a sheltered, warm, and lighted place, which we do not address in this study. Taken together, all these aspects of giving birth inside the house show that the prehistoric people of the Danube Gorges region provided favourable conditions for the survival of their newborns.

It is reasonable to assume that the domestication of birth occurred in all regions where humans built houses. As a consequence of these improved birth and aftercare conditions, it is very likely that infant mortality was substantially reduced, which, in turn, contributed to the first human population expansion. Furthermore, if the prehistoric people of the Danube Gorges indeed experienced a demographic expansion, then they were most probably the founders of the later agricultural Starčevo and Vinča cultures. This, in turn, could mean that there was a strong pre-Neolithic nucleus of people in the Balkans that had emerged from an autochthonic population of hunters-gatherers.



Fig. 5. Rectangular limestone hearth from house No. 4 (photo:* Srejović and Babović 1983.175*). At Lepenski Vir, houses had a rectangular hearth in the centre with an approaching platform and with an outdoor fireplace connected with the hearth through a funnel-like hole, suggesting a possibility of a 'central heating system'.

Summary

Data obtained from Lepenski Vir indicate that at the beginning of the Neolithic there existed good conditions for giving birth and neonatal care. Women gave birth inside warm houses that, in turn, helped to solve one of the most important problems in the survival of newborn infants, thermo-regulation. Evidence from Lepenski Vir indicates that women in this region were "sedentary mothers", and therefore, the act of giving birth became domesticated. This lead to a reduction in infant mortality and, consequently, to population growth.

Appendix

We used the following heat transfer equation

$$m_B c_B (T_B - T_R) = m_A c_A (T_R - T_A)$$

where m_B, c_B and T_B are mass, heat capacity and the initial temperature of the limestone blocs, m_A, c_A and T_A are mass, heat capacity and the initial temperature of the air inside the house, respectively, and T_R is the temperature of heated room air. This equation describes heat transfer from a heated limestone block (T_B) to a cold air temperature (T_A) inside the room. The heat transfer takes place until the room temperature raises to equilibrium value (T_R), after which a heat balance is established. All other heat losses are ignored.

It is assumed that the limestone blocks are heated to T_B = 100 °C = 373 °K, and that the initial room temperature is T_R = 10 °C = 283 °K. The mass of the block is assumed to be m_B = 1 kg. To calculate the mass of air inside the house (m_A), we assumed for simplicity that the dimension of the house is 2x2x2m, i.e., 8m^3. Since the air density is 1.29 kg/m^3, it follows that m_A = 1.29 kg/m^3 x 8m^3 = 10.32 kg. The heat capacities of limestone and air are obtained from engineering tables: c_B = 850 J/kg °K and c_A = 716 J/kg °K, respectively. By substituting these values in the above equation, we obtained the room temperature of a heated house: T_R = 19.3 °C. By placing two limestone blocks inside the house, the temperature could be raised to T_R = 26.8 °C.

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Violence in the Mesolithic

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ABSTRACT – *The Mesolithic populations of the Danube's Iron Gates Gorge (Serbia/Romania) spanned over 1500 years (from before 7000 BC to around 5500 BC) in one of the more favorable foraging environments of Europe. Over most of this period, the dominant economy was foraging, but farming was practiced by communities in the region from around 6500 BC. This research examines individuals from four sites on the Danube (Lepenski Vir, Vlasac, Padina, and Hajdučka Vodenica) whose traumatic lesions can be most plausibly interpreted as resulting from violent interactions. Given the number of individuals buried at these sites (MNI = 418), the episodes of violent interactions were few and without evidence of a specific temporal pattern. They probably represent sporadic episodes of interpersonal conflict that do not support the notion of endemic warfare deemed typical of the Mesolithic, or elevated levels of interpersonal/intertribal conflict at the time of contact with farming communities. The difference in the pattern of violence between the Mesolithic sites on the right bank of the Danube and a coeval site of Schela Cladovei on the left bank is explained in terms of differences in archaeological context, geographic location and possibly specific local histories.*

IZVLEČEK – *Mezolitske populacije so na področju donavske soteske Železna vrata (Srbija/Romunija) živele več kot 1500 let (pred 7000 BC do okoli 5500 BC) v enem izmed bolj ugodnih okolij za nabiralništvo v Evropi. Večino tega časa je bilo nabiralništvo dominantna ekonomija. S poljedelstvom so se skupine v tej regiji začele ukvarjati od približno 6500 BC dalje. Ta raziskava preiskuje osebke iz štirih najdišč ob Donavi (Lepenski Vir, Vlasac, Padina in Hajdučka Vodenica), katerih travmatične poškodbe so najverjetneje posledica nasilnih interakcij. Če upoštevamo število osebkov, ki so pokopani na teh najdiščih (MNI = 418), so bila ta dejanja redka, pa dokazov o določenem časovnem vzorcu ni. Verjetno predstavljajo občasne konflikte. Vzorec ne podpira predstave o lokalnem vojskovanju, ki naj bilo značilnost mezolitika, ne medosebnih/medplemenskih konfliktov v času kontaktov s poljedelskimi skupnostmi. Drugačen vzorec nasilja med mezolitskimi najdišči na desnem bregu Donave in sočasnim najdiščem Schela Cladovei na levem bregu pojasnjujemo z razlikami v arheološkem kontekstu, geografski legi in morda specifični lokalni zgodovini.*

KEY WORDS – *prehistoric violence; prehistoric trauma; Mesolithic/Neolithic transition*

Anthropological approaches to warfare

After the relative neglect of warfare and violence in anthropology, there has been a revival of interest in theoretical questions regarding violent interactions in present-day small-scale societies and in archaeological populations. Recent editions – such as Reyna and Downs' series War and Society (in 5 volumes, from 1992 to 1998), Haas (*1990*) Anthropology of War, Ferguson's (*1984*) Warfare, Culture and Environment, to mention a few – confirm the growing interest in questions of war and warfare and the theoretical bases for understanding war and its impact on developing structures within societies. Walker (*Walker 2001*) laments the lack of significant contributions to the study of violence by anthropologists, as opposed to the importance it has for historians. Nevertheless, books like Kelly's (*2000*) Warless Societies and the Origin of War, Guilaine and Zammit's (*2001*) Le sentier de la Guerre, Carman and Harding's (*1999*) Ancient Warfare, and Keeley's (*1996*) War before Civilization – with their emphasis

on understanding early prehistoric evidence – stem from an interest in discerning the predominance of violent interactions in the past that might help explain one of the most common, but perhaps undesirable, modes of human social behavior.

Warfare has always been part of the explanatory mechanism for the archaeological record and has been invoked in interpreting a number of structures, arms, evidence of village burning, and evidence of multiple deaths. What is perhaps new in this recent attitude towards the study of past warfare is the quest for its origins, for an interpretation of its roots in human societies. The focus on non-state societies, whether contemporary or prehistoric, seems to represent a logical choice in such explanatory attempts. The evidence gathered from present-day indigenous people practicing traditional ways of life, as well as historical accounts of such people, still provides the most immediate insight into the diversity of human responses. This evidence must be paramount. Considering these societies as pristine is passé (to use Reyna's word: *1994a.xiii*), and only very few anthropologists would claim that they afford "*an intimate glimpse beyond history*" (*Chagnon 1977.xii*). Direct ethnographic analogy is often misleading, as it takes evidence out of its historical context. The recognition that these groups have their own history has to be the basic premise of all theory building and explanatory attempts (*Ferguson 1992; Marshall Thomas 1994*). "*Wars are often fought locally, even world wars: they are conjunctural events*" (*Simons 1999.92*). This local and historical character has to be kept in mind in all attempts to understand war and its background. Haas (*1999*) has stated that we can only begin to understand the origins of war by identifying repeating patterns of warfare in pre-state societies. Keeley shows that warfare is present in the archaeological record of non-state societies, and he demonstrates (*1996.175*) that pre-state society warfare cannot be regarded as different in extent and lethality from wars between states. Nevertheless, Haas questions Keeley's contention that warfare is universal and a given, and notes that Keeley "*forces us to examine the critical question of why warfare appears and disappears at different times and places*" (*Haas 1999.13*). Whether analyzing the causes of war in human society in general, or searching for similar patterns and causes on a regional level, it is crucial to take an historical approach to warfare from its emergence to its resolution. That an historical approach is crucial for archaeological interpretation is also stressed by ethnographic research (*Ember and Ember 1997; Ferguson 1992*), which shows that all present-day small-scale societies have to be seen in the context of their interactions with state societies and the global economy.

There is no doubt that almost every human being is capable of violent behavior. Socialization and learning help to direct and channel this type of behavior. In any given group, certain kinds will be praised, others shunned. Individuals in a given group have to find the modality that will meet both individual needs and social expectations in a particular situation, including violence. However, societies differ both in the amount and direction of violent behavior that is considered permissible or appropriate. Furthermore, war is "*not related to violence as simply more of the same*" (*Kelly 2000.21*). This brings us to an important question in studying war: Can all violence be interpreted as warfare? When interpersonal violence in a studied group is rampant and involves more than one group perceived as a more or less coherent unit, do we need to distinguish between warfare and feuding? And even more importantly, how do we distinguish between them in the archaeological record? If we decide that warfare does not appear before a certain level of socio-political complexity (such as the state) within any society is reached (*Reyna 1994b*), then all of the violence experienced by non-state organized groups remains in the domain of "*resolution of individual personal grudges*" (*Reyna 1994a*). If we conceptualize war as restricted to centralized polities (*Reyna 1994a.xiv*), the question of warfare in the Mesolithic does not even arise.

Definitions of warfare

The definition of warfare which Reyna offers is based on its proximate (stated and real) causes, and he resorts to a 'grudge-accumulation process' as an explanatory mechanism for the protracted tribal fighting in which members of villages became involved in raids and battles (*Reyna 1994b.42*). But can we really emphasize causal factors as the determinant in our definition of warfare; and which cause do we consider: an immediate proximate cause, or an underlying one? It is more than obvious that the proclaimed causes that have prompted states to declare war have rarely been anything more than propaganda tools aimed at the domestic population, the people who are required to accept and support the war. The motives of the society (or rather its elite) are usually well hidden behind ideological proclamations aimed not so much at the enemy or future historians, but at its own population whose dissent

has to be prevented. Repetition Thus Keeley (*1996. 114*) asks: "*Should any motive declared by anyone be considered? Should motives be inferred from the operation, results, and effects of specific wars or acts of war?*" (Emphasis L. K.). The predominant motives for pre-state warfare (based on cross-cultural studies as reported in Keeley (*1996.200*) are revenge for homicide and various economic issues (*p. 115*). As a motive, personal aggrandizement, prestige, is actually more commonly associated with higher levels of political centralization (chiefdoms and states). Apparently, subjugation and tribute are the only motives absent in non-centralized polities (*p. 116*), the major reason being that a kin militia (typical of non-state societies) has no means of maintaining violence beyond a few weeks. Even when continuous raids result in territorial gain (a common enough motive) through the expulsion of opponents, this is not a form of control, but a dispersion (*Carneiro 1994; Reyna 1994a*). Keeley argues, however, that repeated violence can result in 'gift' giving (or tribute), a form of tax similar to 'extortion rackets exercised by urban gangsters, rural brigands and pirates in civilized societies.' Thus the motives of centralized versus non-centralized societies cannot be easily distinguished – they do not offer a good set of variables for defining warfare.

A definition of warfare offered by Kelly seems to be applicable to all levels of political centralization, and offers a good working definition for examining prehistoric warfare. Kelly (*2000*) considers war (including feuds) to be grounded "*in application of the principle of social substitutability*" (*sic, p. 21*). And further, "*the principle that one group member is substitutable for another in these contexts underwrites the interrelated concepts of injury to the group, group responsibility for the infliction of injury and group liability with respect to retribution*" (*p. 5*). All of this would distinguish it from murder, duels and capital punishment, since these are directed against the perpetrator of a crime.

The origins of warfare

The cultural anthropological literature on warfare is mainly concerned with its evolutionary significance, summed up as 'when it started and how we can end it.' Cultural anthropologists consider that biology plays a relatively unimportant part in the emergence of war (*Carneiro 1994*), although proponents of evolutionary ecology maintain that warfare is based in maximizing inclusive fitness (*Gat 1999; Gat 2000a; Gat 2000b*) and can not be regarded as characteristic of humans, since it is based in the common heritage of social animals from chimpanzees to wolves (*Wrangham 1999*). Another commonly evoked source of warfare, population pressure – prominent since Thomas Malthus' famous *Essay on the Principles of Population* (1798) as a major predictor of the frequency of war – is not supported by cross-cultural studies (*Keeley 1996.118*). Kang (*2000*) demonstrates that under certain historical circumstances, warfare can result from the underpopulation caused by environmental stress. However, Kelly (*2000.Ch. 3*) suggests that population density does play an important role if we limit the analysis to either segmented or non-segmented societies. Keeley (*1996.119*) recognizes that some relationship between population pressure and frequency of warfare exists; however, this relationship is either complex or very weak, or both, and he concludes that "*warring societies are equally common, and peaceable ones equally uncommon at any level of population density*" (*Keeley 1996.120*). Along the same lines, Walker states that "*throughout the history of our species, interpersonal violence, especially among men, has been prevalent. No form of social organization, mode of production, or environmental setting appears to have remained free of interpersonal violence for long*." (*Walker 2001.573*). Since no form of social organization or mode of production can be causally linked with war or peace (*Ember and Ember 1997; Otterbein 1997; Otterbein 2000*), all societies will eventually indulge in war.

Much less often stressed is the fact that all these societies will know periods of peace and stability, and I would not necessarily agree that peaceable societies are as uncommon as they seem to be: the lack of diversity in responses offered by modern societies to stressors resulting in warfare could be obscuring a number of possible responses in the past. As noted by Kelly (*2000.11*), the importance of studying peaceful societies cannot be over-emphasized, yet the literature on it is much less abundant than on warring societies (*Sponsel 1994*).

Any of the above-mentioned factors: biological, ecological and cultural will not necessarily result in warfare if the society is unsegmented. Unsegmented hunter-gatherers have a low frequency of warfare, as they lack the organizational features associated with social substitutability that are conductive to development of group concepts. Segmented foragers, on the other hand, show a much greater frequency of warfare: 16 out of 17 examined (*Kelly 2000.51*). Thus recognition of group identity provides the best expla-

natory mechanism for the emergence of warfare. It is important to stress, however, that social structure in itself does not result in feuding or war. Certain external conditions will need to be imposed in order to generate warfare. Accordingly, Kelly states that "*warfare is not an endemic condition of human existence, but an episodic feature of human history (and prehistory) observed at certain times and places, but not others*" (*2000.75*).

Groups archaeologists study

That local history has to be a component in understanding warfare is no less true for the groups that archaeologists study. The examples presented in this volume are societies of relatively long duration and local history, spanning anywhere between 1000 to over 1500 years. Illustrative of the quality of evidence we are dealing with is the fact that we consider the sample size of 100 individuals from a single site of this period as substantial, and often make inferences based on fewer than 20 individuals. Given concerns about preservation bias, the inability to detect soft tissue wounds as causes of (violent) death (*Jackes 2004*), and the near impossibility of distinguishing between violence and accident, we are left with an even more difficult question. If we can indeed recognize evidence of violence, how can we interpret it: are we dealing with short episodes of unresolved conflict with high mortality rates, or a constant, but low rate of 'endemic' warfare? And furthermore, if we can ascertain a case of intertribal warfare can we consider the group (or as is currently done, for the whole era of the Mesolithic) as warlike? Could not sporadic episodes of – even organized – violence, be just what they seem to be: episodes of stress resolved through conflict having no further impact on the society and its long-term history?

How do we proceed from the evidence of an individual's violent interactions and death to interpretations of organized violence? And taking a step further in the same direction: is all organized violence warfare? Indeed, how do we make this leap in interpretation based on skeletal data alone? The often cited massacre at Offnet (*Frayer 1997*) could have more than one explanation, and could have involved more than one type of action. How do we interpret a cache of bones: 1) as the simultaneous burial of body parts rescued after a massacre; 2) the simultaneous burial of war trophies; 3) the diachronic burial of decapitated individuals sacrificed to a bloodthirsty god; 4) the diachronic burial of skulls, evidence of an ancestor cult? Any of these explanations, and a score of others, is possible. Only careful excavation and documentation can give us a sufficiently fine-grained resolution to allow reliable identification of the synchronicity of the burials, a crucial argument in the interpretation of a collection as deriving from a massacre. Unfortunately, for Offnet, and many other sites excavated earlier in the twentieth century, this is not an option.

If we accept that some of this evidence is strong enough to stand meticulous examination, is this indicative of organized violence? And further along the line of deduction, can the violence be interpreted as warfare? Ideally, only when we have answered all these questions in succession, and in the affirmative, can we presume to answer the question, by examining many of these individual societies, of whether the Mesolithic in general witnessed a higher incidence of warfare than previously. In that case, we can start building explanatory mechanisms for this elevated level of warfare. Unfortunately, we are still struggling to prove each case to be one of violence as against a number of other possible explanations. Even where violence is proven beyond doubt, we have too little information to begin delineating a picture of war and peace. Thus we are left with an examination of origins and causes of organized violence and a definition of warfare borrowed from the cultural anthropological literature. I propose that combining the insights of cultural anthropology with skeletal evidence and contextual archaeological information will result in a more reliable picture of prehistoric warfare.

The Mesolithic

Mesolithic times have been singled out as a period for which the evidence of violence becomes far more common than for earlier periods of human history (*Frayer 1997; Thorpe 2003; Thorpe 2000; Vencl 1999*), to the point that it is taken as a confirmed fact by non-specialists (*De Pauw 1998*). But is it really so? What unequivocal evidence do we have to claim that the Mesolithic was more violent than earlier periods? And if that, indeed, were true, what explanations can be offered? Is the violence related to sedentism, accumulation, prestige, or other elements of the social structure (*Pospisil 1994*); or might it not be a sampling error, stemming from the fact that we have far more skeletal remains from the Mesolithic than from earlier periods? If indeed we can demonstrate higher levels of conflict in the Mesolithic than in previous periods, what happens later: more conflict, less conflict? Does violence – and more spe-

cifically, organized violence – play an evolutionary role in creating large-scale aggregations with a centralized power structure (*Carneiro 1994*), is it the by-product of the centralization of power (*Kang 2000*), or should war and society be regarded as co-evolving as Kelly (*2000*) proposes?

For most of the Mesolithic populations, at some point in their history, contact with farming communities was possible (*Lubell et al. 1989; Radovanović 1996a*), even if it did not occur. Some of the groups participated in these communications through trade (evidenced by imports of non-local products) and possibly by other means. This period of latent and possible change had an important impact on the ideological integrity of these populations. In the case of the Iron Gates Gorge, it produced a stronger ideological integration of the community, at a time when contact with farming societies became possible (*Radovanović 1996b; 1996c*). It is often suggested that this kind of contact might have resulted in conflict through greater population pressure and territorial claims, as well as other economic or ideological factors (as in Schela Cladovei).

The Iron Gates Gorge

Few archaeological sites have elicited more debate and fewer publications than Lepenski Vir and the contemporaneous Iron Gates Gorge Mesolithic sites. Transition from the Mesolithic to the Neolithic and interactions between foragers and farmers are central themes in this debate. While artifact typology has played a major role in determining Lepenski Vir culture as Epipaleolithic (*Boroneant 1973*), Mesolithic (*Srejović 1972*), or Neolithic (*Jovanović 1984*), it is currently understood that a foraging economy and semi-sedentism characterized these communities even after they had (at least sporadic) contacts with farmers in the second half of the 7th millennium BC (*Radovanović 1996a; Roksandic 2000*). To date, violent interactions in the region have been discussed only briefly, and in the context of possible conflicts between foragers and farmers at the site of Schela Cladovei, on the left bank of the Danube (*Boroneant et al. 1999a*).

In an attempt to distinguish between individual acts of interpersonal violence and possible warfare, we examine the available evidence for violent interactions from the six sites on the right bank of the Danube and compare our data with published evidence from the coeval site of Schela Cladovei (Fig. 1). The violent interactions are examined against the backdrop of availability of contact (as defined by *Zvelebil 1996a*) between Mesolithic Iron Gates Gorge foragers and Neolithic farmers (Tab. 1). Since there is no archaeological evidence of defensive structures or armaments, our interpretation is based on bio-archeological data derived from skeletal lesions associated with violent trauma such as those described by Walker (*2001*).

Warfare, differentiated from homicide and execution on the basis of "*social substitutability*" (*Kelly 2000.21*), and "*the interrelated concepts of injury to the group, group responsibility for the infliction of injury, and group liability with respect to retribution*" (*Kelly 2000.5*), requires the examination of individual traumatic lesions in their archaeological context and the assessment of the temporal patterning of violent trauma. Given unequal preservation and problems associated with inferring levels of violence or warfare from skeletal populations (*Jackes 2004*), we restrict our interpretation to examining how well our data support two hypotheses that have been proposed in the literature for the Mesolithic in general and this population in particular.

The first hypothesis proposes that the Mesolithic period was characterized by endemic violence or warfare. Based on the incidence of projectile points em-

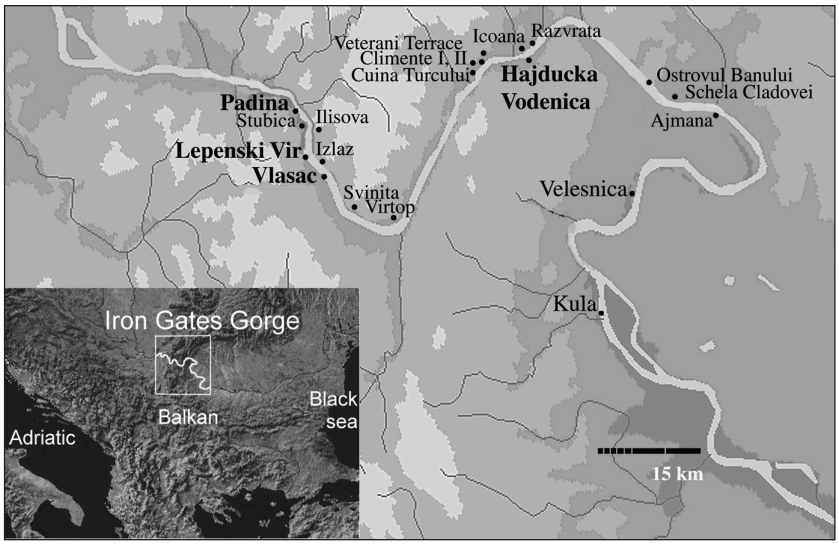


Fig. 1. The map of the region with the sites of the Lepenski Vir Mesolithic/ Neolithic complex.

bedded in different skeletal elements, Vencl (*1995; 1999*) has suggested increased levels of violence in the Mesolithic. Frayer (*1997*) drew a similar conclusion based on the osteological evidence of a massacre from the Offnet cave, while Thorpe (*2000*) furthered this argument and proposed that violence was endemic in Mesolithic Europe. However, before these claims can be accepted, we need to examine the role of sampling bias, since, in comparison to earlier periods, a more substantial number of skeletal samples are attributed to the Mesolithic, which could result in the under representation of embedded projectiles and other violent injuries in the Paleolithic period. We also need to examine the possibility that different tools used in combat situations by Mesolithic hunter gatherers in comparison with previous groups could have left more physical evidence of violence, i.e., projectile points could remain in a skeleton, while a spear would have been removed. In addition, given the lack of proper excavation documentation for the Offnet cave, which was excavated in the early part of the 20th century, we cannot exclude burial ritual as the cause for this supposed massacre.

The Iron Gates Gorge sites, with their large number of buried individuals (MNI = 418) and long duration (8200–5500 BC), represent a good choice for testing the hypothesis of endemic violence and warfare in the Mesolithic. In order to validate the first hypothesis, the Mesolithic population of the Iron Gates Gorge should show high levels of interpersonal violence throughout the duration of this cultural group, potentially affecting any member of the community, regardless of age or sex. Caution should be exercised in the strict application of the first requirement, since persons dying a violent death could be subject to a differential burial treatment, in which case only well healed old injuries would be present in the osteological record (*Jackes 2004*). We propose that a combination of healed and unhealed injuries would be sufficient to warrant the application of the first criterion. The second requirement is self-explanatory, i.e., if violence was endemic, it should be present throughout the duration of the Mesolithic. The third requirement stems from "social substitutability" (*Kelly 2000*) as a crucial element in defining warfare, since violence is not directed towards an individual, but towards the society as a whole.

The second hypothesis proposes that the conflict in the Iron Gates Gorge Mesolithic resulted from contact with farming communities. Based on the evidence from the site of Schela Cladovei on the left bank of the Danube, which belonged to the same Mesolithic tradition, Boroneanț et al. (*1999a*) have suggested that the high level of violent interactions at the site could be explained by contact with advancing farmers.

In order to validate the second hypothesis, the skeletal material from the right bank of the Danube should show a marked increase in violent interactions after 6500 BC, i.e., after contact with farming communities is either established or possible.

Materials and Methods

The six sites from the Iron Gates Gorge Mesolithic and Early Neolithic periods examined here are situated on the right bank of the Danube (see Fig. 1). The Mesolithic sites (Padina, Lepenski Vir, Vlasac, Hajdučka Vodenica) are characterized by a relatively large number of burials (ranging from thirty at Padina to well over a hundred at Lepenski Vir) and houses of the Mesolithic Lepenski Vir type. On a fertile plane outside the gorge, Ajmana and Velesnica are two Early Neolithic sites contemporaneous with the Early Neolithic component of the Lepenski Vir. The first four localities were recovered from salvage excavations in the late 1960s and early 1970s (*Jovanović 1966a; 1966b; 1967a; 1967b; 1968a; 1968b; 1969; 1970; 1971a; 1971b; 1972; 1974; Srejović 1966; 1968; 1969; 1971; 1972*) , while the two sites downstream from the Gorges were excavated in the 1980s (*Radosavljević-Krunić 1986; Stalio 1986; Vasić 1986; Živanović 1986*). Previous analyses of human skeletal remains have been oriented towards understanding the population characteristics of the individual sites within the paradigm of "anthropo-typology" (*Mikić 1980; 1981a; 1981b; 1988; 1978; Nemeskeri and Lengyel 1978a; 1978b; 1978a; 1978b; 1978c; 1978d; 1978e; Schwidetzky and Mikić 1988; Živanović 1975a; 1975b; 1975c; 1976a; 1976b; 1976c*). The first overall study concerns only two aspects of population biology (*Roksandic 1999; 2000*). Paleo-pathological analysis is available only for Vlasac (*Nemeskeri and Lengyel 1978b*). Only traumatic lesions that could be accurately interpreted as bearing evidence of violent interactions are presented here. They are compared to the published evidence of violent interactions from the coeval site of Schela Cladovei (*Boroneant et al. 1999b; Nicolaescu-Plopsor and Boroneant 1976; Vencl 1995; 1999*). An attempt is made to integrate this data set into the larger picture of the Mesolithic and Neolithic populations in the Iron Gates Gorge.

Table 1 provides a summary of site sequences and chronology for the area. During the Mesolithic proper (from 7500 to 6500 BC), the population of the Iron Gates Gorge is characterized by a sedentary or semi-sedentary pattern of mobility and a foraging economy. During the Contact period (beginning after 6500 BC) we find evidence of contact and interaction with the farming communities in the region, but no change in the pattern of mobility or subsistence (*Radovanović and Voytek 1997; Zvelebil 1996b*). The Neolithic (regardless of the dates associated with individual sites) is distinguished on the basis of increased reliance on domesticates, even though hunting remains important.

The Iron Gates Gorge skeletal series

The Iron Gates Gorge Mesolithic burial practices include cremation, primary inhumation, secondary interment, removal and re-organisation of body parts within primary burials, as well as the re-burial of skulls and fragmentary remains. Given the diverse burial practices and complex stratigraphy of the sites, coupled with the excessive speed of excavations and inadequate curation of the collection, it is not surprising that the individuals from this group show extreme variability in terms of preservation, with potentially strong effects on reported frequencies of any condition examined.

The most straightforward approach was to rely on the archaeological determination of the burials as separate entities, and to determine the minimal number of individuals (MNI) for each of these burial units following established procedures (*Lyman 1994*). Apart from burials sensu stricto, there were two more categories of bones recovered from the site: 'extra individuals' from within the burial units, and 'scattered human remains' from non-burial contexts. These 'extra individuals' were, because of the patterning of their occurrence, incorporated into the MNI of individual graves. Since "scattered" bones could have, at least theoretically, belonged to any of the buried individuals, they were not included in the MNI count (for further description of procedures for MNI assessment see *Roksandic 2000*).

Whenever possible, sex determination was based on pelvic bones and followed standard procedures (*Bruzek 2002; Buikstra and Ubelaker 1994*). In all other cases, post-cranial robustness provided more accurate results than skull morphology. Adult ages were assigned to four categories: "young adult" (YA), "fully adult" (FA), "mature adult" (MA), and "senile adult" (SA), based on all available age indicators. This approach was deemed optimal, since restricting age assessment to a set of pre-selected criteria would have greatly reduced the number of possible observations (*Roksandic and Arbeev 2002; Roksandic and Love 2000*).

A total of 263 adults of both sexes were considered. The remaining 155 immature individuals were not considered because of the lack of macroscopically identifiable traumatic conditions that may be associated with violent interactions.

Discerning trauma and violence in the skeletal record

Violence can be traced in skeletal remains from archaeological sites if it involves skeletal trauma. In order to assess injuries correctly, it is necessary to distinguish between pre-mortem, post-mortem and peri-mortem conditions. Evidence of healing is the best indicator that traumatic lesion occurred pre-mortem (*Aufderheide and Rodriguez-Martin 1998. 23*). Similarly, post-mortem fractures occurring on dry bone are relatively easy to recognize (*Berryman and Haun 1996*). Because bone needs at least two weeks of survival to show signs of healing (*Mann and Murphy 1990*), and remains somewhat plastic up to two months after death, peri-mortem fractures are very difficult to interpret: a blunt force impact on the skull resulting in depressed fractures could easily be the cause of death and therefore a pre-mortem trauma, a post-mortem intentional or ritual breakage of the skull, or even the result of rough handling of the body after death (*Walker 2001*). The accidental

Period	Padina	Lepenski Vir	Vlasac	Hajdučka Vodenica	Velesnica	Ajmana	Schela Cladovei
Neolithic		IIIb			whole	whole	
Mesolithic/	B(III)	II/IIIa	–	Ib			
Neolithic	B(II)	I(3)	–	Ia			
Contact	B(I)	I (2)	III	Ia			II
Pre	A-B	I (1)	Ib-II				II
Contact	A/A-B	Proto LV	Ia-b	1a			
Mesolithic	A	–	Ia	–			I

Tab. 1. Synchronisation for the sites examined (Based on* Radovanović 1996a.289; Radovanović and Voytek 1997*).

breakage of long bone shafts soon after death (due to sediment collapsing within the grave or similar causes) can be misinterpreted as pre-mortem trauma. In many cases careful excavation and recording of the exact position of every bone fragment can clarify the issue (*Duday 1987; Duday et al. 1990; Roksandic 2002*), but since such documentation does not exist for the assemblage in question, it was necessary to rely on circumstantial evidence, positioning of the trauma, type of fracture, and experience (following *Maples 1986*).

All evidence of bone fractures was carefully examined for signs of post-traumatic healing. The cases where the breakage was clearly post-mortem were excluded from further consideration. Most lesions that were associated with violence showed clear signs of healing. Peri-mortem trauma was considered only if the position of the injury was concordant with violent encounters.

Reporting prevalence of violent trauma follows the archaeological classification of the sites into three periods: Pre-contact or the Mesolithic proper, Contact or the Mesolithic/Neolithic period, and the Neolithic period (for detailed definitions of these periods, see *Roksandic 2000.24*). Since unequal preservation of skeletal parts has a potential to underestimate any pathological condition (*Roberts and Manchester 1995*), the frequencies for the six sites on the right bank of the Danube were calculated by skeletal element. However, element counts were not available for the site of Schela Cladovei, and comparisons between the sites had to be reported per MNI.

Results

Vlasac 4a: Projectile point injury. (Figs. 2, 3) The individual is a young male, 18 ± 3 years old. ^{14}C date of 7500–6500 and dietary data (*Grupe et al. 2003*)[1] place it in the Mesolithic pre-contact period.

Reconstruction of the pelvic bones revealed an embedded bone projectile in the *iliac fossa* of the left coxal (Fig. 2). The projectile point might have been shot at high velocity (as an arrow or a dart) from the postero-lateral direction. It penetrated the *gluteus maximus* and *medius* and both laminae of the ilium (Fig. 3). Subsequently, the tip and the lower portion were broken off, leaving a 12 mm long embedded portion, 4 mm in diameter at the point of penetration and 3 mm at the point of exit. It is impossible to ascertain whether the breakage happened during the impact or after death. No micro-trauma that could indicate a failed attempt to remove the projectile from the bone *in vivo* could be observed, suggesting a post-mortem scenario for the breakage; alternatively, the micro-trauma could have been obliterated by post-traumatic bone remodeling.

Whether we interpret the above evidence as indicating temporary, post-traumatic survival or not, several possible explanations can be offered for this injury: 1) a hunting accident, 2) homicide, 3) execution, or 4) warfare (including feuding). Given the position of the impact – lateral and posterior in the lower part of the body – execution would be the least likely scenario. A hunting accident, homicide, or warfare are equally likely, as they could all result from an ambush; the age and sex of the victim are

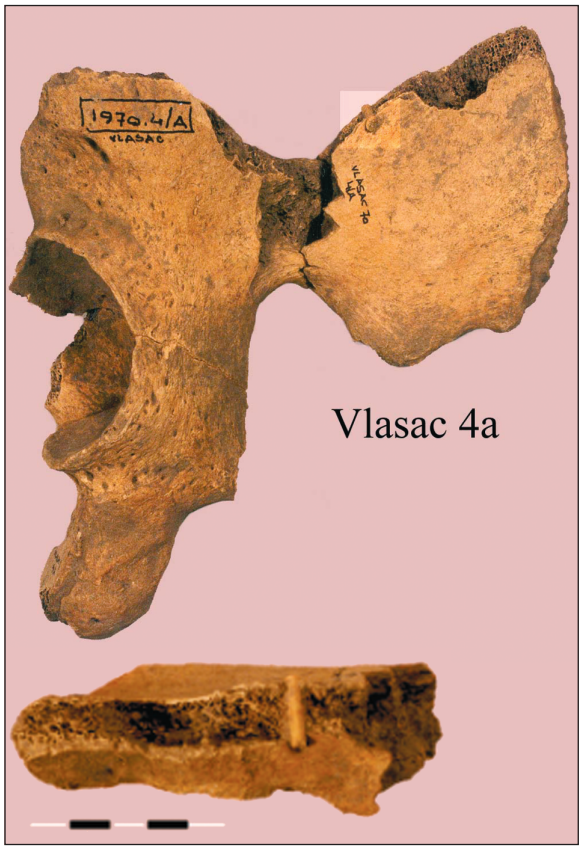


Fig. 2. Reconstructed left coxal of Vlasac 4a with embedded projectile point highlighted. Inset shows the cranial aspect of the coxal with the projectile point traversing the bone.

1 Grupe et al. (*2003.Tab. 1a*) report the calibrated ^{14}C age as 7600-6500 BC without any further details on the specimen Laboratory ID number and methods of calibration, and isotope values within the range of those reported for Mesolithic Vlasac by Bonsall et al. (*1997.72*), concordant with Radovanovic's (*2000*) "early diet type" in which most of the protein was obtained from aquatic food sources.



Fig. 3. The fragment of the Vlasac 4a ilium in anatomical position.

compatible with all three. While hunting accidents were probably not very common, they cannot be excluded. Homicide from an ambush seems to be the most likely explanation, but whether it is an individual act of violence or evidence of warfare cannot be deduced from a single case.

Vlasac 51a: Parry fracture of the right ulna with pseudo-articulation. (Fig. 4). The skeleton Vlasac 51 is a relatively well preserved, fully mature female. The ^{14}C date of 7600 to 7080 BC calibrated (2σ) (OxA–5822, *Bonsall et al. 2000.123, Tab. 3*), and an 'early diet type' (*Bonsall et al. 2000; Radovanović 2000*) indicate the pre-contact Mesolithic age.

The lower third of the right ulnar shaft displays a non-united transverse fracture (Fig. 4), with surfaces remodeled into a pseudo-articulation, induced by lack of immobilization during callus formation. The compact bone lining the involved ends shows areas of pitting and an irregular surface. There are no pathological changes on the right radius or any other element of this skeleton.

The type of fracture suggests a direct trauma that could have resulted from a blunt object breaking the bone in a defensive movement of the arm raised to protect the head. Smith (*1996.84*) cautions that in cases where the potentially corroborative cranio-facial injury data are lacking, a violent aetiology for mid-shaft ulna fractures is less likely, and he lists a number of possible causes for this type of forearm fracture: accident, stress or fatigue, or an underlying pathological condition, in addition to interpersonal violence. However, successful fending off of a blow could prevent cranial trauma. Therefore, violence should be considered as a possible explanation for this injury.

Vlasac 82a: Depressed fracture on the frontal bone. The individual is very probably a mature or senile male. As no absolute date or isotope values are reported, the burial is assigned to the pre-contact Mesolithic period based on the site stratigraphy (*Radovanović 1996b*).

On the right side of the frontal bone, between the coronal suture and the frontal protuberance, there is a large (45 mm x 25 mm), ellipsoid, fully healed depressed injury. The base of the lesion is rough, without evidence of change in bone structure, and the medial margin is prominent. In axial projection, there is a well-defined area of radiopacity, with increased bone density resulting, probably, from a post-traumatic calcified intraosseous hematoma. In addition, marked surface porosity is seen on the parietal bones along the sagittal suture. The type of



Fig. 4. Vlasac 51a: radius and ulna, pseudoarticulation of the right ulna highlighted and in detail.

force needed to create this pattern of fracture suggests a blow to the head by a hard, blunt object from an oblique superior direction.

Lepenski Vir 69: repeated depressed fractures on the frontal bone. Field documentation and published photographs (*Radovanović 1996b.172, Fig. 4.2; Srejović 1969.161, Fig. 64*) reveal a particularly well preserved and complete skeleton. However, only the skull and two femora could be found during our 1998 analysis, probably due to inadequate collection practices in the field. The individual was male of mature adult age. Both the 7000 BC ^{14}C date (calibrated) reported by Grupe et al. (*2003.Tab. 3a*) and the isotope data (*Bonsall et al. 1997.64–65, Tabs. 3 and 4*) indicate the pre-contact Mesolithic period.

Two healed depressed fractures are observed. The first one, on the frontal squama approximately 15 mm anterior to the bregma, is a deep oval depression (35 mm x 24 mm), with smooth walls and rounded edges. The other, located in the region of the right frontal eminence, is a shallow irregular depression (14 mm x 7 mm), with a prominent lower edge. In addition, in the region of the coronal suture of the right parietal and frontal bone there is an ellipsoid defect (35 mm x 12 mm) that lacks the characteristic concentric fracture and beveling typical of fresh bone breakage (*Berryman and Haun 1996*), and was probably damage to the dry bone because of the irregular and sinuous aspect of some of the issuing cracks (*Botella et al. 2000.93*).

Vlasac 69: Repeated depressed fractures on the frontal bone. (Fig. 5) The skull and the postcranial bones indicate a mature adult male. Since no absolute age is reported, assignment to the Mesolithic/Neolithic period is based on archaeological data (*Radovanović 1996b*). Dietary data, however, suggest an 'early diet type', indicating pre-contact times.

A healed depressed fracture (Fig. 5a) is observable in the area of the right frontal eminence. It is small and shallow (8 mm x 6 mm), with a prominent lower edge. The unhealed injury (15 mm x 9 mm) – with several thin fissures on its lower margin – is situated on the left half of the frontal bone, in the area of the frontal eminence (Fig. 5b). The position of the fracture is concordant with interpersonal violence and suggests that the force was applied from an antero-superior direction with a blunt instrument. The prominent radiating fractures in the area should be considered as a peri-mortem, or more probably, a

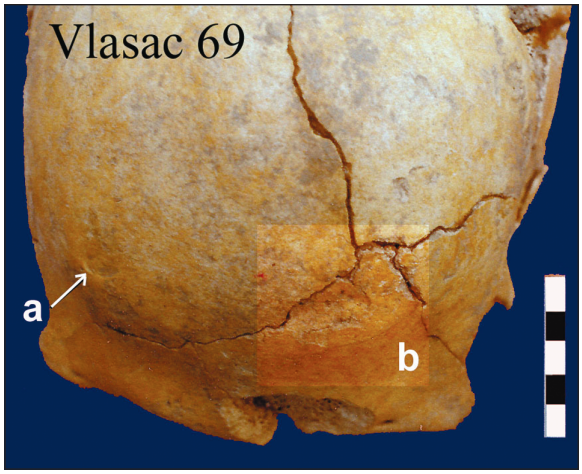


Fig. 5. Vlasac 69. Evidence of a) a small healed depressed fracture and b) a perimortmem blunt force trauma on the frontal bone.

post-mortem trauma. The only other pathology observed on elements associated with this skull is the eburnation of the proximal humerus.

Lepenski Vir 20: Blunt impact with a conical object. (Fig. 6) The field drawing of the burial (*Roksandic 2004.63, Fig. 10*) shows a nearly complete post-cranial skeleton; however only the skull was found during the 1998 analysis. The individual was probably a mature adult male. No absolute dates or dietary information exist for this burial. Archeological data suggest either Mesolithic/Neolithic (Lepenski Vir II) or Neolithic (Lepenski Vir IIIa) provenance, both of which fall within the period when contact with farming communities became possible (*sensu Zvelebil 1996b*).

The skull is almost complete, with fragments of the base and the right frontal bone adjacent to the lesion missing. The injury is a fully healed depression of the frontal squama in the area of the right frontal protuberance (22 mm x 24 mm). The fracture is pyramidal in shape, with smooth walls and poorly defined rounded margins. The adjacent annular zone of bone is sclerotic. The impact is much deeper and narrower, and appears to have been produced by an object with a sharp conical end.

Discussion

A total of six skeletons excavated on the right bank of the Iron Gates Gorge exhibit traces of *probable* violent trauma (Tab. 2). While violence as etiology is the most likely explanation in the case of the five men, the parry fracture recorded in the female individual is concordant with both accident and violence.

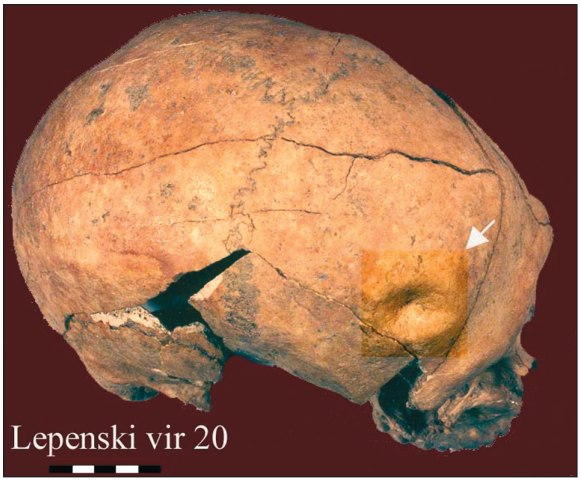


Fig. 6. Lepenski Vir 20. a) Arrow points to the depressed frontal impact produced with a conical object.

There are two injuries that could have been lethal: Vlasac 69 could have died of an unhealed cranial trauma, and Vlasac 4a from the consequences of the projectile penetration shortly after the incident. This allows us to argue that there is no differential burial treatment of the victims of violence, and that the frequency is, at least in that respect, a realistic estimate of the frequency of violent interactions. Cranial depressed fractures are consistent with 'face to face' fighting: all are on the frontal bone, with definite side preference: the four healed impacts are on the right side of the skull and the one unhealed injury is on the left. Two skulls have multiple impacts, of which at least one is healed, further confirming violent etiology (*Judd 2002*).

These six violent injuries are recorded on the 263 (2.3%) individuals examined (Tab. 3): 1/86 ulnas (1.2%), 1/52 coxae (1.9%), and 4/109 skulls (3.7%). The difference in frequencies per MNI and per element is not significant (Chi-square = 1.4009, distribution is not significant, *p* is less than or equal to1, allowing us to consider frequencies per individual when those per element are not available.

Frequencies for the two post-cranial injuries are not conclusive, and can not be compared between periods as only one injury is present per bone type. Four of the 109 (3.7%) sufficiently preserved skulls show evidence of blunt force trauma. Two skulls belong to the pre-contact, Mesolithic period (2/42 or 4.7%), and the remaining two to the post-contact Mesolithic/Neolithic or Neolithic periods (2/59 or 3.4%). It was not possible to assign period affiliation to a further eight skulls. The difference between the pre- and post-contact periods is not significant (Chi-square = 0.1214; p is less than or equal to 1).

With such low frequencies in the series, we can not claim that the material meets the first criterion of elevated levels of interpersonal violence. When injuries are examined by element and sex combined, the picture is different: all four are recorded on the 42 preserved male skulls, raising the frequency to 9.5%, and indicating that interpersonal conflict was not as rare as overall frequencies suggest, at least among men.

Given low overall frequencies and the small number of injuries, the second criterion (of relatively equal distribution of the injuries over the duration of Mesolithic) can not be evaluated; to further elucidate the question of endemic warfare we have to turn to the third criterion. Out of six individuals with violent injuries, five are men (83.3%) and only one is a woman. At least one individual is concordant with social substitutability as the principal determinant of warfare. As in the case of the second criterion, low

Site	Burial	period	^{14}C BC cal	diet	sex	age	Trauma
Vlasac	82a	M	no data	no	m	MA/SA	Frontal (R)
Lvir	69	M	**7000	early	m?	MA/SA	Frontal, healed (R,L) perimortem (R)
Vlasac	51a	M	*7600–7080 (2σ)	early	f	FA	Ulna parry fracture (R)
Vlasac	4a	M	**7600–6500	early	m	YA	Projectile point in the ilium (R)
Vlasac	69	M/N	no data	early	m?	MA	Frontal, healed (R) perimortem (L)
Lvir	20	M/N/N	no data	no	m?	MA	Frontal, deep conical (R)

Burial = number assigned to the burial by excavators. Period: M = Mesolithic, M/N = Mesolithic in contact with Neolithic, N = Neolithic; ^{14}C: radiocarbon date where available * from Bonsall et al. (*1997.2000*); ** from Grupe et al. (*2003*) Diet: early = predominantly aquatic, late: large portion of terrestrial (*Radovanovic 2000*). Sex: m or f = male or female assigned based on pelvic remains, m?/f? male or female assigned based on postcranial robusticity; age: YA = young adult, FA = fully adult, MA = mature adult, SA = senile adult. Trauma, position and type of traumatic lesion.

Tab. 2. All recorded incidences of skeletal trauma possibly caused by violence in the Iron Gates Gorge sample.

	skull					ulna					pelvis				
Site	**total**	VT	%	M	F	**total**	VT	%	M	F	**total**	VT	%	M	F
Precontact	**42**	**2**	**4.8**	**19**	**22**	**33**	**1**	**3.0**	**13**	**18**	**20**	**1**	**5.0**	**8**	**11**
L Vir	4	1	25.0	4	0	1	0	0	1	0	1	0	0	1	0
Vlasac	31	1	3.2	14	16	28	1	3.6	10	16	19	1	5.3	7	11
Padina	7	0	0	1	6	4	0	0	2	2	0	0	0	0	0
Postcontact	**59**	**2**	**3.4**	**23**	**33**	**41**	**0**	**0**	**19**	**21**	**30**	**0**	**0**	**16**	**14**
L Vir	19	1	5.3	6	10	9			4	4	3			1	2
Vlasac	17	1	5.9	6	10	14			5	9	8			3	5
Padina	9			3	5	6			3	3	6			4	2
H. Vod.	6			6	3	4			4	0	5			5	0
Ajmana	5			2	2	5			3	2	5			3	2
Velesnica	3			0	3	3			0	3	3			0	3
Not known	8					12					0				
total	**109**	**4**	**3.7**	**42**	**55**	**86**	**1**	**1.2**	**32**	**30**	**50**	**1**	**2.0**	**24**	**25**

VT = violent trauma; M = male; F = female.

Tab. 3. Skeletal elements affected by violent injuries. Breakdown by pre-contact Mesolithic and post-contact Mesolithic/Neolithic and Neolithic periods. Cumulative values for Pre-contact and Post-contact are outlined in bold.

prevalence makes it impossible to ascertain that the third criterion is not met, since the low frequency of females and lack of children with violent injuries could be the result of overall low frequency, in which case warfare can not be excluded. On the other hand, the one female in the sample could be interpreted as a result of individual interpersonal or domestic violence, non-indicative of warfare. The already mentioned elevated frequencies of skull injuries in men strongly suggest that violence indeed was a 'male business' at these sites.

Low overall frequencies and the low prevalence of violent injuries in females suggest that the first hypothesis of endemic warfare in the Mesolithic is not supported by the Iron Gates Gorge evidence.

Four of the six individuals with violent injuries (66%) are from the pre-contact period in the Iron Gates Gorges (Tab. 3). The remaining two are individuals with ambiguous chronological designation, Vlasac 69 showing 'early diet type' – isotope values, and Lepenski Vir 20 having no data. Therefore, the criterion for establishing contact with farmers as a cause of warfare in the region is not substantiated by the sites on the right bank of the Danube. In order to evaluate this question for the whole region in the Mesolithic/Neolithic contact, we scrutinize the evidence from Schela Cladovei.

The site of Schela Cladovei, situated on the left bank of the Danube, in the fertile flood-plane downstream from the Gorges, shows a very different picture from the rest of the sites of the Lepenski Vir complex. Out of the total of 57 individuals excavated in two field campaigns, McSweeney et al. (*2000*) reported five individuals (four males and one female), with possibly fatal and multiple projectile wounds, and 14 individuals with evidence of other violent trauma (19/57 or 33.3%).

Seven well-documented cases considered here come from 28 individuals in the meticulously excavated Area III (7/28 or 25%): two skulls (female 42 and male 48) show evidence of blunt force trauma; two individuals, one male (46) and one female (49) had 'parry' fractures, and three had embedded projectiles: bone projectiles in the male individuals 48 and 50, and a flint projectile in individual 47 for which the sex was not reported (*Boroneanţ et al. 1999a. 389*). In terms of dietary information, they all form a tight cluster, interpreted by Bonsall et al. (*1997*) as predominantly aquatic indicating the Mesolithic, pre-contact period. ^{14}C dates are more ambiguous as they fall between 7450–6439 BC calibrated (2σ) when corrected for freshwater reservoir effect (*Bonsall et al. 2000.123, Tab. 3*), concordant both with the pre-contact Mesolithic and the beginning of possible contact with the Neolithic.

Table 4 summarizes the differences between Schella Cladovei Area III and Vlasac and Lepenski Vir in terms of prevalence of different types of injury. As many as seven out of 28 individuals at Schela Cladovei Area III (25%) show one or more violent injuries, compared to four out of 118 (3.4%) for Vlasac and two out of 103 (1.9%) for Lepenski Vir. The distribution is significant (Chi-square = 25.4606; p is less

than or equal to 0.001). A further look at the breakdown per type of injuries shows persistent differences between the left and the right bank for both projectile points and 'parry' fractures. Blunt force trauma to the skull shows relatively similar frequencies for all three sites, with one important difference: it is present in both men and women at Schela Cladovei and only in men at the other two sites. The significant difference in both the prevalence and pattern of injury between Schela Cladovei and sites in the Iron Gates Gorge suggests different archaeological contexts and behaviors associated with violence.

Schela Cladovei III material is restricted in time; the dates form a tight cluster, further corroborated by relatively uniform burial practices. Concordant with the pattern of injuries, they could represent either a single episode of group violence, or a series of related events. Given the number of females involved, it is reasonable to suggest that the whole group was targeted. This meets the criteria of substitutability of an individual, a crucial condition in the identification of warfare as defined by Kelly (*2000*). Warfare (and raiding as part of it) is a likely explanation for this site. The episode of war is, however, nor associated with contact with farmers. The dates do not fall clearly after 6500 BC, and the dietary information suggests that the crucial change between pre-contact and post contact diet type had not taken place. Accordingly, while the site meets the criterion for warfare, it does not clearly fall in the post-contact period and can not be used to support the second hypothesis.

On the basis of the evidence presented above, the violent interactions on sites on the right bank of the Danube in the Gorges could be explained as a series of unrelated and diachronic episodes. These incidents could have as easily happened within the community as with members of other groups. The episode of violent conflict concordant with definition of warfare at Schela Cladovei remains isolated and is not related to the contact with farmers.

Conclusions

Violent interactions in the Iron Gates Gorge Mesolithic and Mesolithic/Neolithic Contact period are confirmed by a restricted number of skeletal elements with traumatic injuries for which violence is a likely etiology. There is an important difference in the pattern of violence between the right bank of the Danube in the Gorges area and the flood-plain on left bank downstream from the Gorges. When viewed separately, the Gorges area shows sporadic violence and does not support the first hypothesis of endemic warfare in the Mesolithic. Not only is there very little evidence of violence, most of it is non-lethal (ritualized?) face-to-face conflict among men (*Walker 1989*). While no trend towards increase or decrease can be discerned given the restricted numbers of individuals with trauma, it is apparent that violence on the right bank is not associated with contact with farmers.

Schela Cladovei follows a different pattern, with high levels of violence and involvement of both sexes. The individuals form a tight cluster in terms of ^{14}C dates, dietary information and burial ritual. Mesolithic type diet and dates, which are borderline between the pre-contact and contact periods, indicate that the contact with Early Neolithic cultures further south in the Balkans was – if at all possible – on a small scale. A large displacement of farming communities that would shrink the territory of Mesolithic peoples and cause stress is unlikely at this early stage. The causa belli that have most often been evoked – decrease in territory under pressure from the Neolithic communities in the region, increase in population and other stresses associated with contact

site	Projectiles/ per individual	%	parry fracture/ per element	%	skull fractures/ per element	%	all injuries/ per individual	%
Schela Cladovei Area III	3/28	10.7	2/28*	7.1	2/28	7.1	7/28	25.0
Vlasac	1/118	0.8	1/42	2.3	2/48	4.2	4/118	3.4
Lepenski Vir	0/103	0.0	0/10	0.0	2/31	6.4	2/103	1.9

* No data on number of skulls or ulnae in Schela Cladovei were reported, accordingly, the frequencies could be even more elevated if reported by element. Site photos suggest relatively complete skeletons.

Tab. 4. Comparison between the three sites for violent injuries per type of injury. Schela Cladovei data are restricted to the Area III for which the numbers for different types of injury are reported by Boroneanţ et al. (1999).

with farmers can therefore be excluded as explanatory mechanisms for these violent interactions.

Based on the evidence presented, warfare can not be ascertained on the right bank of the Iron Gates Gorge. If there indeed was organized violence and warfare, as suggested by the Schela Cladovei data, it was localized and temporarily restricted, countering the notion of endemic warfare. Conflicts caused by advancing Neolithic farmers can be excluded on the basis of the evidence presented here, since most of the violent interactions happened during pre-contact or early contact times.

Examining archaeological data with building regional histories in mind strongly counters generalizations based on sporadic evidence of warfare. While it is possible and even likely that organized violence increased in the Mesolithic due to a number of changing mobility patterns and increased territoriality, and the possible segmentation of groups, it has to be examined in the local context with all the data available.

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The transition to farming and the ceramic trajectories in Western Eurasia: from ceramic figurines to vessels

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ABSTRACT – *In Eurasia the invention of ceramic technology and production of fired-clay vessels has not necessarily been related to the dynamics of the transition to farming. The invention of ceramic technology in Europe was associated with female and animal figurine making in Gravettian techno-complex. The fired-clay vessels occurred first in hunter-gatherer contexts in Eastern Eurasia a millennia before the agriculture. The adoption of pottery making in Levant seems to correlate with the collapse of the 'ritual economy', social decentralization and community fragmentation in the Levantine Pre-Pottery Neolithic. In South-eastern Europe the adoption of pottery making was closely associated with social, symbolic and ritual hunter-gatherers' practices.*

IZVLEČEK – *Začetki in razvoj keramične tehnologije ter lončarstvo v Evraziji niso vezani na pojav kmetovanja. V Evropi so najstarejši keramični artefakti – figurice v obliki ženskih in živalskih teles – dokumentirati v Gravettianu. Najstarejše lončene posode se pojavijo v vzhodni Aziji, tisočletja pred kmetovanjem. V Levanti pojav lončarstva sovpada s kolapsom 'ritualne ekonomije' in družbeno decentralizacijo na koncu predkeramičnega neolitika. V jugovzhodni Evropi so začetki lončarstva povezani z različnimi socialnimi, simbolnimi in ritualnimi praksami lovcev in nabiralcev.*

KEY WORDS – *ceramic technology invention; demic diffusion; ritual economy; transition to farming*

Introduction

The appearance of ceramic technology and production of fired-clay vessels has an extended history that has not necessarily been related to the dynamics of the transition to farming. It is increasing clear that diverse forms of ceramic technology had been 'inhabited' into the agency of Eurasian hunter-gatherers long before the emergence of sedentary social structures appeared. The invention of ceramic technology in Europe was associated with female and animal figurine making in Gravettian techno-complex, dated to about 26 000 BP. The introduction of fired-clay vessels occurred first in hunter-gatherer contexts in Eastern Eurasia, where it was associated with small-scale sedentary or semi-sedentary communities millennia before the advent of agriculture. The adoption of pottery making in Levant seems to have been caught up in processes of social decentralization and community fragmentation, which were part of the collapse of the 'ritual economy' in the Levantine Pre-Pottery Neolithic. In the South-eastern Europe the adoption of pottery making seems to have been incorporated within the hunter-gatherers' social, domestic and mortuary structures. It was the agency of hunter gatherers which initiated and made possible, both the later structural transformations in the economy, but also the almost simultaneous dispersal of a new form of ceramic materiality into the region.

Neolithic demic diffusion and the ceramic figurine paradox

Jacques Cauvin (*1978.134; 2000.22–29, 204–205, 207–208*) has postulated that Levantine ceramic female figurines were markers of the new 'expansionist' religion, which became a powerful social force and facilitated at an ideological level the transition to an agricultural way of life. In identifying what he understood was clear evidence for an inter-linked economic and religious transformation he believed that he had also discovered the reason why hunter gatherer people in villages outside the Levant did not develop subsistence production for themselves. He suggested that their failure to move over to the 'humanisation' of art and related new divinities could also have prevented them from moving over to a new type of economic practice. According to this interpretative scenario Europe thus could not have become Neolithicised until the 'wave of advance' and ceramic female figurines had reached the Balkans.

It was suggested recently that the distribution of Neolithic ceramic female figurines appears to have links with human genetic evidence. As Roy King and Peter A. Underhill (*2002.707–714*) have hypothesised, these figures are perhaps 'the best genetic predictor' of Neolithic farmers' haplogrups and of the (re)population dynamics in Europe and Western Asia. It is due to the postulates that their geographic distribution correlates closely with the southeast-northwest cline of frequencies of Y chromosome markers and associated haplogroup Eu9 (J-M67* and J-M92 according to *Semino et al. 2004.1030*) in modern populations in Asia Minor and Europe, and, that all appear to originate in the same area of south-central Anatolia. The ceramic female figurines were hypothesised to appear at the same time as the emergence of cereal cultivation in the PPNA of the Levant. Moreover, they were believed to symbolise a series of gender and symbolic attributes that were carried forward with the spread of farming and went on to constitute part of the 'new materiality' that defined the key economic and ideological features of the Balkan Neolithic (*Gimbuts 1989; Biehl 1996. 153–175; Marangou 1996. 176–2002; Chapman 2000; Bailey 2005; Hansen 2005. 199–200*).

However, the introduction of ceramic female statuettes, animal figurines and constructional ceramics were certainly not within the cultural domain of earlier Levantine hunter-gatherer societies, and nor they did not appear only on the 'eve of the appearance of an agricultural economy' as Cauvin (*2000.25*) suggested. The tradition of making figurines can be traced back to Central Europe, across the Russian Plain, into southern Siberia, and ultimately back to the Levant and Northern Africa. It is now clear that the clay figurine tradition was deeply embedded in pre-existing Eurasian hunter-gatherer social and symbolic contexts and that the dates of these figures begins as earlier as 26 000 years BP (*Verpoorte 2001*; *Budja 2004.59–81; 2005.53–72*). For example, more than 16 000 fragments of anthropomorphic figurines, zoomorphic statuettes, pellets, 'earplugs', flat fragments and constructional ceramic were recovered from the Central European Palaeolithic sites of Dolní Věstonice, Pavlov, Petřkovice, and Předmostí in Moravia. In the same region poorly preserved fragments of fired clay have also have also been recorded at Krems-Wachtberg, Moravany-Lopata, Jarošov, and hypothetically at Kašov and Cejkov (*Soffer and Vandiver 1997.383–402; Verpoorte 2001*) (Figs. 1 and 2), and while some may have been statuettes, their exact form remains unclear. Further to the East, on the Russian Plain, low-temperature-fired clay fragments were reported at Zaraisk and Kostenki Gravettian sites. At the latter, located on the banks of the River Don, more than four hundred fragments were found, contextually associated with marl and ivory Venus figures, and animal statuettes (*Iakovleva 1999.125–134; Soffer, Adovasio and Hyland 2000.511–537; Soffer et al. 2000.814*). Finally, the most easterly anthropomorphic ceramic figurine was found at an open air site at Maininskaya (Maina), on the left bank of the Yenisei River in Siberia (*Vasil'ev 1985.193–196; Maina on-line*).

All these early ceramic figurine assemblages can be assigned to the Pavlovian, a local variant of the Eastern Gravettian techno-complex, which dates back to

Site	Anthropomorphic	Figurative	'Ceramics'
Dolní Věstonice I	12 (note 1)	> 721	> 5,760
Dolní Věstonice II – north	–	⩾ 2 (10?)	431
Dolní Věstonice II – west	–	1	7
Dolní Věstonice III	–	–	1?
Pavlov I	8 (note 1)	> 100	~ 10,000
Pavlov II	–	?	~ 135
Předmostí I	–	⩾2	> 2
Jarošov II	–	–	1?
Krems-Wachtberg (note 2)	–	3	3

Fig. 1. Statistics of ceramic assemblages of Upper Palaeolithic Pavlovian sites in Central Europe (after* Verpoorte 2001.Tab. 5.1*).

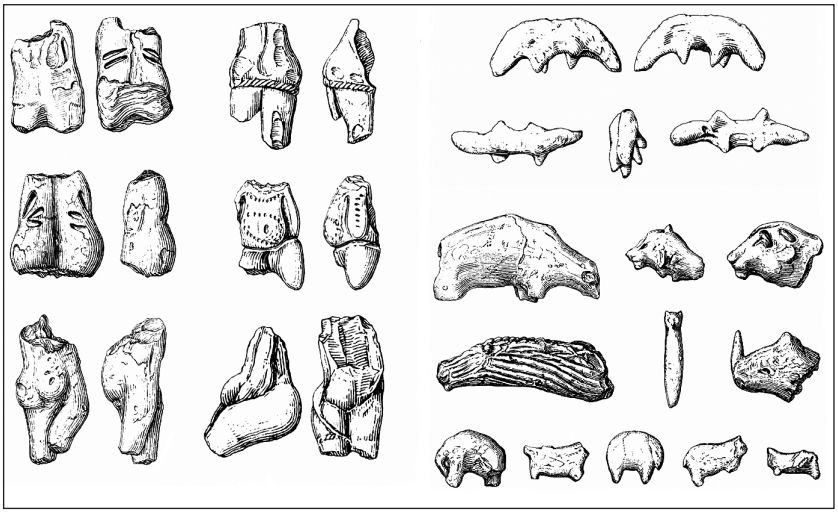


Fig. 2. Anthropomorphic and zoomorphic ceramic figurines from the Upper Palaeolithic Pavlovian sites Dolní Věstonice, Pavlov and Předmosti (from* Verpoorte 2001.Figs. 3.6, 7, 8, 9, 46, 3.73, 8.1 and 54*).

around 26 000 BP (*Verpoorte 2001.86*). For example, the ceramics at Kostenki were embedded in range of contexts, the oldest of which dates to 24 100 BP, and the most recent, to 18 000 BP (*Soffer et al. 2000. 814*). Two dates are available for a ceramic figurine at Mayininskaya: at 16 540±170BP and 16 176±180 BP (*Vasil'ev 1985.193–196; Vasil'ev et al. 2002.526, Tab. 1*). In addition, a lesser known fired ceramic sculpture, possibly representing a wild Barbary sheep (*Ovis tragelaphus*), was recovered from Tamar Hat Cave in Algeria, in an Ibero-Maurisian context which has been dated to 19 800±500 bp (*Saxon 1976.327–329*).

These finds point clearly to the fact that knowledge of ceramic technology had become 'embedded' into the agency of Eurasian hunter-gatherers many millennia before the appearance of food-producing agricultural societies. We must also note two other facts, first, that the making of ceramic figurines predates the making of pottery, and second, that pottery was not necessarily associated with the emergence of farming, as ceramic vessels were being made before the practice of early agriculture in Eastern Asia, and subsequently in the Levant, and Anatolia in Southwestern Asia.

If we look more closely at the contexts in which early hunter gatherer ceramics were produced we can attempt to generate insights into social significance of these sculptures. For example, in Central Europe, a total of sixteen thousand ceramic objects have been found in a series of Gravettian and Pavlovian period Palaeolithic hunter gatherer camps, which points towards the widespread practice of the ceramic craft. At the famous site of Dolní Věstonice there was an 'oven-like hearth' located in the centre of the hut-like structure, where "two thousand pieces of 'ceramic', among which about one hundred and seventy-five with traces of modelling" were dispersed (*Verpoorte 2001.56 and 128*). In addition, other ceramic finds had been deposited in the vicinity of a single male burial, around a triple burial, and in the vicinity of a large hearth (*Verpoorte 2001.95*). The available statistics indicate that almost all the figurines and statuettes were deliberately fragmented, although many of the pellets and balls which form a large part of the ceramic inventory was found in an intact state.

Vandiver, Soffer, Klima and Svoboda (*1989.1002–1008; Soffer et al. 1993.259–275; Sofer and Vandiver 1997.383–401*) generated some very interesting insights into the material by attempting to reconstruct the ceramic production process by examining the technological skills involved. They discovered that the local loess was suitable for shaping the female figurines, animal statuettes and pellets. Figurines and statuettes had been made from several small pieces of clay joined together, with heads, legs, feet, ears and tails shaped separately and then attached to the bodies. Firing temperatures were low, between 500° and 800°C. However, the most important finding was widespread evidence that thermal shock, rather than breakage, had caused the fragmentation of the artefacts. This explosive reaction occurs when clay is subjected to sudden increases in temperature, for example during firing, and is especially violent when the clay is not fully dry. The researchers discovered that the figurines had been either dried or partially fired, but then subjected to a deliberate re-wetting after which they were cast into the fire where they would explode loudly sending fragments flying in many directions. Rather than being evidence for poor mastery of ceramic technology, they concluded that the communities were carefully exploiting and manipulating the inherent characteristics of the clay, with thermal shocking used deliberately for special visual and audible effect. This production for spectacular destruction was clearly of greater significance to the community than creation

of an enduring and final artefact. In contrast, all ivory objects and stone figurines survive in fairly complete states. It is surprising that the entoptics, generally associated with the shaman's altered states of consciousness, were not attached to the new medium, the ceramics, although being broadly applied to ivory and bone imagery, and also stone figurines (*Marshack 1991.24; Svoboda et al. 1996.167–168; Lewis-Williams 2002; 2004.107–111*). The suggestions that the audio-visual effects of 'magic transubstantiation, the conversion of mud or dust into stone' (see Childe below), and figurine fragmentation simply replace them, and the visual and audible magic of the new medium, become accessible to the all members of community remain hypothetical.

We may postulate the ceramic female figurines are 'predictors', to paraphrase King and Underhill, of the Palaeolithic hunter-gatherers' as much as the Neolithic farmers' genetically determined haplogrups in Eurasia. It is unlikely that they represent the materialisation of the ideological *conditio sine qua non* for the successful transition to farming or the demic diffusion and the associated replacement of indigenous European population by which farmers expanded geographically, carrying with them their own culture (*Budja 2005.53–72*). We must note that the European genetic landscape was reshaped recently by the identification of subclades I1a, I1b*, I1b2, and I1c of I Y chromosomes. The haplogroup I is the only autochthonous haplogroup that is almost entirely restricted to the European continent where it shows frequency peaks in two areas, Scandinavia and Southeastern Europe (*Semino et al. 2000.1155–1159; Rootsi et al. 2004.129–134; Barać et al. 2003. 535–542*; *Peričić et al. 2005.1964–1975;* see also *Peričić et al.* and *Rootsi in this volume*). We must note that I1b* lineages expanded from the refuge in South-eastern Europe before the Neolithic at ca 11 100±4800 BP.

The invention of fired-clay vessels technology

The invention of vessel technology has become archaeologically conceptualized with pottery making since Morgan (*1878*) hypothesised that in context of human social evolution 'lower barbarism' could be distinguished from 'upper savagery' by the presence of vessels, and, since Childe (*1951*) put forward the idea that pottery making represented '*...the earliest conscious utilization by man of a chemical change...*', and went on to suggest that the ceramic vessels were the universal characteristic of Neolithic farming communities and the markers of their cultural identity. More recently it has been suggested that early pottery actually occurred first in hunter-gatherer contexts in Eastern Eurasia, where it was associated with small-scale sedentary or semi-sedentary communities. Currently, the earliest known dates for ceramic vessels are from Southern China, where the direct dating of pottery at Miaoyan and Yuchanyan sites, based on insoluble residues, yield ^{14}C values of 17 200–16 300 calBC (15 220±260 BP [BA94137b]) and 16 150–15 400 calBC respectively (14 390±230 BP [BA95057b]) (*Zhao and Wu 2000.236–237; Pearson 2005.823*). In the Russian Far East very early pottery found was also produced by hunter gatherer societies at the sites of Gromatukha and Gasya and has been dated to between 14 560–13 070 calBC (13 240 BP±85 [AA–20939] and 14 160–12 530 calBC (12 960±120 BP [LE–1781] (*Kuzmin 2002.41,Tab. 1; Zhushchikhovsaya 2005.13,17*). Kuzmin, on contrary suggests there was an almost simultaneous appearance of pottery in Southern China at c. 13 700–13 300 BP, in Japan at c. 13 500 BP, and in the Russian Far East at c. 13 300 BP (*Kuzmin 2006.362–371*; see also *Keally et al. 2004.349*).

It was hypothesized that the earliest pottery was fired at less than 250° C (*Pearson 2005.823*) or at about 350° C (*Zhushchikhovsaya 2005.14–15*). This seems unlikely, as vessels fired below 350° C are not appropriate for boiling food, the presence of which has been confirmed by organic residues. The earliest vessels are described as deep bowls, with flat or pointed bases, with walls up to two centimetres thick. The estimated volume of the pots is approximately 5.5 to 6 litres. The secondary burning, carbonized adhesion, soot and water lines seen on many fragments, show that the basic functions of the pottery were for boiling water and food or other organic materials (δ^{13}C values are closest to C3 plants and herbivore meat) and extracting fish oils from salmonids (*Keally, Taniguchi and Kuzmin 2003.5; Kuzmin 2002.42; Zhushchikhovsaya 2005.15, 29*). These data correspond well with the concept of 'hearth-centred fe-male activities' that stem from increased levels of group sedentism, and are linked to an increasingly gendered focus of food processing and cooking, centred at/or around the hearth (*Haaland 1997.381*).

In recognising that the production of fired-clay vessels has an extended history, we must acknowledge that the emergence of this technology may not necessarily have been related to the technical and economical trajectories and dynamics of the transition to farming (see below), as had been suggested by Childe.

It is increasing clear that diverse forms of ceramic technology had been 'inhabited' into the agency of Eurasian hunter-gatherers long before the emergence of sedentary social structures appeared. Moreover, these hunter gatherer ceramic technologies included not only vessels, but also the much older practice of making figurines from fired clay. In fact, the earliest European ceramic assemblages consist of anthropomorphic and zoomorphic figurines, pellets, 'earplugs' and 'structural ceramics' rather than pottery vessels, and have been dated to the Pavlovian, a local variant of the Eastern Gravettian techno-complex, dated to about 26 000 BP (*Verpoorte 2001. 86*).

Why ceramic vessels?

To answer the question 'Why clay pots?' Brian Hayden (*1995; 2001; 2003*) has suggested an economically oriented socio-political scenario, based on the interconnected concepts of '*private ownership*', '*economically based competition*' and '*prestige technologies*' which appeared among complex hunter-gatherers and early farmers. He hypothesised that ceramic vessels were first created to impress guests at communal feasts. Pottery could be made in unusual forms and decorated in different ways, making it an ideal medium for the host to accrue prestige by serving food and drink during the event.

Hayden argued that the emergence of pottery as a 'prestige technology' can be linked to the critical economic distinction between 'generalized' and 'complex' hunter-gatherers. While sharing food is an absolute obligation among the former, the private ownership of stored food and the competitive use of food resources together with socio-economic inequalities are characteristic of the latter, trans-egalitarian societies. Hayden (*1995.258*) suggests that:

"*Once technologies evolve to the point where private ownership and economically based competition can be sustained without immediate detrimental effects, it seems that some individuals in every community attempt to aggrandize themselves and to acquire material, social and political benefits for themselves and their families*."

Their advantage was maintained through competitive feasting during which aspiring 'aggrandizers' could display their wealth, power and prestige, thereby signalling their successes and attracting new followers, but also through acts of conspicuous redistribution which would generate social debts in the wider collective towards the emerging leader. The crowded and intensely social nature of communal feasting represent ideal conditions for bringing selected products and substances into the focus of wider attention. The vessels used to prepare and serve these foods and beverages would also serve as a powerful means of advertising the prestige, wealth and influence of the event sponsor.

It has been suggested repeatedly that the emergence of social ranking in the farming communities of the Early Eurasian Neolithic grew out of cycles of competitive feasting. These became closely linked to both agricultural intensification, and the desire to produce more exotic foods (for example, domestic animals and cereals), as well as to the increasingly widespread production and use of ceramic serving bowls. The quantity, shape and size of pots associated with luxury foods formed an important indicator of household status (*Hayden 2001.59; 2003.458–469*; see also *Van der Veen 2003.405–427*). While the presence of large vessels may point to the occurrence of communal feasts, a change from large communal pots and serving bowls to the use of individual plates and drinking vessels may also point towards a shift away from eating from a communal bowl to the consumption of individual portions.

This 'competitive feasting' hypothesis for the emergence of agriculture was based on ethnographers' observations of trans-egalitarian societies in which "*the primary force behind intensified subsistence production is not food shortage, but the desire to obtain social and political advantages – to obtain the most desirable mates, to create the most advantageous alliances, to wield the most political power*" (*Hayden 2003.465*).

We must note, however, that domestic foodstuffs as luxury foods and the use of ceramic vessels as serving pots do not necessarily have to occur *together* (if at all) in contexts of transition to farming. The social dynamics of feasting can produce trans-egalitarian societies with or without the presence of either farming or pottery, and as the ethnographic parallels show that 103 of 862 non-sedentary and non-agricultural societies were pottery-making (*cfr. Rice 1999.28*).

Why so many ceramic figurines and why the absence of ceramic vessels in the West Asian Pre-Pottery Neolithic?

The first occurrence of ceramic vessels in Western Eurasia at circa 6900–6800 calBC marks the transition from the Pre-Pottery Neolithic C (PPNC) to the

Pottery (or Late) Neolithic. The earlier pottery assemblages consist of coarse-wares, which are plant-tempered and undecorated. Several centuries pass before the emergence of elaborate painted styles and diverse shapes, which suggests that pottery had acquired a much wider significance in wider social contexts (*Le Mière et Picon 1999.5–26; Aurenche et al. 2001.1197; Akkermans et al. 2006.123–156; Kozłowski and Aurenche 2005*). However, the knowledge of firing clay was older than the first pottery vessels. We see the production of fired ceramic female and animal figurines from the very start of Pre-Pottery Neolithic (PPNA), at about 10 200 calBC onward, although these were being produced alongside 'white ware' vessels of carved sandstone, alabaster and marble.

The Early Neolithic is marked by a series of inter-related changes in subsistence practices, economic systems, the emergence of built environments, and in the formalization of ritual and religious practices.

These diverse trajectories culminate in the Middle, Late and Final Pre-Pottery Neolithic B (PPNC) periods that span c 9800–7300 calBC. In this period the estimated mean site size increases dramatically from 3 to 12 hectares, with shifts in the control of resources into centralized larger settlements, and increasing population aggregation into regional centres. These transformations in the built environment also reflect ideological trajectories in two social domains, the first, in the rise of monumental 'public structures', and second, with 'ritual' architecture placed both inside and outside settlement boundaries. Most ritual buildings of this period were constructed with unique architectural features. They often appear to have been situated in highly visible locations and physically separated from residential areas. The residential area is marked by a shift from oval to small-scale sub-rectangular architecture to standardized rectangular multi-roomed buildings. Buildings were constructed, some with two floors, of stone and/or unfired mud brick in tandem with coloured lime-plaster floors which curved up to the walls. The very small size of the cells suggests they were used for storage and other facilities. Geometrically shaped ceramic objects – counting tokens – were found in some of these settings at Ain Ghazal, Mureybet, Cheikh Hassan, Tell Aswad, Tepe Asiah, Tell Ramad (*Schmandt-Besserat 1992.168, 170–171; Iceland, on line*).

While there is evidence for domesticated caprines at some Middle PPNB settlements, by the end of the Late PPNB domesticated species including goat and sheep, pig and cattle, provided the evident bulk of meat protein. Herding emerged in the context of crop cultivation, and an 'intensive mixed farming' was well suited to the provisioning of nuclear households. Culling patterns for ovicaprines reflect a strategy of keeping animals primarily for meat production rather than dairying. It has been suggested that the economic practices of small-scale herding and the close control of herds in the vicinity of settlements, rather than the keeping of extensive, loosely controlled herds, would fit well with a relative degree of household autonomy (*Flannery 2002.417–433; Byrd 2000.63–98; Wright 2000.89–121; 2005; Bogaard 2005.184–198*).

In these early farming communities mortuary, ritual and cultic practices, as well as the lack of obvious material differentiation among individual burials, have all been interpreted as evidence that the community was practising the intentional homogenization of community members at times of death, which may have emerged as a strategy for minimizing differences and tensions within communities and between households at a time of emerging social and economic differentiation. These community rites are also believed to have included both primary and secondary mortuary rituals which involved skull removal and plastering. In addition to these practices, there is evidence that large plastered statues were being produced, some about half life-size, which were displayed in upright positions within public structures (*Goring-Morris 2000.103–136; Kuijt 1996.313–336; 2000.75–102; 2001.80–99; Kuijt, Goring-Morris 2002.361–440*). These practices persist over 3000 years and the high-profile nature of these public ceremonies suggest both a degree of community cohesion, as well as the persistence of a common underlying belief system.

There are hints, however, that certain individuals were afforded special treatment after death, perhaps an indication of the growing tensions between community cohesion, growing social differentiation and the emergence of individual power. The skulls of certain young males are removed post-mortem and subjected to plastering, moreover, many of these skulls also display specific morphological (brachycephalic) tendencies, perhaps resulting from *in vivo* skull deformation. The skull plastering practices demonstrate that the communities already had a sophisticated knowledge of 'pozzuolanic reaction', which is believed to be the domain of potters in creating hard, resistant and long-lasting clay products (*Goren, Goring-Morris and Segal 2001.671–690*). Whether

the practitioners also had other special leadership or other symbolic roles, such as organizing planting, herding, harvesting, and the building of monumental public and ritual structures remains speculation. For example, Brian Hayden has suggested that these individuals were being commemorated as 'successful aggrandizers' (see above), but they may have served as 'shamans', or members of a ritual elite who possessed the necessary authority to impose economic order and a sense of social cohesion and collective identity (*Rollefson 2000.183–186; Kuijt and Goring-Morris 2002.361–440; Lewis-Williams (2004. 28–59; 2005; Bischoff, on line*).

In addition to the plastered skulls and stone figurines thousands of small ceramic (fired clay) female, male and animal figurines have been recovered from West Asian Pre-Pottery Neolithic sites (Figs. 3 and 4). In Levantine and South-eastern Anatolian sites these artefacts were deposited within the residential architecture, and may be connected to household cult practices. Many of the ceramic animal figurines also appear to have been ritually killed by stabbing with pieces of flint before the clay was fully fired (*Rollefson 1986.5–52; 2000.167–168; Hauptmann 1999.77; Hauptmann online; Voigt 2000.253–293; Cauvin 2000.105–120; Kuijt, Goring Morris 2002. 389*). Human figurines were carefully handled but almost all were found in broken state as heads or as bodies. Some were deposited in ashy deposits within the roasting pits, and it was suggested they were intentionally destroyed as exploded in an uncontrolled firing which might be taken to reflect ritual death at the decease of the figurine's owner (*Rollefson 2000. 168; Voigt 2000.265*).

It is important to note that in Western Asia pottery production had not occurred prior to the end of the Pre-Pottery Neolithic (ca 6900–6800 calBC). Even after this point the manufacture and use of ceramic technology followed different trajectories in different areas; some communities remained 'aceramic' throughout, others adopted pottery at much later dates and only then in its more advanced rather than incipient form. Early pottery appears to have been types of container, which were used alongside 'white ware' and basketry.

Despite these regional variations we can note that the earliest appearance of ceramic vessels in West Asia correlates with the collapse of a 'ritual economy' and aggregation centres, the cessation of previous mortuary and ritual practices and the dispersal of peoples after the 'package' of crops and livestock had been adopted (*Kuijt 2000.75–102*). The beginning of pottery production may thus have been linked to the processes of settlement de-centralization, social fragmentation and, to the appearance of smaller communities or even autonomous households. The transition to small Pottery Neolithic households seems to follow scenario which anticipates the 'scalar stress' (*Johnson 1982.322–333*; see also *Bandy 2004.322–333*), and the tensions between ritual and emerging economic elites, and between new forms of community cooperation, individual lineages (households) and traditional kinship organisation over rights and greater access to and control of resources and privileges, and in shaping social arrangements within communities in combination with regional environmental changes and local environmental degradation.

If earlier periods of the Pre-Pottery Neolithic had seen the activities of food preparation take place in more open arenas which facilitated wider social interaction and linked households, so later periods saw food preparation and storage facilities placed under greater control within the more private spaces of each household's architecture. This increasing 'privatisation' of storage, milling, cooking and eating that took place at the household level (*Wright 2000.89–121; Bogaard 2005.177–196*) may have been material manifestations of the social and status tensions referred to above. We may postulate that the process of social fragmentation and the cessation of commu-

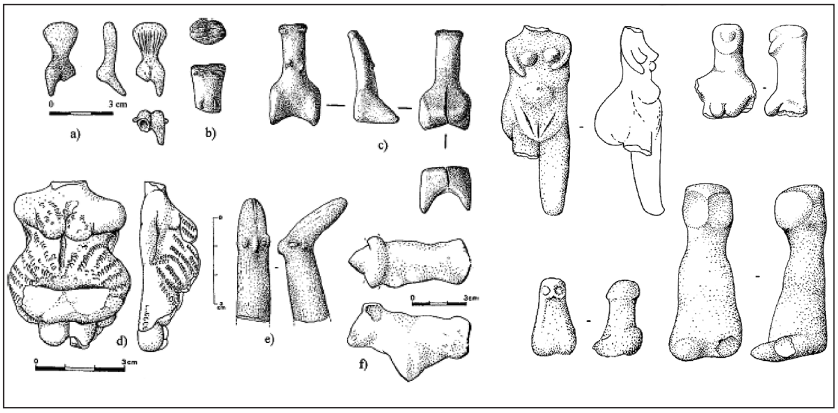


Fig. 3. Anthropomorphic and zoomorphic ceramic figurines in West Asian Natufian and Pre-Pottery Neolithic (from* Kuijt & Goring-Morris 2002.Fig.5 *and* Cauvin 2000.Fig. 8*)

nal ritual practices also led to a shift away from the production of ceramics within a set of ritual acts, towards a 'secularisation' of the ceramic craft, which produced vessels used in more utilitarian roles. Within the newly emerging economically and socially autonomous household units we see the emergence of coarse and undecorated ceramic containers and vessels which became associated with food processing and consumption. Easy access to ceramic technology certainly initiated craft specialization and the much later appearance of 'potters marks' (*Flannery 2002. 417–433*).

In considering the history of the fired-clay technology in this region we may hypothesise that the earlier figurines were produced as part of a 'ritual economy' which had close links to household rituals and mortuary practices carried out in the hearth rooms and most secluded domestic spaces of the house. Less attention has been directed to reconstructing the form and content of much later rituals at sites like Catalhüyük and Asiklihüyük, and the extent to which ceramic technology might have been controlled by ritual practitioners, shamans is, of course, speculative, although early ceramic making could have been not only a prestige, but also a sacred craft, controlled by privileged individuals or groups.

We may postulate the collapse of a 'ritual economy' and the apparent decrease in the manufacture and use of figurines marked the shift away from the production of ceramics within a set of ritual acts. Ceramic technology seems to become 'broadly available' with the emerging economic elites. When applied to vessel production it was clearly associated with food processing and consumption, and well embedded within new forms of community cooperation and more individual – household's access and control of food resources.

The pottery and the transition to farming in the South-eastern Europe

Seventy years ago Gordon Childe (*1936*) argued that ceramic technology and pottery were an almost universal characteristic of Neolithic farming communities, with pottery styles playing important role an indicator of cultural identity. This argument gained widespread support and there remains a lasting assumption that the appearance of pottery is one of the clearest markers of cultural and technological discontinuity between Late Mesolithic hunter gatherers and the farming societies of Early Neolithic. Moreover, the discovery of spatially restricted pottery ornamentation traditions pointed towards the dispersal of early farming and pottery making cultures out of Anatolia.

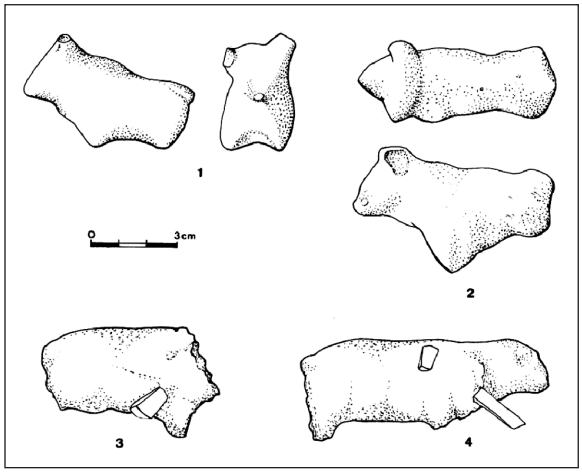


Fig. 4. Levantine Pre-Pottery Neolithic ceramic animal figurines pierced by flint bladelets (from* Cauvin 2000.25, Fig. 38*).

The linking of farming and pottery gave rise to 'centre and periphery' models of the origin and dispersal of farming communities. In these models finds of pottery have been employed as proxy indicators for determining the direction of farmer's migrations, and have been used to locate geographical boundaries marking out the line between advancing pottery-making farmers, and earlier hunter-gatherers, who were assumed to have had no prior knowledge of this technology. These interpretations are grounded in the assumption that Neolithic colonising populations brought an integrated 'package' of skills, technologies and languages with them when they crossed the border between the Levant and Europe.

If we look in more detail at early farming communities in South-eastern Europe we see that the role of pottery in these societies is more ambiguous. For example, in settlement contexts at Thessaly and Peloponnesus in South-eastern Europe, potters appear to have made few vessels, and that the pots do not show evidence of use on fires, and that the vessel volumes are too small for adequate storage Claude Björk (*1995*), Karen Vitelli (*1993; 1999*), Paraskevi Yiouni (*1996*), and Catherine Perlès (*2001*). In addition, annual pottery production has been estimated at between 12 to 13 pots at Franchthi and 7 to 22 pots at Nea Nikomedei (*Perlès 2001.214*). These insights suggest that pottery was not a mundane form of vessel technology in widespread day-to-day, but rather, that pottery appears to have the characteristics of 'elite goods' with special meanings and values.

More recently, for example, Vitelli (*1993.213–219; 1999.184–198*) has suggested that these early ceramic vessels were produced for, and used in, shamanistic ceremonies, for a number of the highly decorated saucers and plates show evidence of burning incense or narcotic substances. These point to their manufacture for special public occasions and ceremonies. Vitelli also argues that these vessels were probably made by female shamans who had the restricted knowledge of pottery technology, as well as a deep understanding of how to use the medicinal and narcotic properties of plants to produce altered states of consciousness and relief from pain, perhaps during public ceremonies. These specialist vessels are chronologically embedded in the period of ca 7050–6450 calBC (*Perlès 2001.84–92; Reingruber and Thissen 2005 on-line*).

In the Danube Gorge in the Northern Balkans the earliest pottery was well embedded in local architectural traditions and closely associated with social and symbolic hunter-gatherers' practices. A series of mortuary and domestic palimpsests at Lepenski Vir, Padina and Hajdučka Vodenica provide a useful window onto the agency of social and spiritual interactions, practices and ritual landscape. I have argued elsewhere that pottery was a new form of materiality that was adapted by local complex hunter-gatherers, and as such should be understood as a material medium which was intentionally incorporated into rituals and feasting practices which upheld and reproduced across generations the communal perception of cosmological systems (*Budja 2004; 2005*).

The uniformity of the constructed spaces and internal structures at the complex hunter gatherer sites of Lepenski Vir, Padina and Hajdučka Vodenica is striking, and points towards a shared set of values, tastes and practices. The buildings consist of trapezoidal structures whose interior floor is mortared with limestone, with rectangular hearths made of vertical stone slabs are positioned in the centre. The interiors are also decorated with figurative stone statues and boulders sculpted in complex designs and coloured in red and black. They are placed on the floors primarily at the rear of the hearths. In addition, many of these sculptures were found in association with primary and secondary human and animal burials, which were placed under the floors (*Radovanović 1996; Borić 1999; 2002a; 2002b; 2005*).

Over seventy of these structures, which have variously been described as 'houses' or 'shrines', have been reported from the site of Lepenski Vir. Pottery was found in some of the structures, and the pots found in two deserve further discussion due to its obvious association with a series of other artefacts. In the first, the pot was recovered from structure 54 (Fig. 5), which is centrally located within the rest of the structures. The pot itself is decorated with two

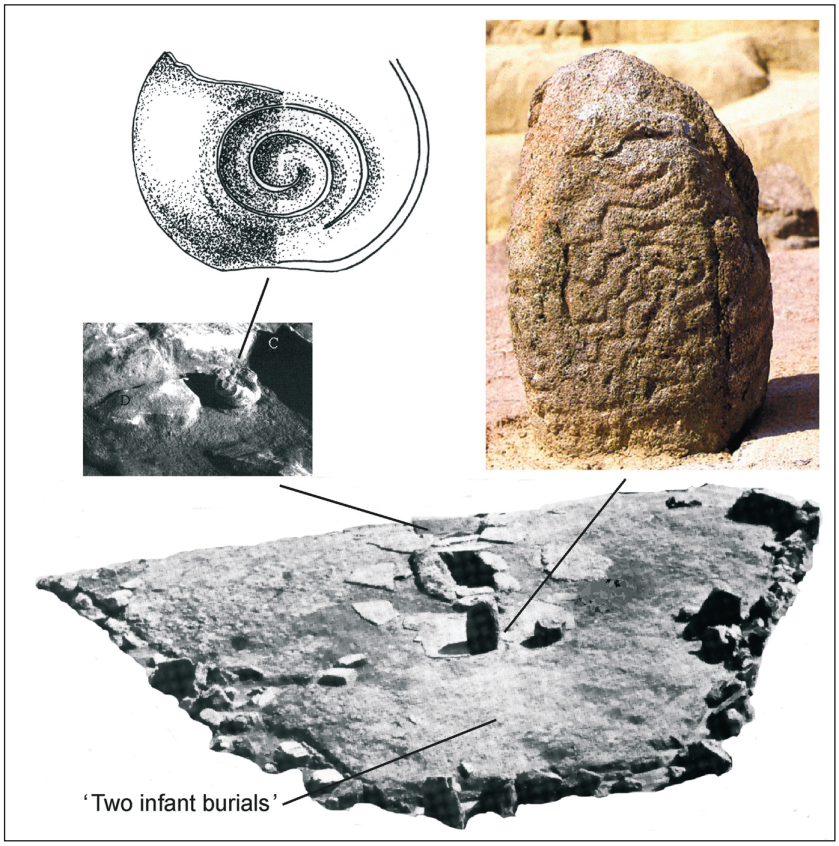


Fig. 5. In the centrally positioned trapezoidal built structure 54, a pot decorated with two plastic spirals placed on the two opposing sides of its body was associated with newborn and infant burials at the rear, the secondary burial of the mandible of a mature woman (within the hearth), and carved and coloured boulders and mortar (from* Srejović & Babović 1983.8, 18, 92–93, 167; Garašanin & Radovanović 2001.Figs. 1–3*). The structure was dated to ca 6430–5980 calBC (at 2σ)(*Whittle at al. 2002. 67; Borić et al. 2004.235*).

plastic clay spirals which had been joined on to opposing sides of the vessel before firing. The pot was associated with new-born and infant burials located towards the rear of the house, as well as with the secondary burial of the mandible of a mature woman, which was located under the hearth, and finally with two carved and coloured boulders and mortar. In the second 'house' the peripherally located structure number 28 (Fig. 6), the pottery was closely associated with three child burials, one with an absent skull. The entire burial was covered by a large stone plate with two flanking sculpted boulders at its sides and a huge red deer skull with antlers placed on the floor (*Dimitrijević 2000.113–114; Borić 2005.59–60; Stefanović and Borić 2004.539; Radovanović 1996.183*). It is worth noting first, that there is no evidence that domesticated crops and animals were being used at the site, although farming practice had already been adopted in the region, and second, that the first structure can be dated back to as early as ca 6430–5980 calBC (at 2σ) (*Whittle at al. 2002.67; Borić et al. 2004.235*).

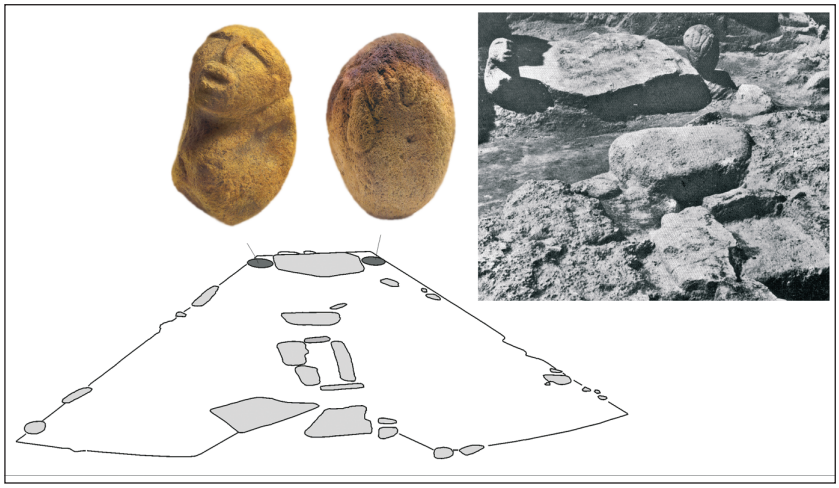


Fig. 6. In the trapezoidal built structure 28, pottery was contextually associated with three child burials, one with the skull absent, covered by a large stone plate with two flanking sculpted boulders at its sides and a huge red deer skull with antlers (from* Srejović & Babović 1983.69, 85, 107*, but see also* Dimitrijević 2000.113–114; Borić 2005.59–60; Stefanović and Borić 2004.539; Radovanović 1996.183*).

The situation at the contemporary site of Padina is slightly different. There is no clear evidence of burials within the trapezoidal built structures, and "the floors of these houses, made of a hard coating of burnt earth, do not show any noticeable damage or repairs corresponding to the position of the burial pit" (*Jovanović 1972.53*). Nonetheless, the houses are stratigraphically, and to some extent chronologically well-related to the burials and mortuary structures at the site. Interestingly, the palimpsest of the burials is chronologically embedded in a considerable 'time depth' from 9965–9275 to 5780–5560 cal BC (at 2σ). In contrast, the sequence of ^{14}C dates of trapezoidal structures is available in fragments, as research interest seemed to be focused on selected burial contexts and related individual diet and palaeodietary patterns mainly. Only three of twenty-one trapezoidal built structures and associated contexts are dated, and are fixed to between 6410–6090 and 5990–5720 calBC(at 2σ) (*Borić 1999.47–53, 57–59; Whitle et al. 2002.92; Borić and Miracle 2004.341–371; Borić et al. 2004.221–248*). In total, fifty-two individuals have been found buried within the wider site, some incorporated into four distinct levels of a stone burial mound, others located below the trapezoidal structures, and some in secondary burials (for example, a skull with pebble and boulder cover). Four burials consist of individuals in a sitting position with legs crossed (*Jovanović 1969(1971).32*). Two of these seated bodies were walled into a conical stone structure up to the skull. Over this a monumental carved boulder with complex designs was positioned 'at the upper level' of the stone burial mound, and over the skulls. Although these stone constructions appear to be spatially well connected with the two trapezoidal built structures, there are no ^{14}C dates available for the latter, making conclusions about the chronological and structural interrelations between these features speculative (*Jovanović 1969(1971).24–38; 1972.53; 1974.1–22; 1987.1–16; Borić 1999.49–70; Roksandić 2000.26–27; Borić and Miracle 2004.Figs 2–3*) (Fig. 7).

Across the Padina site, similarly to the Lepenski Vir, complete pottery vessels were found on the floors deposited within the trapezoidal built structures, and contextually associated with carved and painted pebbles and ornamented boulders. One of the most interesting pottery finds consists of small cups and bowls, a square dish on a low pedestal and a rhyton. In their form and scale they appear to be inappropriate for the household, and too small, and too unusual for routine domestic activities. As a result it has been suggested that they were perhaps 'prestigious serving dishes' (*cfr. Radovanović 1996a.43; Borić*

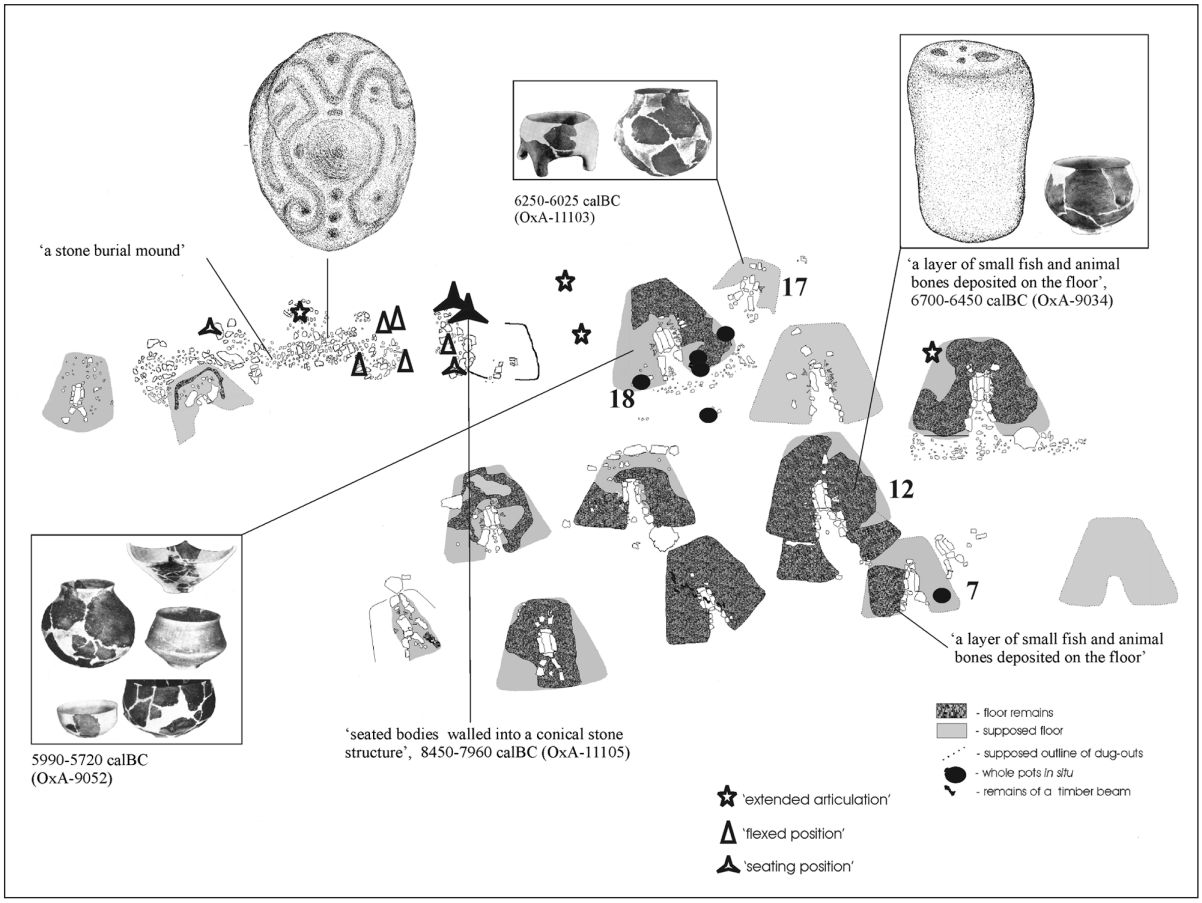


Fig. 7. Trapezoidal built and mortuary structures at Padina (from* Jovanović 1969(1971); 1972; 1974; 1987; Borić 1999; Borić and Miracle 2004*).

1999.53). The second interesting set of pots was found on the floor of trapezoidal structure number 12, and is associated with a decorated boulder, and covered 'by a layer of small fish and animal bones' (*Jovanović 1969(1971.30*) (see Fig. 7). ^{14}C dates fix the pottery sets in structures 12, 17 and 18 within the period of 6700–6450[1], 6250–6025 and 5990–5720 calBC (at 2σ) (*Borić and Miracle 2004.347, 350*).

At the third, contemporaneous site of Hajdučka Vodenica in the micro region, pottery was reportedly linked to an elongated stone construction composed of a rectangular 'hearth', large plates of stone, with red burned flooring and a carved boulder. A few individual burials had been placed beside the hearth and had been covered by stone plates. In addition, a group of twenty-seven skeletons and a secondary skull burial were embedded inside the 'grave chamber' and are suggested to have identified and objectified the associated mortuary structure, which was located by the side of the built structure. The excavator points out the fact that a stone axe and deer skull and antlers were placed beside the deceased inside the 'grave chamber'. The mortuary structure is dated to 6500 to 6090 calBC (at 2σ) (*Radovanović 1996.219–222; Borić and Miracle 2004.357–361*).

In summary, we can suggest that when pottery vessels were placed on the trapezoidal floors of the structures found at Lepenski Vir Padina and Hajdučka Vodenica, these ceramic containers were being actively incorporated into the local, whether hunter-gatherers' (Lepenski Vir) or supposedly farmers' (Padina, see note 4 below) mortuary and ritual complexes. In addition, the use of pots appears to be embedded into wider enduring symbolic practices and associations, which include the re-construction of similar architectural structures, the practice of primary and secondary burials, the placing of inhumations in

1 The date acquired from the dog bone was not corrected for the freshwater reservoir effect, as suggested in Borić and Miracle (*2004. 347, 350, Tab. 4*). If we apply it, the date is two hundred years later, 6500–6230 calBC(at 2σ), calibrated with OxCal v. 3.10 (*Bronk Ramsey 2005*) and 220±23 years correction applied.

the sitting position, and associated suite of distinctive artefacts that include carved and painted boulders and mortars, the use of horned skulls of a large wild bovids, and the placing of deer skulls with a huge antlers.

In the Balkans and Transylvania these artefacts, structures and symbolism maintained a long tradition. The sculpted boulders were embedded in burials as well as in domestic contexts, and some were placed on ceramic pedestals and stone plates, for example, in the Early Neolithic settlement at Gura Baciului (*Vlassa 1972.187–191; Lazarovici and Maxim 1995.379*). Children buried in the sitting position were incorporated into Early Neolithic settlement contexts at Velesnica and Obre I, and a large deer skull and infant burial were placed in a centrally positioned trapezoidal pit-dwelling structure at Blagotin-Poljna. In addition, a horned auroch skull was placed at top of a female body in a burial in a pit-dwelling at Golokut. ^{14}C dates indicate that these traditions continued into contexts in which farming was present: Blagotin, 6230–6030; Obre[2] 5730–5520; Golokut, 5620–5470 calBC 2σ (*Whittle et al. 2002. 66, 70–71; Benac 1973.27–28,35; Gimbutas 1974. 19; Borić 1999.26–27; Radovanović 1996. 223*).

Several new interpretations of settlement, mortuary and ritual complexes in the Northern Balkans have been published in the last decade. Some have focused on the dialectic opposition and symbolic confrontation between 'culture and nature' as part of a wider process which led to the 'the domestication of society', others have discussed the role of 'apotropaic power and potency', and 'body metamorphosis and animality'. In Hodder's (*1990.21–31, 41–43*) reading, the trapezoidal structures are seen as the 'locus, agency and habitus' within which hunter-gatherers were able to domesticate themselves, their ancestors and their 'wild' surroundings. In order to undertake this symbolic process of domestication they performed inhumations of ancestral bones and the dead, and installed into the domesticated setting of the home stone sculptures and statues, which represented wild fish-like ancestors.

In contrast, Borić (*2002b.46–74; 2005.35–69*), argues that the huge sculpted boulders commemorated particular individuals as much they commemorated the domestication of a wider 'realm of the dead and an-cestors' and 'cognitive logic of animality' which was practiced by hunter-gatherers and farmers in Northern Balkans.

A third interpretation has suggested that the large stone boulders, which were decorated with sculpted representations of fish-human beings, were material commemorations of the '8200 BP event', a global phase of climatic cooling that may have led to a rise in the Danube water levels leading to periodic flooding in the Danube Gorge. Bonsall et al. (*2002(2003). 1–15*) propose that neither the sculptures nor the mortar-floored buildings can be traced back before the catastrophic event, and when they appeared, they were intended to achieve dominance over the floods.

Despite these sweeping interpretations little attention has been paid to the specific symbols and conceptions attached to the boulders. Possibly, they may have been linked to altered states of consciousness, perhaps an important shamanistic element in the wider hunter-gatherer and early farmer cosmologies that were present in the Balkans. Correlations have been made between the boulders, petrogliphs and the cave paintings in the Balkans[3], on the Adriatic and Ionian coast, where identical symbols and construals have been found in red and black on cave walls. These have identified as potentially entoptic motifs and iconography which might have been associated with altered states of consciousness, and wider shamanic beliefs, rituals and practices (*Budja 2005.63–65*).

While the Climente II and Gaura Chindei caves are located within the hunter-gatherers' site distribution in the Danube Gorge in Northern Balkans, the Cervi and Cosma caves are located a thousand kilometres to the south, near Porto Badisco at the Strait of Otranto. Some of the cave paintings demonstrate almost an identical canon in the realisating of red and black symbols and iconographies with those carved and engraved on sandstone boulders and sculptures in the Lepenski Vir deposited within the trapezoidal architecture and directly associated with the mortuary and ritual structures (Fig. 8). It is important to note that in the both caves, Cervi and Cosma at the

2 The date 5730–5520 calBC 2σ, from Obre I (6710±60 BP, UCLA 1605G), calibrated with OxCal v. 3.10 (*Bronk Ramsey 2005*), relates to the settlement context in which the burials were embedded.

3 In the Danube Gorge, paintings have been recorded in Climente II and Gaura Chindei (*Boroneanț 1977.23–34; 1999 on line*), in Magourata Cave in the Northern Balkans (*Anati 1971*) and in Cervi Cave, near Porto Badisco (Otranto) at the Adriatic coast (*Graziosi 1996*). For the painted anthropomorphic figure with head-gear see also Devlet (*2001.50–51*).

Adriatic coast, human burials, stone circles along the walls, containing cereals deposited on the floor, pits dug into the rocky ground with the Neolithic ceramic vessels deposited inside, were found (*Griffoni Cremonesi 1994.179–197*).

One of the most graphic narrative scenes is perfectly preserved in Cervi cave. The iconography of the painting (Fig. 9) on the left has a spiral motif and depicts figures with bows who appear to be hunting deer. To the right are what appear to be headless figures riding deer and bovids, and dancing with raised arms. Above the scene, a painted anthropomorphic figure with head-gear was placed (*Graziosi 1996.117–119. Pls. 12–17*). One possible narrative reading of the scene is that these are depictions of shamanistic practices, and associated mental experiences, which are associated with altered states of consciousness. When interpreting a similar frieze in Çatalhöyük, Lewis-Williams (*2004.38–46*, see also *Lewis-Williams and Pearce 2005*) suggested that in shamanistic societies the hunting of meat-producing animals is often linked to the belief that successful hunting requires the acquisition of the animals' supernatural powers. Moreover, the headless figures may well represent the dead, who may not merely have been present during the hunt, but might actually have been able to influence and assist in assuring a successful outcome. These ancestors, who in death may have departed to the other parallel world of spirits, may have acted as intermediaries between the animals' spirit masters and the actions of the humans in their desire to acquire animal power through hunting. Moreover, the severing of skulls from bodies may have related to the enactment of the ritualised 'death' and 'rebirth' of a shaman, and to his subsequent ability to travel between the realms of the lower and upper worlds. We may note that the spiritual experiences associated with the de-composition and re-constitution of the physical body may take place during neurologically-generated hallucinations generated by altered state of consciousness, the painted visualization of these experiences, whether through the medium of built structures or in cave tunnels, may have been driven by the desire to ritually (re)enact the core experiences through a complex ritualised setting, for example, as part of initiation into shamanism, which perhaps provided future practitioners with the necessary knowledge and skill, but also the social status and in some instances, the political influence which the post both required and commanded.

Returning now to the Northern Balkans we may hypothesise that the cosmological paradigm we noted above, in which distinctive burials and structured associations with other material artefacts were placed within the settings of the trapezoidal structures may have depicted a similar set of conceptions to those of shamanism and hunting as depicted in the cave art. For example, the skull of an old woman, the horned skull of a large bovid and the skull of a deer with antlers were placed beside the body of a man (Fig. 10); a headless child burial had been covered by a large stone plate with two flanking sculpted boulders at its sides and with a huge red deer skull with antlers on the floor (Fig. 7); finally, a skull of an older man was placed beside the body of child in a sitting position, whose legs were crossed (*Radovanović 1996. Fig 4.15*).

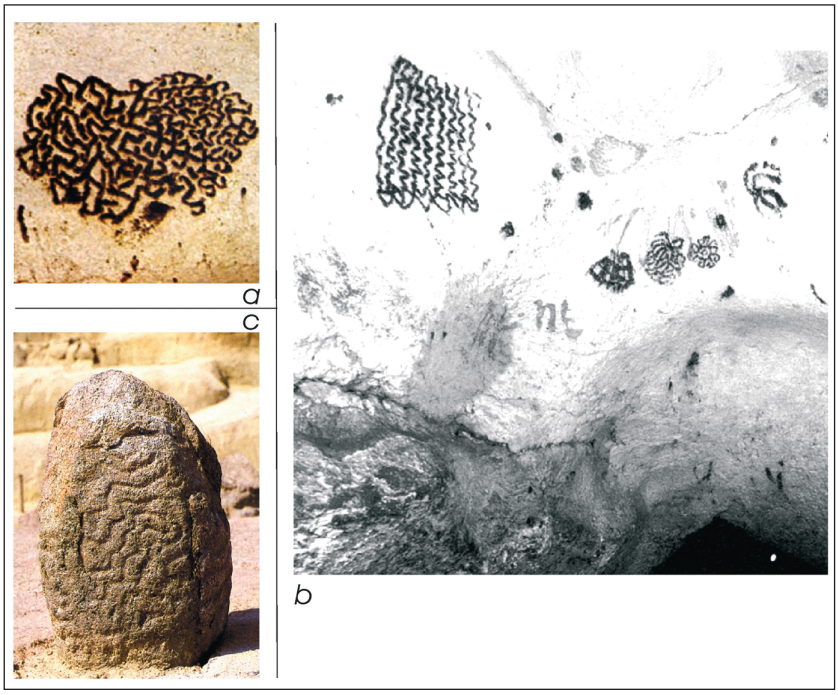


Fig. 8. The entoptic motifs and construals painted on the cave walls in Cervi cave near Porto Badisco (a and b) and carved and engraved on sandstone boulders and sculptures, deposited within the trapezoidal architecture and directly associated with the mortuary and ritual structures in the Lepenski Vir in Northern Balkans (c) (from* Graziosi 1996.Pls. 70 and 72; Srejović & Babović 1983.8*).



Fig. 9. The painted scene from in Cervi cave (Porto Badisco, Otranto). The iconography of the painting consist of a spiral motif and figures with bows who appear to be hunting deer on the left, and the headless figures riding deer and bovids, and dancing with raised arms on the right. Above the scene, a painted anthropomorphic figure with head-gear was placed. (from* Graziosi 1996.Pl. 12*).

We may also hypothesise that, along with monumental boulders, the 'small cups and bowls, square dish on a low pedestal and rhyton' (see above), the 'layer of small fish and animal bones'[4] which were deposited within these structures were all part of a ritualised set of practices which involved not only the 'bridging the world of the living and that of the dead', as suggested, but also included feasting and ritual communion and exchange with different realms of the cosmos. Like the shamanic soul-flight ritual, the feast provides a site, medium and context in and through which social relations could be symbolically negotiated and represented (*Dietler 2001.65–114; Jordan 2004.117–134; Price 2001.3–16*). In the case of the Northern Balkans these ritualised acts included the control of rites as well as mediation between the community and the supernatural. They were also caught up with the reproduction of social hierarchies and status, but also re-forged social networks within which the structural transformation of hunting and gathering communities was eventually leading to the advent of farming.

Within these local and regional settings it is clear that if pottery was an element of 'Neolithic' materiality it production, use and deposition was being actively and creatively incorporated within the enduring frameworks of pre-existing hunter-gatherers' social, domestic and mortuary structures. Within these contexts it was the agency of hunter gatherers which initiated and made possible both the later structural transformations in the economy, but also the almost simultaneous dispersal of a new form of ceramic materiality into the region. This scenario contrasts strongly with the Levant, where the adoption of pottery making seems have been caught up in processes of social decentralization and community fragmentation, which were part of the collapse of the 'ritual' elements in the Early Neolithic economy. Following this, pottery became contextualised within the more routinised practices of food processing and consumption that were part of the form and fabric of the new agricultural economy.

Conclusions

In recognising that the appearance of ceramic technology and production of fired-clay vessels has an extended history, we must acknowledge that the emergence of this technology has not necessarily been related to the technical and economical trajectories and dynamics of the transition to farming, as had been broadly accepted. It is increasing clear that diverse forms of ceramic technology had been 'inha-

4 Animal domesticates: *Bos tauros*, *Ovis/capra* and *Sus domesticus* have been reported from Padina (*Clason 1980.141–173*).

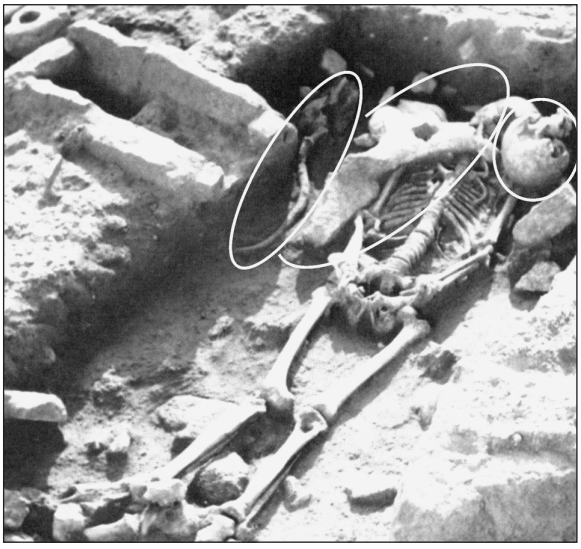


Fig. 10. Lepenski Vir, burial No 7a (from* Srejović & Babović 1983.18 *and* Radovanović 1996.Fig 4.3*). The skull of an 'old' woman, the horned skull of a large bovid and the skull of a deer with antlers were placed beside the body of a man.

bited' into the agency of Eurasian hunter-gatherers long before the emergence of sedentary social structures appeared. Moreover, these hunter gatherer ceramic technologies included not only vessels, but also the much older practice of making figurines from fired clay. The earliest European ceramic assemblages consist of anthropomorphic and zoomorphic figurines rather than pottery vessels, and have been dated to the Pavlovian, a local variant of the Eastern Gravettian techno-complex, dated to about 26 000 BP. In fact, there were two very different and indeed independent technological trajectories in Western Eurasia, the first the use of fired clay to make figurines and later vessels, and second the plant and animal domestication and rise of agro-pastoral farming.

We suggest the ceramic vessel as serving pot is certainly not the part of 'competitive feasting' scenario for the emergence of agriculture in Levant since the domestic foodstuffs as luxury foods and the use of ceramic pots have not occurred *together* in contexts of transition to farming in the region. The fired-clay technology in Pre-Pottery Neolithic was restricted to the production of female, male and animal figurines and limited by the ideology of the 'ritual economy' which had close links to household rituals and mortuary practices. The earliest appearance of ceramic vessels there correlates with the collapse of aggregation centres, the cessation of previous mortuary and ritual practices and the dispersal of peoples after the 'package' of crops and livestock had been adopted. We may postulate the collapse of a 'ritual economy' and the apparent decrease in the manufacture and use of figurines led to a shift away from the production of ceramics within a set of ritual acts, towards a 'secularisation' of the ceramic craft, which produced vessels in more utilitarian contexts, linked to the emerging economic elites, and associated with the new forms of community cooperation and more individual, household's access and control of food resources.

This scenario contrasts with the South-eastern Europe where the adoption of pottery making was closely associated with social and symbolic hunter-gatherers' practices. The pottery seems to have been a new form of materiality that was adapted by local complex hunter-gatherers, and as such should be understood as a material medium which was intentionally incorporated into rituals and feasting practices which upheld and reproduced across generations the communal perception of cosmological systems and social networks within which the structural transformation in the economy become verified. It was the agency of hunter gatherers which initiated and made possible both the transition to farming, but also the almost simultaneous dispersal of a new form of ceramic materiality into the region.

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Red, black or white? The dawn of colour symbolism

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ABSTRACT – *In this paper the use of the pigments in the Paleolithic is presented, and some ideas of the symbolic meaning of colours are suggested. The colour red might have been a symbol of transformation, and as such, it was used in burials and for painting the Venus figurines. In the Slovenian Paleolithic, there is scant evidence of importance of colour and only a few finds of stones used for the grinding of the red pigment have been found.*

IZVLEČEK – *V članku je predstavljena uporaba barvil v paleolitiku in poskus interpretacije njihovega simboličnega pomena. Ta je najbolj očiten pri rdeči barvi, ki je morda bila simbol transformacije, kar se odraža v njeni uporabi pri pokopih in pri barvanju ženskih figur. V slovenskih paleolitskih najdiščih je le malo sledi obdelave pigmentov, tolkači, s katerimi so drobili rdeč pigment, so znani le iz treh jam.*

KEY WORDS – *pigments; ochre; Paleolithic; burials; Venus figurines; Slovenia*

Introduction

Why do three colours – white, black and red – have an outstanding position in the palette of the first artists? It is interesting that two of these, white and black are not 'real chromatic colours' with fixed wavelengths, but more expressions of light and darkness. And yet their names are the first in the evolution of basic colour terms and they exist in all languages (*Berlin & Kay 1999*). So white and black basically express what colour really is – our perception of light (white) or the absence of light (black). In Palaeolithic art some images could be the expression of a white and black colour scheme, like the black paintings on the white wall from the 'Salon Noir' in the Niaux cave (Fig. 1). Marshack found combinations of these two colours on the engraved mammoth ivory from the Russian plain. The engravings were filled with thick black paste, so the images appeared black against the white background of the ivory (*Marshack 1981.189*).

Red is the first 'real' colour with a defined wavelength. It is the third term that emerges in language after white and black. In languages with only a few terms for colours, the term red includes many hues, which means that it includes all reds, oranges, most yellows, browns, pinks and purples. Separate names for these colours and for other colours like blue and green evolve later (*Berlin & Kay 1999*). The variety of names for colour also depends on the environment in which people are living, or on their main activity. The Damara people of Namibia have many names for the colours of livestock, since they are herders, but they lack names for green and blue, since they are not interested in them at all (*Berlin and Kay 1999, with citations*).

The visual and auditory senses are important for the human perception of surroundings. Colour and sound are both wave phenomena: colours are electromagnetic, while sounds are mechanical waves. As such, they have different wavelengths and different energies. Both influence our feelings. With some colours we have the impression of energy, while others calm us down; the same applies to sound. Speaking

produces sounds. So not only words express our feelings, but also the sound of speaking itself. Different voices make different impressions on us. Some people have pleasant voices, and we react positively to them, while others may provoke negative feelings. So we communicate with sound, as well as with words, and we also communicate our feelings through colours. If talk and language are a form of social grooming, since they influence our feelings (*Dunbar 2004.114*), then sound and colour are a type of grooming also. If elaborated speech emerged with modern humans, then improved communication through colour is also probably part of modern human behaviour. Refined art as an expression of feelings and as a bearer of information was possible when humans were capable of forming complex communication systems to transfer their feelings and information to others. Only in such systems was there a possibility for the perception of colours as symbols. Symbols strongly influence our feelings, just as colour does. So colours have the potential to be very powerful symbols.

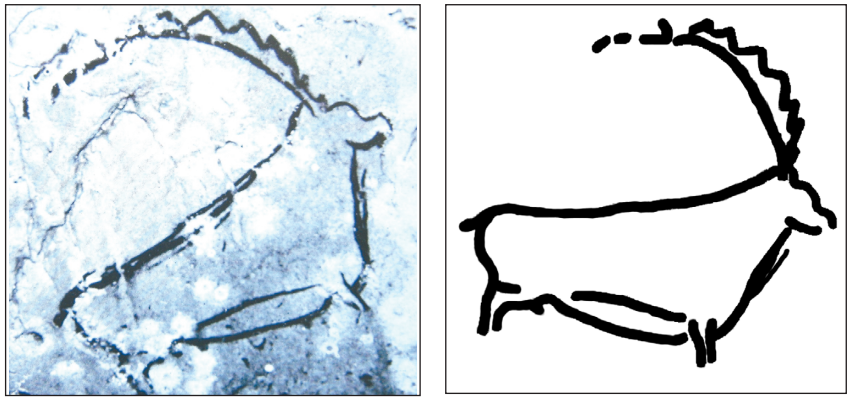


Fig. 1. Ibex from Niaux (from* Graziosi 1956.Tav. 198*). Black and white painting.

It is difficult to imagine how much colour in the Palaeolithic was perceived as colour per se and how much as an essential part of a depicted object – so red might mean red ochre, not just a red hue. Even today in some languages the names for different colours are the same as the names for objects which are of that colour. In the language of the Ndembu people in Congo word *amatamba* that means 'water of sweet potato' leaves is used for green colour. The Aborigines in Queensland use the same word *ŏti* for blood and red colour (*Berlin & Kay, with citations 1999*).

The first colorants are known from Old Palaeolithic contexts, and in some cases there are indices that they were used for colouring different objects. Bednarik (*2003*) claims that the naturally formed 400 000 years old Tan-Tan figure was artificially modified and coated with red paint. At the Zambian site of Twin Rivers the use of ochre was known at least 200 000 years ago. Minerals for the production of pigments were systematically collected and used (*Barham 2002*). In the Middle Palaeolithic, pigments became even more frequent. A review of the pigments found during the excavations of Bordes indicated that black and red were often present in French Mousterian (*Demars 1992*). In the Mousterian site of Tata a mammoth molar plaque was covered with red ochre (*Marshack 1981.189*). But it was in the Upper Palaeolithic that colorants became ubiquitous, and their power was expressed and preserved through art and in graves.

Black and red are quite common in Palaeolithic art, while white is almost completely absent at first sight. But it should not be forgotten that the walls on which images are depicted are frequently white. Artists produced white hues by leaving areas of limestone wall blank, or they even scraped the dust off the wall surface to create an area of white. In the painting of the 'Chinese horse' at Lascaux (Fig. 2), blank wall represents the unpainted white underbelly of the horse (*Marshack 2003*). That white pigments were used was confirmed in the Magdalenian cave of Bedeilhac, where a white clay plaquette was found. It was used as a crayon to colour animal hide or human skin (*Marshack 2003*). It is also possible that white paint was frequently used, but since it was less durable than other colours it was not preserved. Such is the case with the San paintings at Rose Cottage Cave and from other South African sites, where the parts of the paintings which were coloured white disappeared with time (*Williamson 2000.755; Lewis-Williams 2002.146*).

Only mineral colours are preserved for a long time, which could be the reason there is such a scarcity of colour in Palaeolithic art. There might be colours made from organic material extracted from plants or animals, but such material does not survive over the course of thousands of years. Another problem is that the extraction of plant pigments like green or blue is complicated, and the plants which could be

used in the process grow mostly in tropical areas (*Couraud 1983.107; 1988.20*). The only organic pigment preserved is charcoal, which was used for black colouration. Manganese oxides were also used for black colouration. These oxides can be found on the walls of limestone caves as a product of alteration (*Clottes et al. 1990.178*).

Red pigments were produced from iron oxides, like hematite or limonite, and from ochre. Hematite was the most frequently used mineral. It occurs in the form of aggregates of small red crystals, or in the form of bigger black crystals, which are difficult to crush (*Clottes et al. 1990*). White was obtained mostly from kaolinite or illite.

Pigments were mixed together with other components to obtain colours. Extenders were added for a many reasons – to economize the consumption of pigment or to improve colour characteristics, such as different shades, adhesion and durability. Investigations in the Ariège region in France indicated that in some cases feldspar was used as an extender, while in others biotite or talc was used. Different recipes for the preparation of colour were known, and research of portable art from well-dated contexts in this region indicated that recipes could be chronologically defined. But it is also possible that the use of recipes depended on the season, the social occasion or ritual, in which case they might have had symbolic meanings (*Clottes et al. 1990*). Pigments themselves might also have had supernatural powers in Palaeolithic, as they had for the San people of South Africa. In San society, the transformation of the pigment into paint was accompanied by ritual procedures (*Lewis-Williams 2002.255*)

Sometimes different materials, such as blood, egg white or urine were added to colorants as binding. In the Rose Cottage Cave in South Africa, the pigments of San paintings were examined, and blood was detected as binding. It was mixed with yellow ochre, but not with red colorants. This might had symbolic meaning – yellow, that lacked the appearance of blood, needed additional 'power', so they mixed it with blood, while red was already powerful enough (*Williamson 2000*). Human blood protein was also a constituent of red pigment in two Australian caves dated to late Pleistocene. Art motifs in those caves consist of hand stencils and panels covered with red pigment. It is interesting that even in the recent past human blood was often used in Australian Aboriginal ritual activities (*Loy et al. 1990*). In France, experiments were carried out to determine the possible binding materials in Palaeolithic paintings. As Couraud found, organic substances were unsuitable, and the best binding agent was water, especially cave water rich in calcite, since it fixes and conserves pigments on the wall (*Couraud 1988.23*).

In some cases manganese was burnt and used for black pigment. Burning might have had practical use to facilitate the making of the pigment powder, but it might have had also symbolic and even ritual aspect. The same might be true for the burning of ochre and hematite. With burning, the colour of ochre changes from yellow to different hues of red or to violet (*Leroi-Gourhan 1968.69*). The burning of ochre might have already been known in the Old Palaeolithic site of Terra Amata, where pieces of ochre of various colours from yellow and red to brown were found (*Groenen 1991.14, with citations*). Fire played important role in Paleolithic rituals, which is confirmed in Central and Eastern Europe, where clay was burnt to make figurines used in rituals (*Guineau et al. 2001.222*). Perhaps the early modern humans at Qafzeh cave were already burning yellow goethite to transform it into red hematite – fire was used intentionally to change the yellow colour to red (*Hovers et al. 2003.502*). Possibly the transformation of a yellow stone to a red one was viewed as magical (*Vreschner 1980.632*).



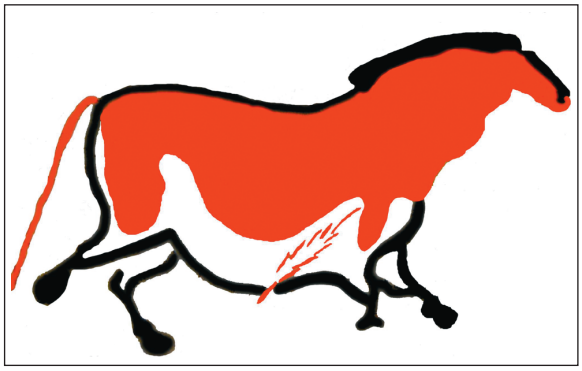


Fig. 2. 'Chinese horse' from Lascaux (from* Graziosi 1956.Tav. 182*). Three colour scheme painting.

Fire also had important symbolic meaning; it was the agent of transformation. In times of cold and harsh weather, fire was indispensable, since it changed cold into warmth. If ochre is treated with fire, it is transformed and it changes colour. If clay is burnt, it changes its structure and hardness. That is probably why red was so important, since it was the symbolic colour of fire and transformation.

As a symbol of transformation red ochre is present in graves. Death is the ultimate transformation known to human beings. Ochre was used in funeral rites, probably because it passes through a powerful colour transformation when burnt. Together with the whiteness of bones and the blackness of the grave, red was part of the mighty tricolour scheme which symbolised death. As a symbol of fire, red ochre might have been sprinkled over a cold dead body to warm it up and to restore life. The early co-occurrence of the use of fire, burials and ochre is known from Qafzeh Cave in 90 000 to 100 000 years old layers, where the skeletal remains and burials of the first early modern humans in the Levant were found (*Hovers et al. 2003.508*). Hovers et al argue that ochre was selected and mined for its colour, rather than for any other property. The specific hues of red had been desired. The symbolic use of ochre is suggested rather than practical (*Hovers et al. 2003*). The findings from Qafzeh cave are the only certain evidence of the relation between ochre and human skeletons in Middle Palaeolithic contexts, while in the Upper Palaeolithic, ochre becomes more frequent grave good (*Riel-Salvatore & Clark 2001.454–457*). It was important in mortuary rites and was present in almost half of the known burials (*Groenen 1991.18*).

Two interesting burials of children sprinkled with ochre are from Lagar Velho in Portugal and from Krems in Austria. In Lagar Velho a 25 000 years old burial of a child who exhibits a mix of early Modern human and Neanderthal features was found. The four years old child was covered with red ochre and laid on a bed of burnt vegetation together with pierced teeth and marine shells (*Trinkaus & Duarte 2003.32*). The burial of two newborn children was found recently in Krems, Austria. The children were sprinkled with ochre and wrapped in skin, together with a necklace of mammoth ivory. The 27 000 years old grave was covered with a mammoth shoulder blade. Besides the ochre, there were also other colorants found at the site: red chalk, graphite and muschelkalk – a type of limestone which was used for the production of white pigment (*Einwögerer 2005*).

In the Upper Palaeolithic, there was also a powerful symbolic relation between ochre and femininity (*Groenen 1991.24*). Many Palaeolithic venus figurines were painted with red ochre or hematite. The Venus from Mauern is completely covered with a thick layer of ochre (*Mussi 1997*), ochre was also found on the Venuses from the Grimaldi Caves (*Bisson & Bolduc 1994*), and on two of the most famous Venuses – from Willendorf and Laussel (*Bahn 1998. 75*). Red colour on the female body could also have been a symbol of transformation. There is a noticeable transformation of the female body during pregnancy, which ends with the delivery of the new life. A male body never experiences such a drastic change. The concept of transformation is even more expressed in the Venus figurine from Dolní Věstonice, which is made from clay. The figurine was transformed, as it passed through fire, from a soft piece of clay into something solid and lasting. It is interesting that in San societies, the preparation of pigment was associated with women. It was a woman who had to heat the pigment at full moon until

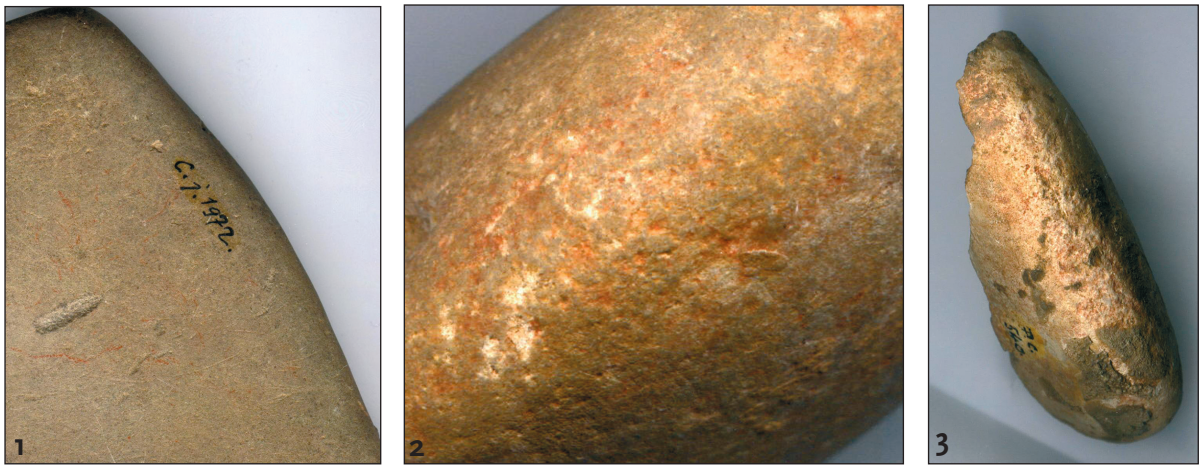


Fig. 3. Grinding stones with traces of ochre: 1. Ciganska jama, 2. Lukenjska jama, 3. Poljšiška cerkev.



Fig. 4. Decorated stone from Zemono.

it was red hot (*Lewis-Williams 2002.114, 255*). In this act, femininity, burning and colour were connected as symbols of change. The act of grinding colorants was also an act of transformation from solid rock to powdered pigment, and might, together with burning, have had symbolic meaning and been accompanied with rituals.

There is another aspect of the close relation between colour and women in the Palaeolithic. After women became pregnant and had children it was difficult for them to hunt, so they had to switch to gathering. Good colour vision is indispensable for primates who are mainly dependent on gathering and collecting berries and fruits of different colours (*Dominy et al. 2003*), so women needed to develop excellent colour discrimination. Even today a feeling for colour is a female province, and women use more names for colour schemes than men. For hunting, colour vision is not very important, since colour-blindness doesn't affect functional ability. Consequently, defective colour vision today is nearly a hundred times more common among males than females (*Gage 1999.31, 36*).

As a symbol of transformation, ochre might also have been important medium during shamanistic séances, when the shaman was going through a transformation from a normal state of mind to a trance. Shamanistic healing is also a process of transformation – from sickness to health and well-being. For a South African San shaman, not just painting, but also paint in itself was powerful and trance-inducing (*Lewis-Williams 2002.114*).

There are only a few indices of pigment preparation from Slovenian Paleolithic sites. Grinding stones with traces of ochre are known from three Late Paleolithic sites: Ciganska jama, Lukenjska jama, and Poljšiška cerkev (Fig. 3). In Ciganska jama a lower layer with Paleolithic stone tools was in a red zone. This zone might have been colored red with ochre, since many small grains of ochre were found there (*Brodar 1991.30*).

The only other evidence of the importance of red color in the Slovenian Paleolithic is a decorated stone found in Zemono. The stone has a simple pattern, composed of parallel and perpendicular lines (Fig. 4), and is rich in iron, so the freshly engraved lines are red, which may very well have had some symbolic significance (*Petru 2005.637*).

The problem of colour in the Palaeolithic is complex, and there are no easy answers to many questions regarding preparation, use, and the meaning of pigments used in art, and in everyday life. But there is no doubt that colour was an important agent of transmission of information and feelings of the first artists. Together with speech, art also developed, since people became able to express their feelings and thoughts through both, and to share the information that is the basis and reason for the evolution of language and art.

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Light at the end of the tunnel: the way megalithic art was viewed and experienced

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ABSTRACT – *This paper explores how megalithic art may have been viewed during a period when Neolithic monuments were in use as repositories for the dead. The group of monuments discussed are primarily passage graves which were being constructed within many of the core areas of Neolithic Atlantic Europe. Although dates for the construction of this tradition are sometimes early, the majority of monuments with megalithic art fall essentially within the Middle to Late Neolithic. The art, usually in the form of pecked abstract designs appears to be strategically placed within the inner part of the passage and the chamber. Given its position was this art restricted to an elite and was there a conscious decision to hide some art and make it exclusively for the dead? In order to discuss these points further, this chapter will study in depth the location and subjectivity of art that has been carved and pecked on three passage graves in Anglesey and NW England. I suggest that an encoded grammar was in operation when these and other passage grave monuments with megalithic art were in use.*

IZVLEČEK – *V tem poglavju raziskujemo, kakšen je bil pogled na megalitsko umetnost v obdobju, ko so neolitske spomenike uporabljali kot grobnice. Skupina spomenikov, o kateri razpravljamo, so predvsem 'grobovi v hodnikih', ki so pogosti v osrednjih področjih neolitske atlantske Evrope. Čeprav so nekateri datumi gradnje zgodnji, sodi večina spomenikov megalitske umetnosti v čas od srednjega do poznega neolitika. Zdi se, da je umetnost, običajno gre za izklesane abstraktne vzorce, strateško razporejena v notranjem delu hodnika in v osrednji grobni komori. Glede na položaj se lahko vprašamo, ali je bila ta umetnost omejena le na elito in, ali je obstajala zavestna odločitev skriti del umetnosti in jo nameniti izključno umrlim. V nadaljevanju bomo detajlneje preučili lokacijo in subjektivnost umetnosti, ki je bila vklesana in vgravirana v treh 'grobovih v hodnikih' v Angleseyju in severozahodni Angliji. Domnevamo, da so v času, ko so uporabljali te in druge megalitske spomenike, operirali s kodirano gramatiko.*

KEY WORDS – *chamber; façade; fire; hearth; illumination; megalithic art; passage grave*

Introduction

...he came to a mouth of a passage covered with a square stone similar to that at [nearby] Plasnewydd, anxious to reap the fruits of his discovery he procured a light and crept forward on his hands and knees along the dreary vault, when lo! In a chamber at the further end a figure in white seemed to forbid his approach. The poor man had scarcely power sufficient to crawl backwards out of this den of spirits...

(Reverend John Skinner 1802)

There is a limited but significant passage-grave art tradition in England and Wales which, although restricted to two passage grave monuments in Anglesey, Bryn Celli Ddu and Barclodiad y Gawres and a destroyed megalithic structure located in a park in Liverpool, the Calderstones, marks the eastern extent of megalithic art in Britain and Ireland. The passage grave tradition is also one of the last megalithic architectural styles of the Neolithic. Outside these two areas are a number of sites that possess simple

decoration, usually restricted to single and multiple cupmarks (*Darvill & Wainwright 2003; Sharkey 2004; Nash et al. 2006*; see Tab. 2). However, these monuments are not classified as passage graves.[1] Outside England and Wales; in Ireland and north-western France, megalithic art and passage grave architecture is both numerous and complex in form and many of the traits incorporated into these monuments are also replicated in the British examples (*Forde-Johnstone 1956; Lynch 1967; 1970; Shee-Twohig 1981*).

These three passage graves each possess complex carved art that is usually located within the inner section of the passage or forms part of the chamber alignment (*Nash et al. 2006*). Both Anglesey monuments have the passage and chamber architecture incorporated into large covering mounds. Despite the intense and comprehensive archaeological investigations of these monuments and the near complete destruction of the Calderstones monument, one can make an assessment of how these monuments may have functioned during ritual-symbolic events. Recent investigations by the author have shown how light may have played an important role especially in illumination of various parts of the chamber and passage architecture; more significantly, how the rock-art was viewed and experienced.

This chapter will assess the impact of light on the chamber, façade and passage areas, focusing on how and why the rock-art was illuminated. I suggest that megalithic art was deliberately placed in such a way as to visually change the ambience of the space between various sections of the passage and chamber, in particular at the point where natural light in the passage area fades and was no doubt replaced by the illumination of fire. Based on two types of light and their intensity, two cognitive emotions are at play. One based on the familiarity and safety of the façade and the outer passage areas, the other based on the ignorance and anticipation of the individual entering the inner passage and chamber which were initially dark, foreboding and unknown.

The data set

The distribution of the passage grave tradition is within the Atlantic zone of Europe, occupying five major core areas, from Iberia to southern Scandi-

Site Name	Sample/Area	RC14 date	Lab. No.	References
Alberite Cadiz, Spain	Funerary phase	5320+70 BP **4255 –4000 cal. BC**	Beta–80602	Ramos Munoz & Giles Pacheco 1996
El Palomar Cadiz, Spain	Funerary phase	4930+70 BP **3780 – 3640 cal. BC**	Beta–75067	Ramos Munoz & Giles Pacheco 1996
Ile Gaignog, Brittany	Construction phase (tomb C)	3850+300 bc **4630 cal. BC**	Gif – 165	Shee-Twohig (1985.51)
Barnenez, Brittany	Sealed deposit in chamber G	3050+150 bc **3800 cal. BC**	Gif – 1309	Shee-Twohig (1981.51)
Barnenez, Brittany	Lower deposit in chamber F	3000+150 bc **3600 cal. BC**	Gif – 1556	Shee-Twohig (1981.51)
La Hougue Bie, Jersey	Primary cairn deposit	3450 – 3200 bc **4365–4055 cal. BC**	Beta–77360/ ETH–13185)	Patton (1995, 582)
Knowth, Ireland	Monument construction – Charcoal from mound	2455+35 bc **3100 cal. BC**	GrN–12357	Eogan (1986.225)
Knowth, Ireland	Pre-mound surface, contemporary with construction of the mound	2540+60 bc **3150 cal. BC**	GrN–12358	Eogan (1986.225)
Newgrange, Ireland	Monument construction -burnt soil putty used to infill the cracks between the roofing slabs	2475+45 bc **3100 cal. BC**	GrN–5462–C	O'Kelly (1982.230–1)
Newgrange	Same as above	2465+40 bc **3100 cal. BC**	GrN–5463	O'Kelly (1982.230–1)

Tab. 1. Radiocarbon date ranges for passage grave construction along the Atlantic Seaboard.[2]

1 Frances Lynch however does describe several of these as being 'short passage graves (*1969a & 1970*)'. However, I am inclined to suggest that these monuments have little architectural or chronological associations with the passage grave tradition *per se* of the Late Neolithic.

2 There are no radiocarbon dates for the Welsh passage-graves.

navia. Its development can be clearly traced and it probably terminates in Wales and north-west England by about the mid-3rd Millennium BC (*Shee-Twohig 1981*). The majority of the passage graves, in particular those monuments found in southern Scandinavia, are not decorated with megalithic art and are considered earlier than those that are, dating between 3200 and 3500 BC (*Tilley 1991.77*) and probably represent an initial wave of immigrant farming or the translocation of ideas (or both). Megalithic art can therefore be considered a secondary tradition that occurs only in certain passage grave areas such as Iberia, Brittany, Ireland, Wales and Scotland. The latter two areas are restricted to no more than 12 sites, suggesting limited and late contact with areas fully immersed in the megalithic art tradition.[3]

Discussing the distribution of megalithic rock-art in Britain and Ireland is not new. Significant work has been undertaken in Ireland by a number of eminent archaeologists such as Michael O'Kelly (*1982; 1993*), George Eogan (*1986*), Muris O'Sullivan (*1986; 1993*), Elizabeth Shee-Twohig (*1981*) and a comprehensive summary by Gabrial Cooney (*2000*). The passage graves of Newgrange, Knowth and Dowth, located within the Boyne Valley, and Fourknocks and Loughcrew (Sliabh na Callighe), in County Meath all possess significant megalithic rock-art (*Shee-Twohig 1981; Cooney 2000*). Some designs arguably originate from the south, along the Atlantic seaboard, within the core areas of Brittany and, according to Eogan, from the Iberian Peninsula (*1986.172*). Based on a limited but significant radiocarbon dating range, one can trace the development of the passage grave tradition. It is generally considered that the movement is from south to north with its zenith in central and southern coastal Ireland during the latter part of the 4th millennium BC (Tab. 1).

The demise of the passage grave tradition, in particular those monuments that possess rock-art, appears to occur in North Wales and north-west England, although up to seven sites with megalithic art exist in Scotland and Orkney (*Piggot 1954; Shee-Twohig 1981*). Simple passage graves located on the Isles of Scilly and referred to as entrance tombs date to the late Neolithic but have no megalithic art. It is probable that the same architectural influences were moving northwards but some communities may have considered megalithic art time consuming and developed new ways of expressing burial rites and artistic endevour.

Recently, in 2005, part of an upright from a nearby destroyed passage grave has been discovered in a Bronze Age barrow at Balblair, Inverness, forming one of the cist walls (*Dutton & Clapperton 2005*). This carving, present on a former upright, shows a new and altogether unique curvilinear design that is not found on any other megalithic stone in the British Isles. The stone, forming the wall of a Bronze Age cist probably originated from a nearby destroyed passage grave.[4] The stone decoration comprises two large gouges, possibly cupmarks with each cup measuring around 0.20m in diameter and up to three finely carved lines radiating away from one of the cups. One is perforated and may have possessed a functional rather than a decorative role. The second and more intriguing design field is located on the upper section of the slab comprising of a series deeply gouged semi-ovate lines which resemble (but not necessarily is) the trunk and branches of a tree. However, more probable and incorporating the two large gouged cups from the lower section of the slab, the two design fields may represent a stylised penis (with accompanying testes).[5] The upper design, measuring approximately 0.70m x 0.70m is symmetrically placed with the outer gouges running parallel with a possible deliberately cut and shaped recess. Despite the uniqueness of this art, however, elsewhere in Scotland the designs show evidence for a regional style developed from probable contact and exchange with monument builders in Ireland. Spirals and concentric circles at Pickaquoy and Eday Manse, both in Orkney, have similar decorative styles with monuments in central Ireland (*Shee-Twohig 1981.136–7*).

The people who constructed the monuments in Anglesey and on Merseyside would have been involved in varying degrees of socio-political contact and exchange with passage grave builders in central eastern Ireland, operating in what Herity and others refer to as the *Irish Sea Zone* (*1970.30–3*). This zone is identified mainly through the stylistic similarities in monument building and the deposition of material cul-

3 Shee-Twohig (1981.93) notes 11 passage graves in Wales and around 250 in Scotland.

4 The reuse of stone at sites such as Balblair is significant but is not discussed here.

5 Sexual and body iconography is not uncommon in early and later prehistoric art. In megalithic art Thomas and Tilley (*1993*) for example has suggested that certain infilled rectangular designs represent the rib cage (and acts as a metaphor for the 'body' of the tomb).

ture within each of the core areas that lie in this zone. It is clear that the architectural traits that form the passage grave tradition within both Ireland and North Wales are similar.[6]

Excavations undertaken at Newgrange and Knowth in the Boyne Valley, Ireland, have revealed that megalithic art is not just confined to the passage and chamber areas. Both monuments, two of the largest passage graves in Europe, possess rock-art on in front and back of kerbstones which delineate the extent of each of the mounds (*Eogan 1986; O'Kelly 1972*). Although specific groups of carvings are used, no two stones are the same.

At Knowth, Eogan recognised two distinct forms of megalithic art, one angular, the other curvilinear (*1986*).[7] Both forms occur within the passage and chambers of the same monument, mainly within the inner passage and chamber areas. The eastern passage at Knowth measures c. 30m and both the curvilinear and rectilinear art is positioned around the inner passage and chamber areas (*ibid. 188–95*).[8] These images therefore would be near impossible to view from the façade. Further restricted visual access is hampered by a slight kink in the outer passage area. At Newgrange angular and curvilinear art are positioned in the same way. Also, angular carvings in the form of infilled diamonds, multiple zigzag lines and triangles dominate the chamber and inner passage areas at Fourknocks. This art too, cannot be viewed from the façade area; the art is hidden and can only be seen by people within the central chamber and possibly from the short passage.

A similar design complexity and strategy is found within the British passage grave tradition. At Barclodiad y Gawres (ANG 4) the passage, measuring approximately 6m, leads to a cruciform chamber area which has a series of uprights decorated with chevrons, lozenges, spirals and zigzag designs. These lightly pecked designs are similar to decorated uprights found elsewhere along the Atlantic seaboard. There is also a design association with nearby Bryn Celli Ddu (ANG 1) and monuments found in the Boyne Valley (*Lynch 1967.1–22*). Carved decoration occurs on six stones, located either within the inner passage or chamber areas.[9] Decorated uprights included Stone 5 (L8), 6 (C1), 7 (C2) 8(C3), 22 (C13) and 19 (C16) (*Shee-Twohig 1981.229*).[10] On Stone 5 are lozenges and vertical zigzags; Stone 6 exhibits a conjoined circular motif, lozenges and vertical zigzags; Stone 7 has a large chevron and on Stones 8 and 19 are a series of spirals and a series of unrecognisable motifs. Finally, on Stone 22 is a spiral, with supporting motifs, lozenges, a horizontal chevron band and a series of vertical zigzags. This particular stone bears some resemblance to the decorated *Pattern Stone* carved on a fallen upright found over a central pit at Bryn Celli Ddu. Unlike the monuments found in the Boyne Valley, at Barclodiad y Gawres all six stones have their decoration facing into the chamber and are being hidden from view. A large percentage of the megalithic art within the Boyne Valley appears to be public art, carved onto mound kerbing.

Perceiving scapes: art, doorways, thresholds and passages

Before I discuss the social (and antisocial) divisions of space within and around the monument, I want to look at the perception given to different spaces and how our senses react in different ways within these spaces. The passage grave builders would have been aware of sensory arousal, of how people using the monument should act and react. The passage grave blueprint, used throughout most of the Atlantic zone during the Middle and late Neolithic, consists of the façade area, the outer passage, the inner passage and finally the chamber. It is clear that as one progresses through these quite different spaces, one's sensory perception changes. In order to move from, say, the façade to the outer passage area, the change of space is represented by both a physical doorway (doorstone) as well as a metaphysical one. Static points such as a stone threshold, constricting or protruding uprights or a lowering of a passage capstone usually represent the physicality of a space. The changes in the physical statementing was argu-

6 Earlier architectural traditions in Ireland and Western Britain are also present such as the wedge tombs of the Carlingford-Clyde Group and the Court tombs of southern Ireland and Cornwall etc. (*Daniel 1950*).

7 These terms in many ways do not capture the style but for the sake of this section of the paper I will use them.

8 The chamber measures around 20.21m

9 Powell & Daniel (*1956*) and later Lynch (*1967*) record five stones. However, in March 2006 a team from the University of Bristol discovered a sixth stone that formed the northern upright of the eastern passage. This multi-phased decoration comprised a large chevron that was either superimposed or underlying a series of horizontal pecked lines (*Nash et al. 2006*).

10 The numbering system uses Powell & Daniel (*1956*), later used by Lynch (*1967*) and Shee-Twohig's numbering (in brackets) (*1981*).

ably accompanied by changes in ambience; changes in light intensity (from light to dark), changes in smell (from open air to stale musty air, due partly to the putrefaction of decomposing flesh) and changes in audibility; from the familiar noises made by the family group within the façade area to the near silence of the inner passage and chamber.

Christopher Tilley's pioneering work on passage grave monuments in Västergötland clearly shows the strategic importance and intentionality of certain architectural features (i.e. what materials are used and how they are used). This group of monuments, consisting of over 265 passage graves within an area of 38km by 25km is the most northerly Neolithic group in Europe. According to Tilley, tombs become 'socialised' through their construction and use, thus allowing sites to become socially-politically manipulated (*1991.68*). This process is evident through the changes to the tomb architecture or changes in burial practice. From Tilley's analysis all monuments are standardised in design, comprising an east-west oriented passage leading to a north-south oriented chamber, which are incorporated into a round mound. The mound is delineated by stone kerbing and it is more than likely that the capstones of the chamber were exposed during use. The interplay between the different colours and textures of the stone, the arrangement of the passage and chamber uprights and the way one moves through these different spaces would have been paramount to users of the monument. Not surprisingly many architectural traits are replicated in the two Anglesey monuments and passages along the Atlantic Zone. What is absent though is rock-art.

These single-phased monuments are regularly spaced within the landscape, sometimes in rows of up to twelve and are very visible. Tilley has also identified a series of intriguing architectural traits that are replicated in most of the Västergötland monuments which further suggests a recognised blueprint in design associated with the ritual use of the monument. Nearly all the uprights used to construct the passage and chamber walls are of sedimentary rock, while the capstones (or roofing stones) are of igneous rock (*ibid. 70*). The entrance to all the passages are narrow, measuring between 0.5m and 0.8m in width. The entrance to the passage is also low, suggesting that during use, people entering the monument would have to crawl in order to gain access. However, as one progresses through the passage, the walls and the roof open out and upwards until one reaches the keystone (or threshold). The keystone, located at the transition point between the chamber and passage is a deliberately placed capstone that is lower than the other capstones and, when entering the chamber area, one has to crouch lower in order to gain access to the chamber. Like other thresholds, the keystone is yet another device to restrict visual access from those looking into the passage from the façade area. It also possibly marks the point where the body (or body parts) finally enter the other world of the ancestors.

Between the entrance to the passage and the keystone and entrance into the chamber, the body has to travel, albeit a short distance through what Tilley and others has termed as 'liminal space' (*ibid. 74–5*). This liminal space acts as a rite of passage whereby the body is neither of this world or the next. This simplistic hypothesis can be further dissected to represent a series of journeys and not surprisingly adding further complexity to the rite of passage and the way the dead are deposited.

The doorway at Pentre Ifan in Pembrokeshire, SW Wales stands around 2.2m above the façade floor level and is located between two uprights which support an enormous capstone estimated to weigh 30 tons (Pl. 1). The doorway, itself weighing around 5 tons is set in such a way that human bone and associated offerings can be placed though the gaps between the door stone and the uprights (*Children & Nash 1997*). I have suggested that the door stone



Pl. 1. The façade and entrance of Pentre Ifan. The doorway to the chamber is located between the two supporting uprights (Photo: GHN).

may have been physically tilted and moved to one side in order to allow access by certain high status individuals (*Nash 2006*). Once inside the chamber secret rites could be performed where both the dead and living would have interacted in a special way; what goes on behind closed doors! The doorway therefore acts as a thoroughfare to the realm of the supernatural. Special individuals would have the knowledge and power to act as an intermediary between living and the dead. They would deposit the remains of new ancestors, communicate with the old ancestors, replenish the grave goods and offering the new ancestors food and drink for their journey into the next world. However, can the same process of moving the dead across a series of zones be maintained when there are no passages? At Pentre Ifan (Pembrokeshire), the space between the enclosed façade and the chamber is short and the distance between the façade and the chamber, unlike other Neolithic monuments, lacks liminal space. However, one could counter argue and suggest that liminal space is represented by the thickness of the doorstone. This blocking device separates the façade from the large rectangular chamber. Arguably, this journey between the living space and the space for the dead is restricted. Nevertheless, the journey, however short, is still paramount within the act of burial.

Sometimes doorways are set into the fabric of the passage and cannot be moved. Two uprights found within the inner section of the passage at La Hougue Bie, Jersey restricts the visual access between the façade and the chamber (*Baal et al. 1925.Fig. 2*). La Hougue Bie, one of Europe's largest and most impressive passage graves and dating to the latter half of the fourth millennium BC has, like other passage graves, more than one doorway. One of these is located between the passage and the façade while the other is between the inner passage and the chamber (*Nash forthcoming*). This careful and contrived arrangement of stone uprights within the passage establishes restricted visual access. The builders have added further components to the passage to ensure what is undertaken in the chamber remains secret, visually hidden from people using the façade area. At the eastern end of the passage a deliberate but subtle kink within the length of the passage has been made, and like most passage graves, the passage constricts at the façade end, while at the chamber end the passage walls and roof widen and rise. People using the monument would have therefore been forced to crouch at the entrance in order to gain access to the 9m long passage. However, as one progressed along the passage, one could move from a crouching position to an upright position by the time one has reached the inner passage and chamber areas. The living and the dead are also guided through the passage and chamber with a set of strategically placed cupmarks (Fig. 1). Several are carved within the inner passage area onto smooth pink granite, while a further 21 are carved onto the external face of the northern chamber (Pls. 2a & 2b). Arguably, and similar to megalithic art elsewhere these would have been hidden during the Neolithic (assuming that they date from this period). Furthermore, nine subtly-placed cupmarks are located on the roof [capstone] of the northern chamber (*Mourant 1974*). The strategic location of these cupmarks, between the inner passage to the chamber possibly demarcates part of the journey for the dead and it is clear that these marks cannot be seen from the façade. Indeed, only fire from a hearth or torch could illuminate these marks along with other cultural goods such as decorated pottery and the colour of the sea pebble floor (also found within the chamber and passage). Similar to art found at Newgrange and else-





Pl. 2a (left). Passage and chamber arrangement illuminated by artificial light (Photo: Adam Stanford). Pl. 2b. Partially hidden upright forming part of the northern chamber showing 21 cupmarks (Photo: Adam Stanford).

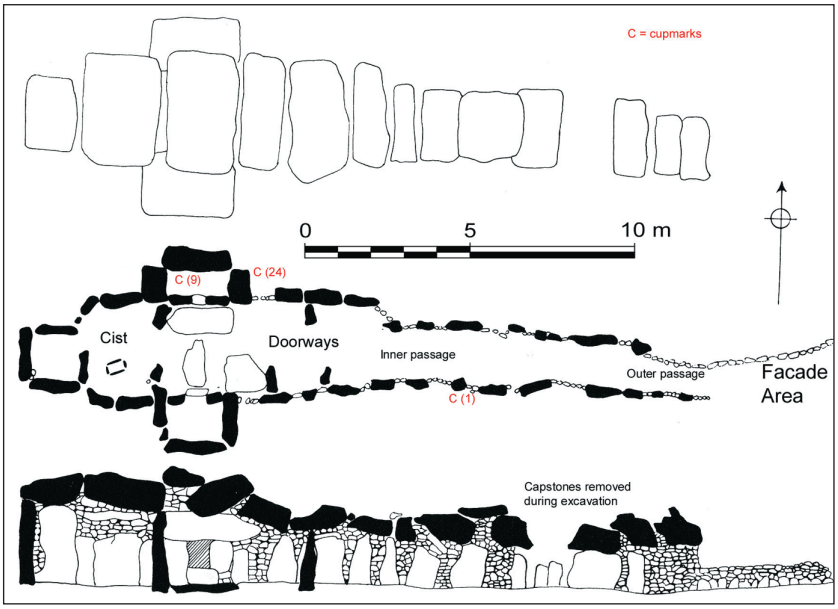


Fig. 1. Plan of La Hougue Bie, Jersey (adapted from* Baal et al. 1925*).

where in Ireland and Anglesey the cupmarks that are located within and around the northern chamber are hidden from the view of the living and are therefore the property of the dead.

A similar passage arrangement is witnessed, albeit on a much smaller scale at Arthur's Stone, a long grave in west Herefordshire, one of the most notable of all Neolithic burial monuments in western Britain. The site lies on the western intermediate slopes of Merbach Hill and faces the impressive eastern slopes of the Black Mountains of central Wales. This monument, one of the most northerly chambered tombs of the Cotswold-Severn Group, is one of eighteen tombs that dominate the Neolithic landscape of the northern reaches of the Dore, Upper Wye and Usk valleys of Breconshire and neighbouring Herefordshire (*Children & Nash 1994; Darvill 1982; Grimes 1936; Hemp 1935; Nash 1997*). The majority of the monuments within this group conform to a number of architectural rules including locally oriented lateral passages and a false portal located within the façade area.

The chamber and passage at Arthur's Stone are set within a cairn rubble mound. The chamber has nine upright stones that support an enormous capstone, estimated to weigh 25 tons. Recent investigations by the author suggest the chamber and passage were set within a long mound that extended some 50m north of the present mound, probably trapezoidal in shape and similar to other monuments within the group (*Nash 2006*). At the north-western end of the chamber is an unorthodox right-angled passage with a pronounced doorway, consisting of a single upright (Pl. 3). Between the chamber and a door stone the passage is oriented east. However, from the door stone to the façade and entrance, the passage changes direction to the northwest, pointing towards an impressive scarp of the Black Mountains locally known as Hay Bluff (*Children & Nash 1994.26; Tilley 1994. 140*). Similar with other monuments mentioned in this chapter Arthur's Stone has a narrow and low entrance that enlarges as one progresses through the passage towards the doorway and chamber. There is clearly no visual access between the chamber and the façade beyond. The 90° kink of the passage alignment where the doorway is sited appears to show a conscious attempt to separate living space and the realm of order and control, from the inside world of death, dismemberment and disorientation.



Pl. 3. The unauthodox passage at Arthur's Stone, Herefordshire. Passage turns 90° between the façade and the chamber (Photo: GHN).

The transition between the two spaces is achieved precisely at that point, equidistant between chamber and entrance, where the passage abruptly changes direction. It is here that the living come into contact with the dead; an act and point in time that is repeated in every chamber monument throughout the Neolithic world. A similar passage arrangement with its restricted visual access is recorded for the majority of passage graves either with or without rock-art.

The three passage graves forming the focus of this discussion, Barclodiad y Gawres, Bryn Celli Ddu and The Calderstones inherently have their problems. The first of these to be considered and problematic to all monuments of this age, is taphonomy. The surviving material culture probably represents a small percentage of what was within each of the chamber and passage areas. Consumables, such as offerings of food, wood and hide would have long disintegrated over time. This is further hampered by acidic soils that cover most of Wales. Finally, there is a problem with antiquarian and non-scientific excavation methods. All three sites have been severely disturbed; the Calderstones completely destroyed. Thankfully, the two Anglesey sites were excavated during the mid-20th century, albeit after initial antiquarian investigations during the 18th and 19th centuries, and attempts to use the sites as stone quarries (Appendix). Following excavation both monuments were restored. However, it is not known if the restoration of both monuments was sympathetic with the original layout of the monument. The excavation of Barclodiad y Gawres in 1952–3 focused on the excavation of the passage and chamber areas although, trenching was also extended through the surrounding cairn (*Powell & Daniel 1956*). One can assume that, based on the excavation report, this excavation was by far the most meticulous and scientific. Excavations undertaken at Bryn Celli Ddu, first by Lukis in 1865 and later by Hemp between 1925 and 1929, reveal the probability of a two-phase monument. It is not clear how meticulous both excavations were. What is known is that, based on a mid-19th century engraving, the monument comprised a chamber and passage and the mound had been almost completely removed (used as a quarry). It is not known from the Hemp excavation report if the passage uprights were in their original position or whether or not the outer passage uprights supported capstones. The Calderstones, presently standing out of context in Calderstones Park, have a sadder but well documented history. They are known to have formed part of a

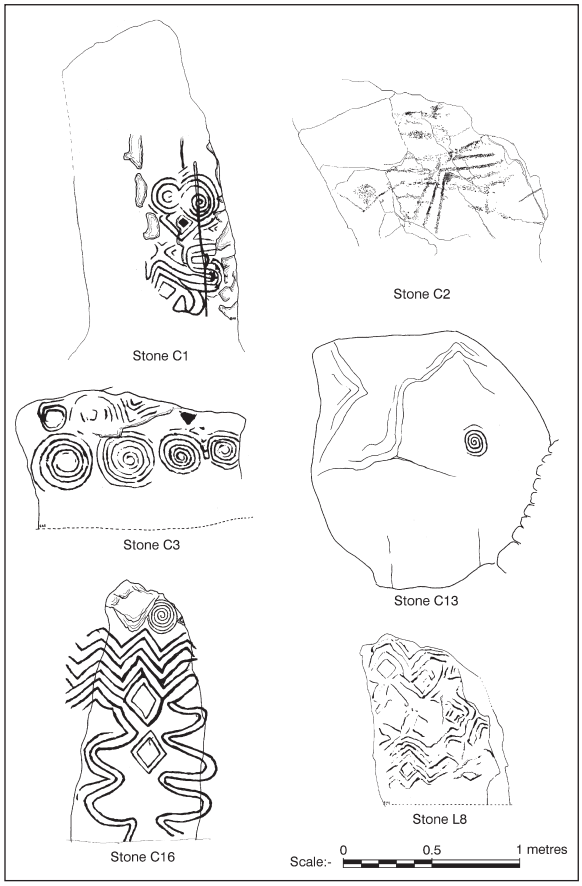


Fig. 2. Decorated stones at Barclodiad y Gawres (after* Lynch 1967 *and* Nash et al. 2006*)

parish boundary during the 16th century and are indeed located on a map from this period.[11] Between this period and the 19th century the stones, probably forming part of a passage grave were slowly but systematically destroyed. In the early 20th century the remaining stones were placed in storage and later erected within the entrance area of Calderstones Park, before finally being re-erected in a purpose built vestibule in 1964.

Despite problems of taphonomy associated with the early archaeological investigations, one can consider a number of similarities between each of the monuments. Firstly, and most simply, two of the three surviving monuments are architecturally associated with other passage graves within the Irish Sea zone. The architectural style used by monument builders in Anglesey and in Ireland suggests complex contact and exchange networks between these and other groups to the north (*Cooney 2000.226–8; Eogan 1986.220*). Secondly, are the more complex issues as to the origins of artistic endeavour. The artistic styles from all three monuments are all very diffe-

11 See Royden on www.btinternet.com/m.royden/mrlhp/local/calders/calders.htm

rent but are nonetheless classified as megalithic (*Shee-Twohig 1981*). Each of their styles may have originated from monuments within different areas of Ireland (*Cooney 2000*).

The artistic style from the Barclodiad y Gawres monument is essentially geometric in form with the predominant designs being chevrons, lozenges and zigzag lines. These occupy four of the six stones that are located within the inner passage and chamber and are essentially hidden from view and cannot be completely seen with natural light. On Stones C3, C13 and C16 large spirals are present while on Stone C3 spirals dominate (Fig. 2). The rock-art from this monument is probably contemporary and despite its unique design coding, many individual design components are also found within Irish passage graves. The meticulous excavation programme undertaken by Powell and Daniel suggests that the position of each of the stones remained in situ and what one witnesses today is roughly what was present during the Neolithic.

At Bryn Celli Ddu the art comprises a spiral and, more impressively, a serpentine-style carving (Fig. 3). Both designs configure with Eogan and O'Kelly's curvilinear classification. The small spiral, (13cm in diameter) located within the southern section of the chamber and carved on an upright, may be a later addition. I suggest this because compared with other spirals elsewhere in Anglesey and Ireland, the Bryn Celli Ddu example has been clumsily constructed. The serpentine form, which is carved on what is referred to as the 'Pattern Stone', was discovered lying prostrate next to a pit, centrally located and west of the chamber (*Hemp 1930*). The style of the decoration on the Pattern Stone is similar to Stone 16 at nearby Barclodiad y Gawres and extends over three faces. Excavation by Hemp between 1925 and 1929 revealed an earlier monument phase that he interpreted as being a henge and it is possible, though perhaps doubtful, that this stone belongs to this earlier monument. However, I am not entirely convinced that a henge phase exists. Instead the characteristics of the henge may be merely an initial construction or ground preparation phase associated with the passage grave. Whatever the phase, the Pattern Stone and its location, hidden from view, has more to do with the dead rather than the living in that it was found lying prostrate, the art lying face down. Likewise, the spiral, if contemporary with the use of the monument as a passage grave, is difficult to locate and could have only been viewed under certain artificial light conditions.

Moving through physical and metaphysical spaces

Previously, I have briefly considered the way our senses change when experiencing different types of space (*Nash 2006*). I now want to focus on visuality and how rock-art may have played a vital role in providing a series of focal points both inside and outside the monument. Of course one can never completely comprehend how and why prehistoric burial was undertaken; there lacks any secure tangible evidence and any burial service cannot survive the archaeological record. A phenomenological approach and the way monuments are approached, has been undertaken by Tilley (*2005*), while a more personal account of how people and the dead move through the monument has been effectively discussed by Parker Pearson & Richards (*1994*). Both approaches extend beyond the realms of empirical discourse. Cynically though, the evidence used is limited to just >5% of the potential material culture. However, the architecture of the passage grave tradition is similar throughout the Neolithic core areas of Europe and in each area there is a limited number of sites whose condition fares better than others. From these sites one can ascertain a 'sense of occasion'; the way one approaches the monument and

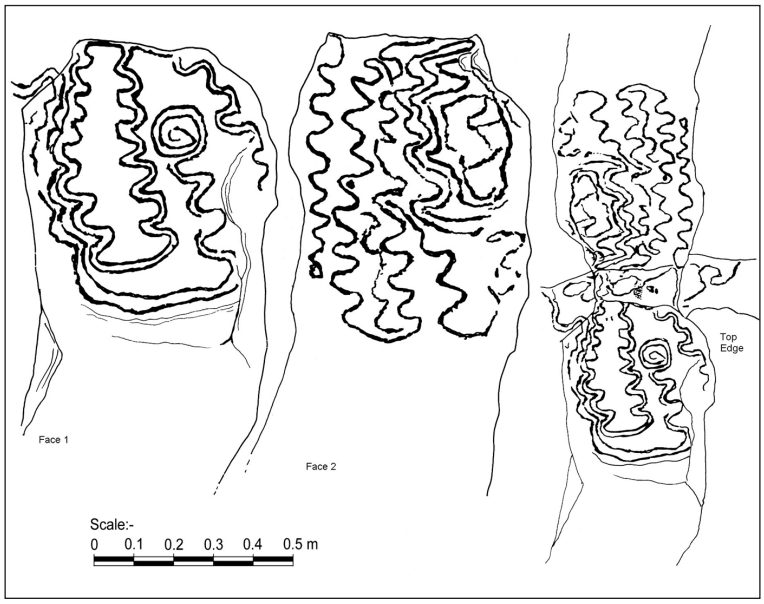


Fig. 3. Decorated stones at Bryn Celli Ddu (after* Shee-Twohig 1981*).

the way one enters the façade, passage and chamber. The ambience for each of these is usually different depending on the condition of the monument. Fortunately, both Barclodiad y Gawres and Bryn Celli Ddu are enclosed within a rubble mound, albeit reconstructed, thus the passage and chamber components are hidden from the outside.

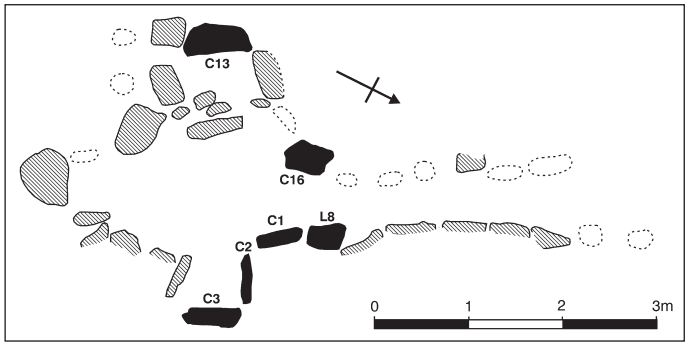


Fig. 4. Floor plan of the chamber and passage at Barclodiad y Gawres showing the position of the decorated stones (adapted from* Shee-Twohig 1981*).

In experiential terms Michael Shanks has probably come close in attempting to understand ambience and the rhetoric of space (*1992*). Shanks' retrospective accounts of visiting the Cotswold-Severn monuments of Maes y Felin and Tinkinswood in South Wales and Dunstanburgh Castle in Northumberland is personal and subjective. He encounters though, an incomplete past, a pastiche of preconceived ideas that affords a casual glimpse of the present. The experience of approaching and entering the monument would have been somewhat different during Neolithic times. One can assume, based on ethnographic and historical evidence, that people using the monument during Neolithic times were high status individuals, and having a similar role to the modern day priest. They would have possessed a knowledge and view of the world that would have made him or her different to others. The experience would have been sublime, fulfilling a plethora of human emotions based on terror with fascination, as each space is encountered and experienced (*Chippindale & Nash forthcoming*). Probably accompanying the priest would have been other status individuals who would also have special sacred knowledge of the dead. The architectural traits such as the constricting passage, the doorway and threshold, and the kink in the passage, would have restricted the visuality between the façade and the chamber. Furthermore, the natural light availability would have diminished as one progressed along the passage into the chamber, adding further visual restrictions on people standing within the façade area. One can see a similar visual restriction within the medieval church. A strategically placed rude screen constructed between the nave and the congregation and the altar area, plus various parts of the act of service being performed by the priest with his back to the congregation, would have established a clear divide between what can and cannot be seen (and understood).

The way the living and the dead move through a *scape* or physical space have serious implications on the way a space is perceived. Each space, either representing a different architectural space or a different stage in the journey from landscape to the spirit world, creates a different experience or ambience. Both the architecture and the art would have played a vital role in how the dead changed physically and metaphysically as they moved from one space to another.

Concerning burial deposition, it is now becoming clear that the passage grave tradition represents a corporate mentality towards death. However, both Anglesey passage grave monuments show little evidence of this. It is probable that corporate mentality actually means the burial of a high status extended family and that each member would have to undergo a series of processes before he or she could enter the next world. I would stress here that the final resting-place is not the chamber, which merely forms one stage before the metaphysical journey begins.

The journey for the dead begins outside the monument, between the moment of death and entrance to the façade area. It is probable that the monument was outside the main settlement area and would have been approached in a certain way using a series of markers within the landscape. According to the limited radiocarbon dating evidence the passage grave tradition in Britain and Ireland suggests many monuments were in use between the Late Neolithic and the Early Bronze Age (3000–2000 cal. BC). At the same time other monuments were being used such as standing stones, stone rows and stone circles. In the case of Bryn Celli Ddu two standing stones are located nearby and are possibly contemporary with each other (*Nash et al. 2006*). It is conceivable that the standing stones provided a pathway to Bryn Celli Ddu from the east; I regard this as the first journey. Once at the monument, the body would enter the façade area and thus establish a second journey. Whilst in the façade area, the dead may

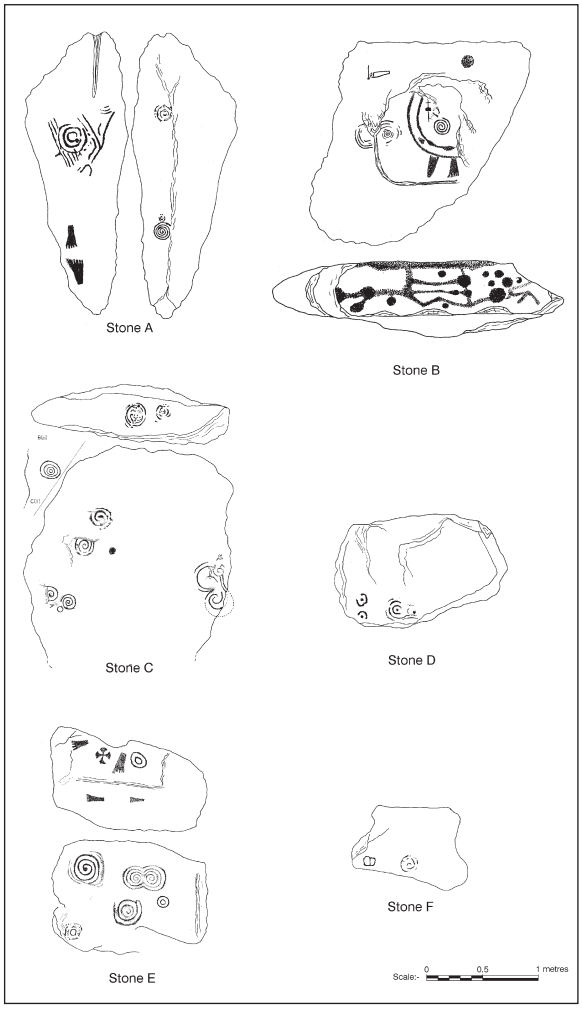


Fig. 5. Decortaed stones from the now destroyed Calderstones monument (after* Shee-Twohig 1981*).

take on a different guise. There is evidence from other Neolithic burial sites in England and Wales of excarnation, such as at Gwernvale in Breconshire and Wayland's Smithy in Berkshire. The body may have lain in state over many weeks, at the same time providing a necessary period for the mourning of the deceased. During this time the body would have transformed beyond human recognition, becoming a skeleton, physically leaving the world of the living and entering an ancestral world.

When the time was right the remains would have been collected and transferred from the façade to begin the third journey, along the passage or what Tilley (*1991.75*) refers to as liminal space. Liminal space, defined as a metaphysical as well as a physical entity where the dead are neither human nor ancestral, would be divided into two spaces, the inner and outer passage areas. Between the entrance and the inner passage, the dead and its entourage would experience a number of visual and audible sensations. Firstly, the natural or artificial light from the façade area would obscure parts of the passage architecture as one progressed toward the inner passage area. The amount of illumination from this light source would begin to fade. At the same time the noises from the façade would get fainter as one entered into a world of ancestors and spirits. Deveraux (*1996*) suggests that certain stones, either *in situ* architecture or movable, may have been struck that could resonate around the passage and chamber adding further sublime sensations for the occupants of the tomb. These noises, along with chanting both inside and outside the monument, would have created an audible sensation that would have been both synchronous and harmonious. It is at this point within the area of liminal space that the entourage would have to light torches or construct a hearth, probably within the chamber area. When approaching the inner passage area the rock-art would be fully illuminated. The carved abstract images each with their own meaning would move [and dance] as the flames from the fire flicker. A large hearth area was exposed during the Powell & Daniel excavation within the chamber area at Barclodiad y Gawres. Similar evidence has been found at the highly decorative monument of Gavr'inis. Here, charcoal has been found in both the chamber and passage areas (*Le Roux 1985*).

Light emitted from the Barclodiad y Gawres hearth would have illuminated nearly all the stones, including the newly discovered Stone C2 as well as Stone C3, each forming the northern and eastern walls of the eastern chamber, as well Stones C13, C16 and L8. The last two stones flank the doorway between the inner passage and the chamber and can only be seen from these two areas (Fig. 4). The ritual activity that would have been undertaken within the chamber probably remained exclusive to people using this part of



Fig. 6. The three sections of a menhir, each section now incorporated into later burial monuments (after* La Roux 1985*).



Pl. 4. Central section of an enormous capstone, later incorporated into the Table des Marchands passage grave (Photo: GHN).

the monument. As suggested earlier, using Tilley's analysis on monuments from Västergötland, restricted visual access would have been in place. The carved symbols, their location within the chamber, and their position on the panel, along with their relationship with other symbols would have been restricted. In the cases of the two passage graves in Anglesey, and probably the Calderstones monument, the art is positioned in such a way that it cannot be seen from the façade or the outer passage. Many passage grave monuments with art appear to conform to this basic rule. It is clear that in some cases, such as the northern chamber or cell of La Hougue Bie or the eastern chamber at Barclodiad y Gawres the rock-art is very difficult to view. It is possibly that this art was to be viewed only by the ancestors before they or their spirits embarked onto their final journey to the otherworld. The finely pecked lozenge and spirals on Stones C2 and C3 respectively suggest that the light emitted from the hearth would not be enough to fully read, and therefore understand each narrative. It is probable that torches would be required in order to fully illuminate these panels. Once the remains of the dead had been interred, grave goods would be offered in order to accompany the dead on their final journey. Based on the fragmentary evidence from both excavations, offerings would have included pottery vessels, flint tools and, in the case of the burials at Barclodiad y Gawres, a finely carved bone pin (*Lynch 1969b.158, fig. 21*). However, based on ethnographic evidence it is thought that the spirits of the ancestors would not have entirely left the monument. According to many non-western societies the ancestral spirits could be summoned back from time to time, maybe to assist with later internment. The rock-art, which was hidden, static and probably possessing a restricted meaning, would have guided generation after generation of ancestors using a prescribed way of moving through the various spaces, maybe emerging from the art itself. It is clear that many passage graves that possess megalithic art have panels that are entirely hidden from view. At Gavr'inis, Newgrange and in some respects, at Barclodiad y Gawres and Bryn Celli Ddu, certain panels are hidden and inturned towards the monuments mound. Some of this art is extremely elaborate in form (*Eogan 1986; Hemp 1930; O'Kelly 1982*). It could be the case that this inturned art originates from earlier monuments. At the Table des Marchands passage grave, Morbihan, one third of an enormous menhir has been incorporated as a capstone into the chamber architecture. Carved onto the stone is a visible axe (Pl. 4). The other two sections of the stone have been also used to form capstones and are incorporated into the roofs of Gavr'inis and nearby Er Grah (Fig. 6). However, the sections containing once continuous figurative art, including two goats and a large axe, have its art hidden. The destruction of the menhir and its incorporation into a later monument appears to be a deliberate act. Moreover, the positioning of certainly two of the three sections conform with how megalithic art is being used in passage graves.



Pl. 5. Stone C3 forming the back wall of the eastern chamber. The art can only be seen using artificial light. Photo: Adam Stranford.

Site	Grid ref.	Art	Location	References*
Arthur's Stone, Herefordshire	SO 318 431	Cupmarks	Portal stone	*Children & Nash 1994; Nash 2003; 2006; Hemp 1935*
Bachwen, Caenarvonshire	SH 407 495	Cupmarks	Capstone	*Daniel 1950; Hemp 1926; Lynch 1969a*
Barclodiad y Gawres, Anglesey	SH 329 707	Spirals, chevrons, zigzags, lines, lozenges, cupmarks	Chamber	*Powell & Daniel 1956; Lynch 1969a; Nash et al. 2006; Shee-Twohig 1981*
Bryn Celli Ddu, Anglesey	SH 508 702	Serpentine, spiral, cupmarks	Chamber, rock outcropping	*Daniel 1950; Hemp 1930; Lynch 1969a; Nash 2006; Nash et al. 2006; Shee-Twohig 1981*
Calderstones, Liverpool	SJ 405 875	Concentric circles, cupmarks, footprints, lines/grooves, spirals,	Chamber uprights (destroyed passage grave)	*Daniel 1950; Forde-Johnston 1956; Nash 2006; Shee-Twohig 1981*
Carreg Coetan Arthur, Pembrokeshire	SN 061 359	Cupmarks?	Capstone	*Children & Nash 1997; Nash 2006*
Cerrig y Gof, Pembrokeshire	SN 037 389	Cupmarks	Capstones, rock outcropping	*Nash 2006*
Cromlech Farm, Anglesey	SH 360 920	Cupmarks, horse-shoe carving	Monument architecture and rock outcropping	*Nash et al. 2006*
Cist Cerrig, Caenarvonshire**	SH 543 384	Cupmarks	Rock outcropping	*Lynch 1969a*
Cae Dyni, Caenarvonshire	SH 511 382	Cupmarks	Located on two uprights	*Nash et al. 2006*
Dyffryn Ardudwy, Merioneth	SH 588 229	Cupmarks	North portal of the western chamber	*Powell 1973; Sharkey 2004*
Garn Turne, Pembrokeshire	SM 979 272	Cup-and-ring, Cupmarks	Capstone, rock outcropping	*Nash et al. 2006*
Garn Wen Cemetery, Pembrokeshire	SM 948 390	Cupmarks	Rock outcropping	*Nash et al. 2006*
Llannerch	SH 559 379	Cupmarks	Remains of chambered tomb?	*Sharkey 2004*
Morfa Bychan, Carmarthenshire	SN 221 075	Cupmarks	Rock outcropping	*Sharkey 2004*
Pentre Ifan, Pembrokeshire	SN 099 370	Cupmark, spiral?	Portal stone	*Lynch 1972*
Treflys, Caenarvonshire	SH 543 384	Cupmarks	Rock outcropping	*Barker 1992; Hemp 1938*
Trellyffaint, Pembrokeshire	SN 082 425	Cupmarks	Capstone	*Barker 1992; Children & Nash 1997*
Ty Illtud, Breconshire	SO 098 263	Geometric forms, semi-representative figures (medieval)	Chamber uprights	*Children & Nash 2001; RCHAMW 1998*
Ty Newydd, Anglesey	SH 617 112	Cupmarks	Capstone	*Sharkey 2004*

* References refer to discussions specific to rock-art rather than the monument as a whole.
** Also known as Treflys

Tab. 2. Megalithic chambered monuments with rock-art in Wales and the border counties.

Concluding remarks

In this chapter I have concentrated on the passage grave tradition, focusing mainly on how the living and the dead may have viewed and experienced megalithic art. I have suggested that rock-art, located mainly within the inner passage and chamber areas of two of the three British passage graves is strategically placed. The art can only be viewed and read if the reader is positioned in a particular place inside the monument. I stress, however, that the ambience experienced by people moving from the façade into the outer and inner passage areas and finally, in the chamber area, changes forming part of a special experience that is restricted to only a few. These changes affect all the senses as people move through the different physical spaces, and this is arguably irrespective of whether or not rock-art is present. Rock-art merely forms a series of focal points for the living and, in particular for the dead, as they move through the different spaces whilst on their final journeys to the spirit world.

I would further suggest that similar emotions are experienced outside the monument as well, and that both the living and the dead are required to undertake a series of journeys that include moving through open spaces via a series of landscape markers, themselves sometimes decorated with rock-art. These markers provide rigid points through which people have to move in a particular way. Similar to the way we bury our dead, people are required to follow protocol, and funeral rites are properly observed. Markers, usually in the form of standing stones and more subtly, exposed rock-outcropping, would have provided a series of way points whereby the dead (accompanied by the living) made a series of journeys before embarking on their final spiritual journey from the chamber to the next world. When in the chamber area, an array of grave goods would have accompanied the remains.

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Pl. 6. Decoration from the passage of the Gavr'inis passage grave. Photo: G. H. Nash.

I have suggested that changes in perception are controlled and manipulated by changes in architecture and that how our senses react would depend on the ambience of each space encountered. Likewise, the dead also change both physically and metaphysically as they embark on their journeys through these different spaces, from a fleshed and recognisable corpse, through to decomposition and putrefaction to finally a collection of bleached bone; unrecognisable to those who are involved in the performance of burial.

Incorporated into inner spaces of the monument is rock-art, usually in the form of a series of abstract geometric forms. Although the syntax is limited to, say, ten distinct symbols, the way they are positioned on the panel suggests a complex grammar was in operation. The dominant symbols from the three monuments, including chevrons, concentric circles, cupmarks, lozenges, serpentine forms, spirals and zigzags are all located on uprights that are visually restricted and appear to function in areas of the monument where probably only a few individuals would attempt to go. Alternatively, the responsibility of moving the dead from a known to an unknown space would have been restricted to may be one of two high status individuals. As the burial monument is used over many generations the original meaning of each of the symbols may have been forgotten or

elaborated on. In order to read each of these symbols the strategic position of a hearth or torch would have been paramount.

Finally, like all architecture, the passage grave tradition indicates that there is an intentionality in design. The design elements repeated throughout the Atlantic zone including mound shape, passage and chamber plans, and the construction methodology would have had a significance to the people using the monument. The idiosyncratic and subtle position of, say, the doorway jambs, the constricting passage, or the location of the rock-art, indicate a status-driven society where by only elite individuals get the privilege of accompanying the dead on part of their journey and experiencing the light at the end of the tunnel!

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APPENDIX

PASSAGE GRAVE DESCRIPTIONS[12]

Barclodiad y Gawres, Llangwyfan

Large passage grave, also referred to as Mynnedd Cnwc or Mynydd y Cnwc, lies 19m AOD on the southern part of a small promontory headland overlooking a small inlet known as Porth Trecastell (SH 3290 7072). This monument appears to have suffered damage until its excavation in 1953. Used as a stone quarry in the 18th century, most of the contents, including archaeological deposits from the chambers, were removed. However, the monument did receive some archaeological recognition in 1799 when a note was published by David Thomas in the Cambrian Register, listing the Cromlechau or Druidical Altars of Anglesey. One of the first accounts of this monument was given by the Reverend John Skinner who on Monday December 6th 1802 described it thus:

"*Instead of a cromlech at Mynnedd Cnwc we found the vestiges of a large carnedd; many of the flat stones of the cist faen or chamber are still remaining but the small ones have been almost all removed to build a wall close at hand. On another fork of the peninsula about a hundred yards distant we observed the traces of another carnedd of much smaller dimensions [This is now regarded as a Bronze Age cairn]. From the nature of their situation, the bay, the earth work &c. it is not possible to suppose that an engagement here took place with the natives wherein some principal officers were slain and interred on the spot*."

In 1869 H. Pritchard published a full description of the site including a plan of the passage and part of the chamber, but made no reference to the destruction of the monument. The monument was later photographed by J. E. Griffith in 1900. In 1910, E. N. Baynes concluded that Barclodiad y Gawres was a small cairn, and it was not until 1937 that the full extent of the chamber area and the mound was exposed in the plan made by W. F. Grimes. In his research, Grimes concluded that the monument was a passage grave of the style 'of Newgrange and other Irish sites'.

The forecourt area opens out onto views across the western coast of Anglesey. Based on pre-excavation photographic evidence, the chamber and passage architecture prior to excavation was not fully covered. However, when constructed it was probably covered by a large turf mound. The profile of the passage appears to narrow as one progresses into the chamber area, an arrangement unlike passage tombs elsewhere. However, one should be cautious in so far as the true lines of both passage walls may no longer be in their original positions.

The passage measures approximately 6m and leads to a cruciform chamber which has a series of uprights decorated with chevrons, lozenges, spirals and zigzag designs. These pecked designs are similar to those found within the Boyne Valley and nearby Bryn Celli Ddu (see above).

The cremated remains of two young adult males were found in the western chamber during the 1953

12 Although without a passage, nearby Bryn yr Hen Bobl, Llanedwen (SH 5190 6900) possesses many passage grave traits such as a sub-circular mound and enclosed façade. However, no rock-art is present.

excavation. According to Powell & Daniel (*1956*) no primary pottery was found, but there was one artefact, which may be contemporary with initial use of the monument. This was a bone or antler pin which was found with the cremation burials in the western side chamber, a pin similar to skewer pins found at Loughcrew and Fourknocks in central Ireland. The pin fragments were all burnt and would appear to be associated with the cremation. The location of a cinerary urn, above the collapsed roof area, also suggests that the deposition of the cremation was subsequent to the initial use of the tomb. The urn had a decorated bevelled rim made up of a series of lines of plaited cord impressions. Within the central chamber was discovered a hearth approximately 1m in diameter which contained a mixture of charcoal and stone chips. Also recovered was an assemblage of shells, fish bones, amphibia, reptiles and small mammals.

Bryn Celli Ddu, Llanddaniel-Fab

Bryn Celli Ddu is located on a low ridge of a glacial moraine at around 33m AOD and close to the Menai Straits and extensive views of the Snowdonia peaks. To the north and west is a slightly undulating landscape. Other Neolithic monuments are sited within the locality including the dolmens of Plas Newydd, Bodowyr and Perthi Duon.

Based on the passage grave sequence in central Ireland Bryn Celli Ddu probably dates from the Late Neolithic and possibly has an association with nearby Early Bronze Age monuments such as the standing stone that is located in a field some 200m west of the monument (SH 50632 70103). Also worth noting is the recent discovery of 26 cup marks on rock outcropping that lies roughly 250m north-west of Bryn Celli Ddu (SH 50623 70240).

The mound, 26m in diameter, may have been possibly larger, but during part-restoration by the Ministry of Works, the monument may have been severely altered. The entrance, with its two uprights (without capstone), is located on the eastern side of the mound. It leads and into a slab-roofed passage approximately 7.5m in length. Intriguingly, the southern wall of the passage is straight, whereas the northern wall is not (*Thomas 1988. 45*). To the west of the monument and almost in line with the alignment of the walls of the passage is a standing stone, suggesting fore planning of the monument. The passage leads into a polygonal chamber roughly 2.5m across.[13] Between the entrance and the passage are two sets of kerbing, which suggests two phases of passage grave building.

The Reverend John Skinner visited the site in December 1802 and writes an important account of how he entered the passage. The site was excavated by Captain F. du Bois Lukis in 1865 and later by Hemp between 1925 and 1929. Hemp revealed a possible complex multi-phased history to the site. Beneath the mound was, according to Hemp a circular henge consisting of 14 upright stones, some of which were broken others, leaning outwards, and within the centre of this was a pit that was a recumbent stone slab. During excavation, socket holes were found which might represent the position of further uprights. Underlying some of these socket holes was evidence of cremation material. Covering the area of this possible henge monument, but underlying the present mound, was a purple coloured clay that Hemp suggests may represent a ritual floor. However, Lynch (*1969a.112*) argues that it is a palaeo-turf line, the colour of which has been affected by drainage conditions from the overlying mound. Lying next to the pit was the Pattern Stone.

Finds from the 1925–29 excavation are meagre and included a petit tranchet arrowhead that is probably Late Neolithic in date. Also recovered was a rounded scraper (thumb-shaped end scraper), a small lithic assemblage numbering twenty pieces and a mudstone bead which was found within the turf line of the ditch, south of the passage. Previous antiquarian interest in this monument (dating to at least the early 19th century) has probably seen the removal of much of the artefactual evidence from this site.

Within the entrance area of the passage-grave were the sockets of five post-holes that may represent a possible burial platform for human excarnation and two hearths. Immediately behind this structure was a shallow pit containing the remains of an ox burial. The presence of the post-holes, the burial pit and the two hearths suggests ritual activity is an ongoing process whilst the monument was in use.

Along with Barclodiad y Gawres, this monument has two stones with megalithic art, one within a pit, the other in the chamber. Decoration of one of two stones includes an anti-clockwise spiral approximately 13cm in diameter. The other stone, known usu-

13 Lynch (*1969a.116*) refers to the chamber as roughly polygonal.

ally as the 'Pattern Stone' was found in a possible ritual pit in the centre of the monument. The Pattern Stone was believed by Hemp to belong to the henge phase.

Considering the design and the presence of an ox burial Lynch suggests that this monument has a greater association with passage graves in Brittany than with monuments in the Boyne Valley in southern Ireland (*1969a.111*). Within the chamber area is a single pillar-stone, which has no structural use and therefore may be considered as possessing some ritual or at least, an aesthetic significance.

The complex decoration of the 'Pattern Stone', located on three of its faces comprises a clockwise spiral which is linked to a meandering curvilinear pattern, referred to by Shee-Twohig as a serpentine form (*ibid. 230*). This design covers both faces of the stone. Also present is a cup-mark. The simple spiral may have direct similarities with stone C16 within the chamber of Barclodiad y Gawres and Stones A, B, C, D, E & F of the Calderstones, Liverpool.

Outside the upright stones were the remains of a silted, flat-bottomed ditch approximately 6m in diameter and 2.2m in depth. It is this feature that is considered to be the henge. However, it is just as plausible to suggest that the henge uprights may in fact represent the kerbing of the passage gave.

Calderstones, Liverpool

This now destroyed site has, in my opinion the most complex decorated carved megalithic art assemblage in southern Britain. The history of its destruction can be traced as far back as the 18th century. Surviving today are just six decorated stones that once formed the uprights of a passage and/or chamber. Documentary evidence for this site is good and several early 19th century engravings exist of the site which by then was much denuded. The original site is not known and today the stones stand within a glasshouse in Calderstones Park. There have been attempts, albeit based on limited evidence to place each of the stones into their original context (*Cowell 1981*). Based on the location of decorated stones at Barclodiad y Gawres, Bryn Celli Ddu and monuments within the Boyne Valley in Ireland, the Calderstones' uprights would have been erected within the chamber and inner passage areas.

The stones were first recorded properly in 1954 by Forde-Johnston who labelled the stones A to F (Fig. 5). However, Forde-Johnston and later Cowell (*1981*) were concerned with recording only the megalithic art. The rock-art present on these stones is divided into at least four chronological phases that include: Phase I – megalithic art includes concentric circles, grooves, lines and spirals. Phase II include Late Neolithic/Early Bronze Age arcs, an axe, cupmarks, footprints and a wheel motif. Phase III includes medieval and post-medieval graffiti (a Maltese cross, shoeprints and text) and Phase IV includes 20th and 21st century textual graffiti.

Interestingly, the art from Phase II does not superimpose Phase I art suggesting some degree of respect for the earlier tradition. It is probable that both phases are within a generation or two of each other. Many components used within both phases are found elsewhere on Late Neolithic/Early Bronze Age exposed rock-art in Northern Britain (see *Beckensall 1999*). Common artistic themes found on all three monuments are spirals and concentric circles and these designs are probably the earliest. Footprints, of which there are four on the Calderstones are considered rare in Britain and are restricted to a limited number of sites. The Calderstone footprints probably belong to Phase II, dating to between c. 2500 and 1800 BC. Similar carvings have been found on a capstone belonging to the Pool Farm cist burial in Somerset and this site is clearly Bronze Age in date.

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Shamanic and/or cognitive evolution

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ABSTRACT – *Many misconceptions have been associated with shamanism. Recent studies, however, show a way to reinterpret basic concepts concerning shamanism. New field data from ethnology/anthropology, and studies on cognitive evolution have provided new results to enable a reconstruction of some mechanisms which contributed to early developments in the social life and intellectual history of prehistoric people. Shamanic healing methods, simple rhythmic and motor patterns and visual/symbolic representations are the focus of this analytical paper.*

IZVLEČEK – *Šamanizem je bil pogosto predstavljen napačno. Novejše študije ponujajo reinterpretacije temeljnih konceptov šamanizma. Rezultati novejših raziskav na področju entnologije/antropologije in kognitivnega razvoja omogočajo pojasniti mehanizme, ki so prispevali k zgodnjemu socialnemu in inteluktualnemu razvoju človeka v prazgodovini. V razpravi se ukvarjamo s šamanističnimi metodami zdravilstva, ritmičnimi in motoričnimi vzorci ter vizualnimi in simbolnimi predstavami.*

KEY WORDS – *shamanic initiation; hunting; singing; visual symbolism; rock art; community rituals*

In this essay, I should like to present and test some hypotheses which I have put together concerning the origin of shamanism. This is important because there are a great number of misconceptions concerning shamanism in general and about its early form in particular. But as an anthropologist I want to learn more about Neolithic Eurasia from archaeology and archaeologists, and about recent findings and theories on the prehistoric cognitive (r)evolution used in the discipline neighbouring anthropology.

From a methodological point of view it is rather risky to attempt a reconstruction of early forms of cognitive evolution. That is why we shall not operate with similarities or analogies, but simpler behaviour like hunting, singing, dancing, initiation, healing, etc. These are functions hypothetically in use in early Palaeolithic times and also used up to now by those shamans I have met.

Initiation Rituals in Hunting Communities

The human need to find food to eat, the so-called *alimentary instinct*, has always been a basic human need. It means that the first human(oid) communities needed skilled hunters, and hunting became a more and more complex action, or even a series of linked actions. Cooperation in hunting became common and important in order to have enough food. The same happened in gathering. In order to obtain food, they became acquainted with a great number of edible plants, and also herbs with healing properties, toxic plants, and even hallucinogenic species.

Andrej Wierciński, a Polish archaeologist, developed a model of initiation of a shamanistic type which is relatively unknown, in spite of the fact that it was published in 1989. Let me quote his ideas here:

"*Intensification of gathering and hunting among the nomadic groups, bearing the character of a joint family, led to a clearer division of biocultural roles between the two sexes and different age categories. Women, bearing children and protecting young offspring, although helped by older children, were mainly concerned with gathering around a temporary place of stay, taking care of the fire, and preparing food; whereas, men were undertaking*

distant hunting expeditions. Their life was full of dangerous events which demanded comprehensive and detailed observation of their environment, the fauna and the flora, the landscape, weather, and the sky. All the data had to be correlated with one another in meaningful mnemotechnical whole, taking into consideration symptomatic signals (cracks of twigs, sounds and trails of animals, etc.). This paves the way for the cognitive development and for thinking, based on figurative analogizing. Hence comes an additional problem as to an intergeneration transfer of quite extensive knowledge about the environment, tool production, and hunting behavior. Next, the hunter must have had at his command a very efficient human organism which could endure physical exhaustion, thermal extremities, hunger, pain, fear, etc., and he had to develop his volitional motivation (self-control). Finally, the hunting expedition demanded a coordinated and self-sacrificial cooperation of all the members of one sex, and age groups variously related to one another. It also demanded the forms of behavior directed towards the obligatory altruism. This is why the upbringing and training of a skilled hunter should, on the one hand, cover an intergeneration transfer of the knowledge about the surrounding and of the hunting craft and, on the other hand, comprehensive perceptive and endurance tests. A complex model of the origin of shamanism is shown in the following diagram."
(*Wierciński 1989.22*)

Initiation was (and still is) an important social function which made individuals mature enough for the daily fight for survival and made them more able to endure pain, fatigue, hunger, etc. Initiation rituals forge communities more powerfully, since their participants accumulate more strength than they had before.

Exactly because of the highly complex and extremely difficult initiatory process, those who pass it successfully, eventually become leaders of a group. As we know from our ethnological cross-cultural research the shaman was (and still are) the informal group leaders who provide protection for the group at a

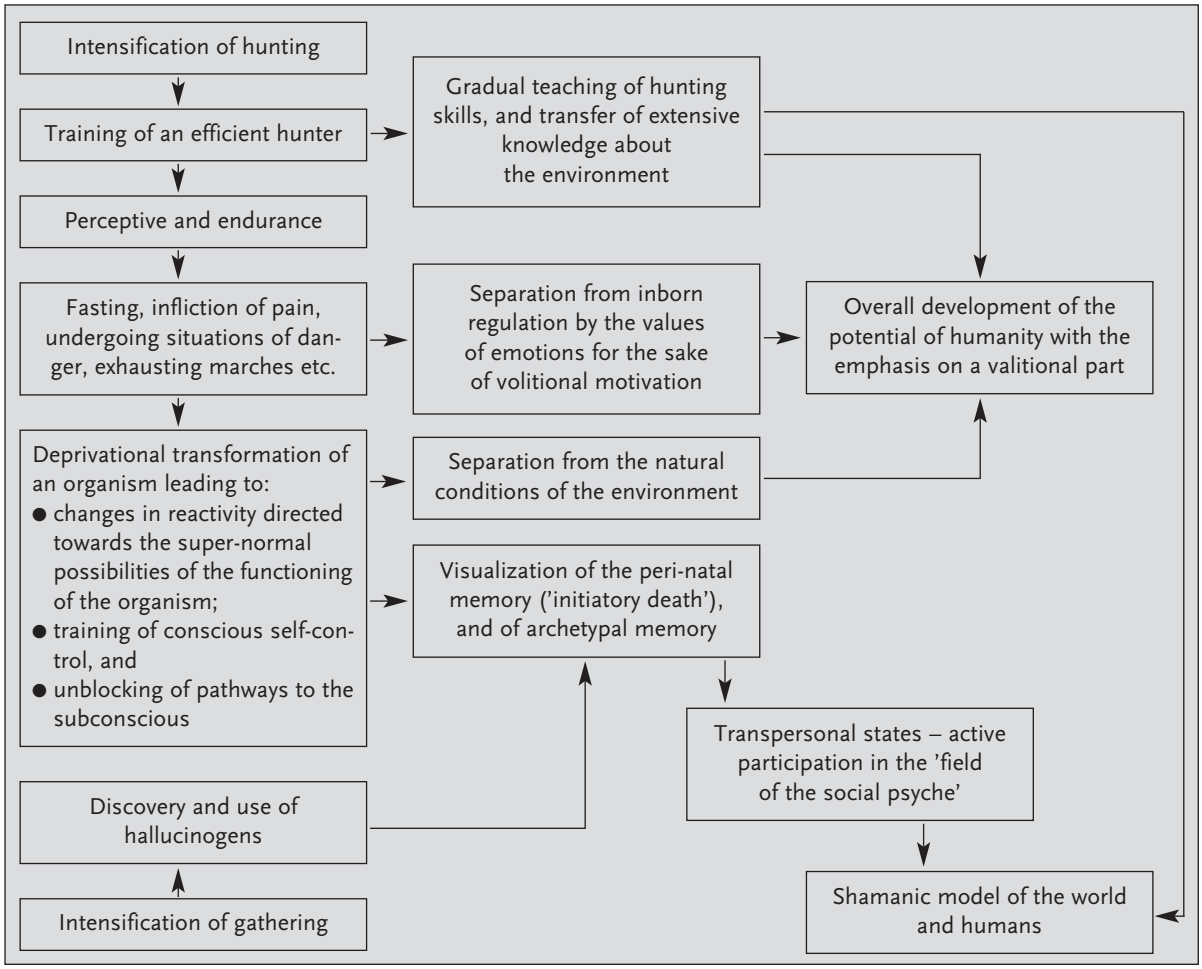


Diagram 1. Wierciński's model of shamanic initiation.

physical level, and as a charismatic individual, was the opinion leader in spiritual matters. As Michael Winkelman puts it: the shaman led the most important group activities, an all-night community gathering for healing which provided a direct encounter with the spirit world. Drumming and dancing ecstatically, the shaman recounted a dramatic encounter with spirit forces. After collapsing from exhaustion, the shaman entered into a phase of 'soul flight' or 'soul journey', in which the shaman experienced entering the spirit world to do battle with evil forces. If successful, the shaman was able to ward from the attacks of sorcerers, or recover the patient's soul from the spirits that had taken it (*Winkelman 2002.72*).

As psycho-biological understandings of mystical and religious states of consciousness have developed, shamanism has emerged as humanities' original '*neurotheology*' (as *Winkelman 2004* labelled it in one of his papers), and bio-psychosocial healing practice. He proposed that shamanism contributed to human social and cognitive evolution by providing mechanisms for enhancing symbolic thought, and manipulating and integrating the functional systems of the brain. He has outlined this neurological basis for shamanism in *Shamanism: The Neural Ecology of Consciousness and Healing* (*Winkelman 2000*).

The universals of shamanism present a challenge to the rationalistic view that these practices are delusional. The universal principles of shamanism reflect an underlying biological basis that provides adaptive mechanisms that have made shamanism a central cultural institution of thousands of cultures and across tens of thousands of years. This widespread distribution of shamanism reflects its adaptive value. The first and most important (and thoroughly studied) social function of shamans was healing.

Healing and Music

Recently there have been new studies which emphasised the shamanic origins of music and healing (*Hoppál 2002*). The very first element of any healing séance is that the shaman(ess) calls on his/her helping spirits. In most cases this happens through song, and the invocational melody is usually accompanied by some kind of instrument.

The most reliable descriptions of Siberian shamanic rituals come from researchers who are themselves members of the nation in question and, what is more important, still live among their own people. Leonid Lar is a Nenets researcher who answers the above description and who has published several volumes of text collected during field work. In one of these he gives an authentic explanation of the role of shamanic song in rituals:

"*An indispensable part of the shamanic séance is the shamanic song. The shaman used to call his helping spirits in song, and talked with them in song, accompanying the whole process on his drum.*" (*Lar 1998.39*)

The Nenets believed that, together, the sound of the drum and the song of the shaman were able to invite the benevolence of the helping spirits and that, on final balance, this had a positive influence on the outcome of the entire séance.

During the healing séance, they had to find out the reason for the illness, which is why the shaman had to make a symbolic journey through both the 'upper' and the 'lower' worlds (*Kazakevitch 2001*) in order to bring back from either of these places the soul of the sick person. This journey was described in detail in the songs, and the song also included naming the helping spirits that they had invited and those that actually came. The tunes of the spirits were different from each other and were easily distinguished both on the basis of the melody's structure and of rhythm (*Seykin 1996; 2000*). Onomatopoeia was a distinguishing feature of these songs, as they represented animal-shaped helping spirits (e.g. the bear, the loon, the reindeer or the moose) through imitating the characteristic sounds they make (*Dobzhanskaya 2002.84*). Onomatopoeia is actually the beginning of music, the first appearance of the musical ability of man. According to ethno-musicologists, in this fashion the songs of shamans retain memories from the times of the original emergence of music (*Rouget 1985*). An important characteristic of healing shaman music is that, besides the helping spirits, the individual shamans themselves each have their own distinguishing tune, sometimes more than one, and this is the case in distant South America as well as in Eurasia (*Walker 2003*).

Thus it is hardly surprising that the power of individual shamans was measured by the number of songs they knew. In other words, the shaman's power lay in his songs, and the power of the instruments was only an additional force. This is the impression I received when in February 2003 I saw a Daur shamaness (*Hoppál 2005*) who, after the healing séance, went on singing to the patient for a long time, giving instructions and advice to the young girl, who

hearing the dramatic song, sobbed and received the healing song kneeling and bowing to the ground. My impression was that the healing power emanated from the singing voice (*Newman 1998.267–272*), and from drumming (*Harner-Tryon 1992*).

Repetition and Rhythm

There is another important element we must mention when talking about music in shamanism, and this is the fact of repetition. Films about the last shamans of the Nganasan people who live in the far north show quite clearly that one of the most important potent features of shamanic song is repetition. Among the Nganasan, who live on the Taymir Peninsula, this was the task of the shaman's assistant (*touptusi*). Let us quote Carolyne Humphrey's evocative lines on this phenomenon, in connection with Daur shamanic song.

"*The refrains, which had to be repeated by competent assistants leading the whole audience, were essential to raise the shaman's soul energy. The shaman's body channels were opened by means of the smoke of a sacred plant to enable soul energy to travel out and spirit energy to come in. Rhythmic words, melody and vibration inspired soul energy*." (*Humphrey 1996.234*)

In some ways the same idea is referred to by a Finish ethno-musicologist in an article analysing Selkup shamanic songs. 'Shaman songs have somewhere an element of recurring pulse structure' (*Niemi 2001. 156*), which eventually lead to the production of endorphins in the human body (*Prince 1982*). This is the hypothesis that recent research on the cognitive evolution of our Paleolithic ancestors has been aiming to substantiate (*Mithen 2006*). It is interesting to quote an American researcher:

"*A range of evidence indicates that shamanistic elements were already part of the cultural practices of the Middle Paleolithic. This evidence includes: 1. the homonids basis of chanting, music and psychoemotional group ritual activities based in mimetic capabilities, and 2. the soul of shamanic practices in meeting a number of individual and societal needs for shared identity and communication. Music's effects include the induction of slow-wave brain wave patterns typical of other altered states of consciousness. Music's adaptive role includes its ability to promote group cohesion and co-ordination, enhancing synchronomy and co-operation among group members*." (*Winkelman 2002.78–79*)

In other words, the groups of humans who banged bones together, hitting on a joint rhythm (*Frolov 1988.3*), were practicing simple forms of co-operation with the leadership of their shamans. Joint dances and collective drumming represented another developmental step, which led to the further development of cognitive structures – in other words when they were able to distinguish different rhythms by the 'music modules' within the brain (*Mithen 2006.64*).

Visual Representations of Cognitive Evolution

The purpose of our study is to offer a survey of recent research which deals with the signs of rock art and their symbolic meanings. Anthropological and archaeological approaches differ from each other; hence it is instructive to become acquainted with the views of groups of researchers, their methodological differences and the configurations of their results. Theoretically, we have a relatively large corpus of signs in rock drawings available to us; but there are few types, a fact that makes it difficult to understand their meanings and the functions (*Hoppál 2003*).

If we look carefully at the features of the Neolithic rock art of North Eurasia, and within this, of Western Siberia, we can see that – as in Paleolithic art – the main subject is the animals. Two Russian Scholars (*Okladnikov and Martynov 1972*) have confirmed that this kind of art is typified by a lively realism. However, in the Bronze Age a completely new method of images came into existence; these two authors stress that at the end of the Neolithic and in the Bronze Age, the use of signs steadily increased, as did the role of symbols; and the art of this period is filled with abstract and conventional symbols. The meaning of the earlier pictures was obscured and the early images were used as signs, and symbols. However, the analysis of the symbols of that period, an attempt to unravel their meanings, raises a number of difficulties. At this point we must make a brief detour into the concepts of sign and symbol.

It is worth re-examining the theory which proposes that the development of art in general moves from a realistic picture to an abstract symbol, a theory to which experts in prehistoric art so often refer. Authors of some publications have taken the position that in the use of signs people developed various types of signs successively, which was not along a simple line of development. In other words, the 'invention' of the symbol can be traced back to a much earlier age than the Neolithic (*Wierciński 1983*). Palaeolithic 'realism', which includes some really mar-

vellously faithful 'drawings' in cave paintings can not be placed in direct contrast to the use of simple graphic signs, since in the cave art a whole range of symbolic representations can be found, the most important of which is hunting magic. The latest research testifies to the clear existence of sign systems even in the early Palaeolithic.

Okladnikov and Martynov state that Siberian rock drawings used many signs which were inherited from their ancestors; this becomes even clearer in the light of Alexander Marshack's research. He is concerned with the use of symbols at the end of the Palaeolithic, and the first appearance of recognisable pictograms on the basis of archaeological findings. He revealed scratches that recall fish shapes on the smallest objects (e.g. mammoth tusk fragments). He believes that these drawings should not be seen as artistic, but as the beginnings of a cognitive process (*Marshack 1972*); this led people to recognise the motif-character of simple zig-zag lines, and later, for example, that the repetition of the seasons could be well illustrated with the help of such signs. These scratches could be, according to these hypotheses, a record of the first prehistoric calendar. The common method of perception, the conscious use of symbol, the identified motifs and the repeated movements, lead to the development of a capacity for abstraction, and over a long period to the formation of the cave and rock art in Siberia.

For the Russian authors, the above arguments about the early development of art undoubtedly suggest an aesthetic attitude in which realism is on a 'higher scale' than symbolic art. At the same time, symbolic signs were an important step in the development of human ability – the creation of symbols is one of the proofs of the capacity for abstract thought. The conscious use of signs is an important point in the intellectual development of human beings. Therefore it is not surprising that in recent years there have been many studies which examine the art of the earliest times in terms of the use of signs and symbols (*Lewis-Williams 2004*). The possibility for a semiotic interpretation emerged based on the obvious idea that the rock drawings at the time they were made were signs which, as in almost every picture, were intended to communicate, to indicate something to others, to members of the community. Our task is thus to understand and explain this ancient sign language (*Hoppál 1992*).

There is another approach which also contributes to the explanation of the formation of the early use of signs. Neolithic people – and their ancestors and hunter successors even until today – met signs in their most simple form every day: the footprints of animals when they were hunting. In the language of semiotics this sign of type is known as an index, a sign which is immediately connected or connects with the signified object – the foot print signifies the animal itself. Naturally this goes further – these traces have extraordinary characteristics; that is, they convey information about the animal to those who know how to read them (for example, the weight, sex, size and age of the animal). We could say that this simple group of signs was of great iconic importance, which contributed to a great extent to the formation of sign usage, and to the recognition of the iconic character of signs.

The appearance of footprints or handprints – or drawings representing them – in rock art possibly had a magical significance, too; however, we believe that it is better to see them as the development of human cognitive capabilities (*Marshack 1972*). In terms of semiotics the sign is more iconic – that is, it is similar to the object in at least some details – but it has broken away from it; that is, not the whole figure is depicted, but a detail only, the form or print of a hand. We could say that this type of sign is half way to being a symbol – in other words, an arbitrarily selected symbol. That this truly came about at the end of the Neolithic period, the transition period to the metal age (that is at the turn of the first millennium BC) as Okladnikov and Martynov believe is yet to be confirmed.

Apart from the earlier mentioned indices (eg. the footprint), signs which are based on the similarity between the sign and the signified object are iconic, while the third main sign type is the group of symbols which are made up of completely arbitrarily selected signs, the use of which established a preliminary (*tacit*) agreement among the members of the community. Clearly this supposes the most developed and conscious use of signs. This all means that this knowledge came to humanity very early. So, for example, symbolic scenes of reproduction – recognisable precisely because of their iconic features – were drawn very early. With the help of these signs they believed they could ensure fertility and an abundance of game. We can say that the people of prehistory were not just 'naive' materialists, but conscious, sign using social beings. V. N. Toporov, on examining the rock paintings of the late Stone Age, wrote about the use of symbols by Palaeolithic people as if they were the beginning of the appearance of poetic sym-

bols. He looked at Western European cave painting, the art of 'underground sanctuaries', where the notion of the power of signs was developed during sacred-ritual activities by ancient peoples. The emergence of the sign of the sun, which is everywhere circular, and its connection with other depictions, is the first obvious clue that its objective was to mediate some sort of more complicated message (*Toporov 1976*).

Returning to the deer and sun mythology connection, it could be said that the golden sun-deer motif was in all probability significant for early nomads, but the rock drawings indicate that, although the original root and formation of the symbol goes back to Neolithic Siberian culture, it spread and survived to become a product of the Bronze Age. Okladnikov and Martynov (*1972.226*) see that Neolithic peoples did not personify the sun – in the Siberian rock art the sphere of the sun and elks are usually separate, although in one case, precisely on the shaman drummer drawing, the symbol of the sun appears on the back of an elk cow.

The sun-deer – whether elk or reindeer – was a frequent feature and remained in Siberian mythology (*Martynov 1991*). A depiction of it can be seen on a rock beside the Tom River – its monumental proportions seem to be a projection of the earthly and upper worlds in the form of a deer. With the help of the Siberian Tagar Culture's bronze (and gilded) deer it is possible to date fairly accurately this huge rock drawing to about the V–IV century BC. This is the period when the ancestors of the Hungarians appeared on the southern steppes of Siberia in a wave of nomadic horsemen. However little we know about the living areas and shelters of our ancestors in those times, the Tom River rock drawings, along with the Tagar culture objects, precious objects that survive, are important structural elements in the reconstruction work of the Ob-Ugrian, and more generally, Siberian mythology. An important task in the next decades will be to reconstruct the mythology within one big language family, namely of the Uralian peoples in the Siberian area; in this task the religious notions of far distant territories are possibly of use (see *Siikala–Napolskikh–Hoppál eds. 2006*).

In the reconstruction of the conceptual systems of the people who did the rock drawings, the beliefs, myths and legends of still surviving ancient Siberian peoples will play an important part. Russian researchers have used this method to reconstruct the origins of the history and folklore traditions of extinct peoples. But this method and practice must be used only on condition that it is understood that spiritual traditions have changed, albeit slowly, over centuries and indeed millennia, and that is why the remnants of these mythologies must be used with reservations, and undergo strict scrutiny (*Crook 1999*).

Rock Art and Community Rituals

The Neolithic art of the Siberian hunters was consequently a continuation, under new historical conditions, of the basic traditions of Paleolithic realistic art. It absorbed the artistic attainments of the preceding era. Here we find representation of animals in profile, a convention that was formulated in Paleolithic art.

It must be emphasized that the basis of Asiatic thought and style remained as before in the north Asiatic Neolithic, because the basic economy and way of life of the hunters changed little. True, there were external discontinuities at the beginning of the Holocene. Glaciers and mammoths disappeared; the Siberian forests filled with moose, and the tundra with reindeer. Hunting conditions changed. But hunting remained the basis of the North Asiatic foraging economy.

The Neolithic art of Northern Asia which has survived to our times is represented basically by three creative genres: ornamentation, sculpture, and numerous depictions on cliffs. The subjects of this art reflect the economic evolution of this era and as a whole have the following fundamental characteristics: (1) animals take a primary role in petroglyphs, while people are clearly secondary; (2) an interesting combination of live, dynamic realism and conventionalism may be observed in the artistic communication of images; and (3) the ideational, semantic bases of this art constitute the world outlook of hunters and primitive hunting magic.

In Neolithic antiquity, cliffs were cult sites, 'clan sanctuaries' (*Martynov 1991.12*). At their foot, on a stone ledge, the ancient hunters evidently conducted clan festivals in honour of their ancestors, spirits protecting the clan animals, and the omnipotent sun. They represented the reproduction of animals, scenes of successful hunts, and the gaining of spirit favours in religious spectacles, dances, and songs. Evidently these festivals ('animal ceremonialism', see *Siikala 1984*) took place in the spring, since concentric circles representing the sun are found among the drawings (see *Okladnikov and Martynov 1972.155*).

The drawings, pecked by an able human hand and incised into the rock, are simple and truthful. They transmit in lively fashion the image of the taiga dweller, the mighty moose. In these drawings, the animal's fundamental features – the immense chest, the characteristic hump of the muzzle, the fleshy lips, the long thin legs, and the distinctive beck hump – are brought out with amazing skill. Many drawings are distinguished by masterly execution. Among them are the remarkable depictions of lightly, timidly treading moose, and of bounding deer on the upper rock of the Tom River assembly. On this upper rock, too, are pecked drawings of an owl and a crane. These are so accurate and precise that even their feathers can be discerned.

In this essay we have examined some phenomena of community rituals, especially healing ceremonies which are considered neuro-biologically mediated, complex forms of social bonding. Recent studies in medical anthropology have pointed out that ritual therapeutic experiences rely on patients' own healing processes by means of various altered states of consciousness that healers are able to control. "*Ritual trance invariably occurs in social context, and the healer's personality and the expectations of the community are profoundly involved in the induction of altered states of consciousness. Trance state is regarded as a result of the mobilisation of endogenous opiates, as an activation of the organism's defensive mechanisms in face of the stress of ceremonial. On the other hand, there is a growing body of evidence that opiate mechanisms are involved in social behaviour as well, especially in symbiotic bonds. It is suggested that this is the neurobiological reason why attachment facilitates trance induction*." (*Frecska and Kulcsár 1989.84*). The homeostatic role of social relationships as a powerful regulator also played an important role in periodically reinforcing social relations within the community of our ancestors in prehistory.

The presence of a community in shamanic healing practices produces therapeutic effects at psychological, social and physiological levels. The communal activities elicit psychosocial support and the mammalian attachment system, provoking the release of endogenous opiates. These endogenous opiates provide direct stimulation of the immune system, enhance feeling of well-being, and intensify group bonding experiences. Shamans use ritual activities and symbols to elicit physiological and emotional responses and produce healing. The activation of the opioid system produces euphoria and a sense of belonging, enhancing coping skills, the maintenance of bodily homeostasis, tolerance of stress and group psychobiological synchronization. This enhancement of community synchronization promotes identification with others and the development of an integrated sense of self (*Winkelman 2004.6*).

Community relations have been reinforced, enhanced, which evidently means a kind of psycho-biological therapy, group therapy which also had positive effects on individuals. Cyclical rituals and the special ritual use of plant hallucinogens stimulated the emergence of shamans (*Ripinsky-Naxon 1998.148*), evidently based on a shamanic cognitive revolution.

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Spondylus and *Glycymeris* bracelets: trade reflections at Neolithic Vinča-Belo Brdo

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ABSTRACT – *In the provision, production and exchange of prestigious items and materials in prehistoric Europe, marine shell ornaments play important role. The marine shell collection at the Vinča-Belo Brdo site is the largest in the central and northern Balkans. More than 300 ornament items manufactured from marine shells have been collected since the first excavations in 1908 up until the most recent campaign. The majority of ornaments were made using recent shells that were obtained through trade with contemporaneous Neolithic communities; few ornaments were made of fossil bivalve shells. Bracelets were the most common type. Two bivalve genera, Spondylus and Glycymeris, were used in their production. These are easily recognizable when complete valves are compared, but difficult to distinguish in highly modified items where shell morphology is obscured. The defining characteristics for shell identification are presented, particularly to differentiate ornaments manufactured from the Spondylus and Glycymeris genera, as well as those made of recent and fossil shells. The possible exchange routes for these are discussed, as well as their diachronic distribution at the Vinča site.*

IZVLEČEK – *Okraski iz morskih školjk so igrali pomembno vlogo pri pripravi, izdelavi in menjavi prestižnih predmetov in materialov v prazgodovinski Evropi. Zbirka morskih školjk iz najdišča Vinča-Belo Brdo je največja na centralnem in severnem Balkanu. Od prvih izkopavanj leta 1908, do danes so našli več kot 300 okrasnih predmetov, izdelanih iz morskih školjk. Večino okrasnih predmetov so izdelali iz recentnih školjk, ki so jih dobili z menjavo s sočasnimi neolitskimi skupnostmi, nekaj pa so jih izdelali iz fosilnih dvolupinskih školjk. Najpogostejše so bile zapestnice. Za njihovo izdelavo so uporabljali dva rodova školjk, Spondylus in Glycymeris. Te rodova sta lahko prepoznavna, če primerjamo cele lupine, težko pa ju razločujemo pri močno spremenjenih predmetih, kjer je školjčna morfologija nejasna. Predstavljamo ključne elemente, ki omogočajo razpoznavo školjk, iz katerih so izdelani okrasni predmeti. Analiziramo poti njihove menjave in diahronično distribucijo na najdišču Vinča.*

KEY WORDS – *Archaeomalacology; Spondylus; Glycymeris; Neolithic; Vinča culture*

Introduction

Marine shell ornaments were recorded at the beginning of Neolithic research in the Central Balkans, in the early 20th century. The famous Vinča excavator Vasić, in an article published after the first excavation season, presented 9 shell bracelets (*Vassits 1910*). However, in later works, including the four tome Vinča monograph, he never mentioned them again (*Vasić 1932; 1936*). Similarly, throughout the rest of the century and following the traditional preoccupation with pottery analysis, these exotic items were largely neglected.

Comprehending the importance and role of shell ornaments in the life of prehistoric communities on

the European continent, noting especially the indications they offer concerning trade and social contacts, we initiated research into the occurrence of marine shells in the Balkans Neolithic, starting with the Starčevo and Vinča cultures (*Dimitrijević and Tripković 2003*).

In these respects, certainly the most important collection is from the central and largest site of the Vinča culture – Belo Brdo, in the Vinča village. In the impressive 10.5 m thick section, layers with remains from the Starčevo and Vinča cultures were formed in the continuation from approximately 5500 BC to 4300 BC (*Garašanin 1979; Chapman 1981; Stevanović, Jovanović 1996; Gläser 1996*), thus covering the time of maximal distribution of *Spondylus* and other marine shells across the European continent. Changes in the numbers and composition of shell ornaments at Vinča–Belo Brdo are a reflection of processes from the wider region, and may disclose important data for understanding prehistoric European contact networks.

Shell identification, origin problems and the aims of analysis

Our first insight into the marine shell artifacts from Vinča-Belo Brdo was an assemblage from the 1998–2001 seasons. Previously, we described 14 bracelet fragments made of *Spondylus* and directed attention to the origin and distribution of shells of this bivalve genus (*Dimitrijević and Tripković 2003*). However, during and after the analysis, in the course of continuing excavations, the more complex content of shell collections was revealed: items were manufactured using not only recent shells, but also fossil mollusks, and not only *Spondylus* shells.

A number of artifacts were made from the shells of another bivalve genus, *Glycymeris*. Its appearance in the north and central Balkans had not been previously analyzed, nor was its role and distribution within the European continent fully understood. However, its importance in prehistory is shown by an example from the Levant, where it was used, in the course of the Neolithic, Chalcolithic, and the Bronze Age, particularly for ornament production, but also for other purposes, such as the substrata foundations of pavements, or as eye applications on the famous statuette of Ur (*Bar-Yosef 1991; 2002*).

Glycymeris occurrences are rather numerous in the coastal region of the Eastern Mediterranean and Black Sea during the Neolithic and Eneolithic. Together with *Spondylus*, they are the most important marine shells used as ornaments at the sites of Sitagroi and Servia in Macedonia and Greece, as well as at the Durankulak necropolis in eastern Bulgaria (*Reese 1987; Karali 1999; Nikolaidou 2003; Todorova 2002*). However, the evaluation of its importance is often difficult, since the shells are so greatly modified in the process of the artefact manufacture that identification of *Glycymeris* and its differentiation from *Spondylus* is hindered.

At the Durankulak site and necropolis, for example, 1505 shell items are characterized as *Spondylus/Glycymeris* (*Avramova 2002*), but only 24 bracelets are specified as made of *Glycymeris* shell (*Todorova 2002.177–186*). An example of Gura Baiucului is also illustrative. A bracelet is described as made of *Pectunculus*, a synonym for *Glycymeris* (*Vlassa 1976. Fig. 14, 11*). In later publications the same item is described as a bracelet of *Spondylus* (*Lazarovici and Maxim 1995.154, Fig. 26.1*). At Anza, a Neolithic site in Macedonia, all shell bracelets found are described as made of *Spondylus* (*Gimbutas 1976*). In fact, at least one specimen is *Glycymeris* shell, as the distinct morphological features of the *Glycymeris* hinge and adductor muscle scar are recognizable in its illustration (see *Gimbutas 1976.Fig. 215.6*). Similarly, the attribution of marine shell artifacts as a priori *Spondylus* items may be oversimplified evidence at many European inland sites.

If ornament production from marine shells was a unique process in prehistory, with no cultural and chronological differences no matter what species of marine shell is used, than this question of *Spondylus/Glycymeris* differentiation could be disregarded. But, there are indications that this is not the case.

In this respect the aims of our paper are:

- to present Vinča-Belo Brdo shell assemblages from the earliest excavation until the most recent campaign;
- to define fossil/non-fossil shell origins;
- to establish identify characteristics for artifacts from different shell species;
- to reconsider the source areas for shell acquisition and probable exchange routes.

Raw material for ornament production – fossils or recent[1] shells?

Fossils were collected in the Vinča surroundings and brought to the site. Two fragments of fossil clam *Lim-*

1 Meaning contemporaneous to the Neolithic, i.e. living broadly in the same time as Vinča inhabitants.

nocardium (= *Pannonicardium*) are present in the material from Vasić's excavations. One is quadrangular in shape (2.5 x 2.5 cm), modified by cutting and scraping (*Babović 198.180, catalogue No. 250*). It is identified as brackish clam *Pannonicardium dumičići* of Pontian (Upper Miocene) age[2]. The other, similar in shape and size (3.5 x 3.2 cm) is perforated, and thus clearly modified into a pendant (Fig. 1a). A third fragment of similar shape and size (4 x 3.3 cm) was found in the last excavation campaign (Fig. 1b). The question arises that, if fossils were modified into pendants, were other ornament items also made of fossil shells?

Certainly for most *Spondylus* ornaments, we expect this is not the case. We should consider at least one specimen from Vinča doubtlessly recent: the one analyzed for oxygen isotopic composition (*Shackelton and Elderfield 1990*)[3]. Should this fact point to the conclusion that all *Spondylus* items were made of recent and not fossil shells? And should, then, other *Spondylus*, and especially *Glycymeris* items, differ from *Spondylus* items according to their origin?

So, the questions are posed: did the raw material for making ornament objects originate from recent, fossil, or both kinds of shell? The answer is important, because fossil origins indicate acquisition in a nearby region of the site, while recent origins imply long-distance trade relations with contemporaries, as the nearest coastline is more then 500 km from the Vinča site. This leads us to the necessity of considering fossiliferous sites with marine shells in the region, investigating the appearance of the fossils, their availability and convenience as a raw material, and establishing whether it is possible to distinguish them among ornament items from recent shells.

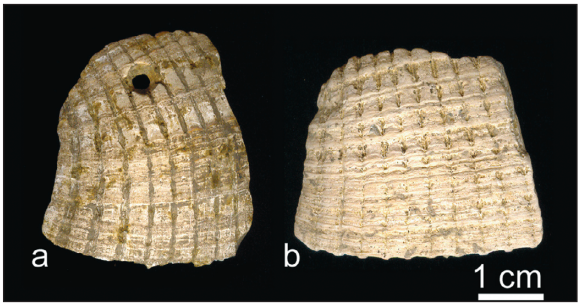


Fig. 1. Worked fragments of Miocene clam Limnocardium: a. perforated specimen excavated by Vasić; b. specimen excavated in 2003.

Several sites with exposed marine Miocene deposits rich in fossil mollusk remains are revealed in the surroundings of the Vinča village. The best known are the villages of Višnjica and Slanci, at a distance of 5–7 km northeast of Vinča, and Rakovica, once a village, but now a part of Belgrade, approximately the same distance to the southeast. Further away, in central, eastern and western Serbia there are other sites rich in nicely preserved fossils of the same age. In total, four fossil species of *Glycymeris* and one fossil species of *Spondylus* have been identified in the marine Miocene of Serbia: *Glycymeris obtusatus*[4] and *Glycymeris pilosus*[5] are frequent species in the whole region. *Spondylus crassicostata*[6] is also found on many sites, while occurrences of *Glycymeris corobtusata*[7] and *Glycymeris fichteli*[8] are more rare, and found in eastern Serbia (*Stevanović 1977; Petković 1987*). *Spondylus gaederopus*, a species that is mostly used as a raw material at Neolithic sites in Europe, was present in the Miocene. But in the Miocene deposits of Serbia its presence is not confirmed, although it is known in an adjacent area in Bulgaria (*Kojumdgieva and Strachimirov 1960.75–76*).

The late Professor Petar Stevanović, who was the most respected authority on Tertiary fossil mollusks in Serbia, identified shells from which two fragmented bracelets from Vinča were made as a fossil Middle Miocene clam *Pectunculus pilosus* (*Babović 1984.127, catalogue No. 235, 237*). *Pectunculus* is the name previously used, but it is now incorporated in the genus *Glycymeris* (*Moore 1969*). Likewise, *G.pilosus* is often treated as the same as *G.glycymeris*, being of similar morphology, although some taxonomists regard them as distinct species.

The fossil finds of other mollusk species at the site were identified by Stevanović as *Cytherea* sp., *Turritella turis* and the previously mentioned *Pannonicardium dumičići* (*1984.128, catalogue No. 251, 250, 253*). These finds show that the Vinča inhabi-

2 Identification was performed by P. Stevanović (*Babović 1984.121*).

3 The isotopic analyses were performed to establish whether shells for making ornaments in Neolithic originate from Mediterranean or Black Seas. However, if differencies were enough to make distinctions between contemporaneus Mediterranean and Black sea, they would certainly be much greater if a shell originated from much warmer Miocene sea.

4 Cited as *Pectunculus obtusatus* Partsch in *Petković 1987*.

5 Cited as *Pectunculus pilosus* in *Stevanović 1977*; *Petković 1987*.

6 Cited as *Spondylus crassicostata* Lamarck in *Stevanović 1977*; *Petković 1987*.

7 Cited as *Pectunculus (Axinea) corobtusata* (Lartsch.) in *Petković 1987*.

8 Cited as *Pectunculus fichteli* Deshayes in *Petković 1987*.

tants visited different fossiliferous sites in the vicinity to collect fossils, as *Pectunculus pilosus*, *Cytherea* sp. and *Turritella turis* originate from the Middle Miocene marine deposits, while *Pannonicardium dumičići* comes from the brackish Upper Miocene. Also, tube-like shells of the fossil scaphopod known as *Dentalium* were used at Vinča as beads (*Babović 1984, catalogue No. 238*).

However, collecting fossils and even using some of them as ornaments does not indicate that fossils were suitable for any ornament, namely bracelet, production. We think that Stevanović was wrong when ascribing shells, from which two fragmented bracelets from Vinča were made from fossils. This mistake is not surprising, as Stevanović was a paleontologist, who was aware that marine animals lived in the region in the Miocene, but not thereafter, as the ancient sea withdrew. So, he was apt to look at marine shells as a priori fossils, especially when dealing with species that are represented in regional fossil sites, like species of *Glycymeris* and *Spondylus* genera.

Aware of possible trade relationships that could supply Vinča inhabitants with recent shells, or bracelets made of them, as well as of the availability of fossils in the vicinity, we did not reject fossil or recent origins of shells, but looked through the material with both options as possibilities. We found the following criteria for distinguishing recent shells from fossil shells useful:

❶ **Ornament item size.** The majority of fossil species are excluded as possible raw material for the production of bracelets since their shells are too small. At Vinča, this is the case with *Glycymeris obtusatus*, *G. corobtusata*, and *G. fichteli*. But shells of some fossil species, like *Glycymeris pilosus* and *Spondylus crassicostata*, correspond to the size of shells that are used for ornament manufacture.

❷ **Shell morphology.** When complete shells are compared it is possible to distinguish species of the same genus, i.e. fossils from recent species. Of course, fragments of broken bracelets, and most complete bracelets as well, are far from having all the characteristics of whole shells, and usually offer nothing to distinguish species of the same genus and similar size. An exception may occur when the hinge area is preserved more or less completely, which is sometimes the case with bracelets made of *Glycymeris* (*Todorova 2002.179, Abb. 201*). No specimen of this kind has been found at Vinča.

❸ **Internal shell structure and color.** What remains recognizable in fragmented items is the internal structure of the shell. Growth lines are often visible either in oblique or cross section, and sometimes the color of the shell, whether from the outer shell layer, or inner, or internal. Usually, fossils are discolored and the shell's exterior form is eroded. However, coloration is not an ample argument for discounting fossil origin. Some fossils from the surroundings of Belgrade, especially those from Rakovica sands, are extraordinarily preserved. Complete valves are present, including the finest details of the outer and inner shell layers, as well as their color.

❹ **Transparency and elasticity.** What remains observable in almost every item, including those strongly modified by ornament production and those severely fragmented, is the transparency and elasticity of the shell. These should reflect a 'fresh' and translucent appearance in recent shells, as opposed to the brittle and opaque appearance in fossil shells, resulting from mineral exchange. Even the best-preserved fossils lack the internal elasticity of recent shells. On the other hand, ornaments made of recent shells may sometimes also be corroded or show some evidence of the process of mineral decomposition.

Consequently, it is not always possible to determine whether an item is made of recent or fossil shell. Another question is whether fossil shells were convenient at all for modifying into ornaments, given their probable lack of elasticity. In an experiment conducted by Miller (*2003*) to replicate the manufacture of *Spondylus* amulets, even beach-collected recent shells were too dry and fragile to withstand the manufacturing process, and they tended to break. Furthermore, it is highly improbable that well-preserved fossils were available in sufficient numbers for sustained production. We found no items among the fragmented bracelets from Vinča that could be identified positively as a fossil. There were several fragments which we were uncertain about regarding as of recent or fossil origin, but the majority was positively identified as made of recent shells, thus acquired by trade or some other kind of contact/exchange with contemporaneous communities of the wider region.

Distinguishing parameters for shell identification: *Spondylus* or *Glycymeris*?

Belonging to two very distant families, *Spondylus* and *Glycymeris* shells are easily recognizable. It is

only because ornament production tends to eliminate as much of the original morphology of the shell as possible that differentiation is problematic. Nevertheless, it is these obscured morphological characteristics we have to address when looking for features which differentiate shells of two genera. To demonstrate the ornaments variability of the two species the particular bracelet fragments found at Vinča have been taken as examples.

***Spondylus*: description.** The shell is massive and consists of two unequal valves. In the hinge area there are large dental sockets and hinge teeth (Fig. 2.1a–b). There are two equal teeth in each valve, positioned symmetrically on either side of a resilium pit where the internal ligament is placed, with two large sockets for receiving corresponding teeth in the other valve. The shell is milk-white, purple or yellowish-brown and with distinct radial ribs and large, irregular spines (Fig. 2.1c). During the lifetime of the animal it is usually attached by its right valve to a solid substrate. Due to the unequal size of the valves and attachment to the ground, the species exhibits great variability in shape, color and ornamentation. On the inner side a large circular adductor scar is placed posteriorly (Fig. 2.1d). The ventral margin on the inner side is scalloped (Fig. 2.1e).

***Spondylus* bracelet: description.** The bracelets were made of transversal sections of the valve. In the dorsal half of the valve the bracelet band is parallel to the arm of the wearer (Fig. 2.2, 4–7), while the central section curves in a spiral (Fig. 2.3, 8) and continues into a vertical position perpendicular to the arm of the wearer (Fig. 2.9–10). The bracelet is thickest in the section made of the dorsal part of the valve, where a hinge arch is incorporated into a bracelet band. Hinge teeth and dental sockets are prominent on some bracelet fragments (Fig. 2.4–5, 7), although mainly only the teeth bases and socket bottoms are left after extensive rubbing of the shell. Some bracelet fragments are cut below the hinge, or the hinge area is so intensively rubbed that no traces of teeth or sockets remain. However, they often bear remnants of umbonal cavity on the inner side of the band (Fig. 2.2, 6). Laterally and toward the ventral side of the valve, the bracelets are much thinner. The purple coloration of the outer shell layer is well preserved in some specimens (Fig. 2.3, 8–10), while in others it is noticeable in traces or is absent. Shell growth lines are also observable on most bracelet fragments both lengthways and in cross-section.

***Glycymeris*: description.** The shell is circular, and valves are similar in size, shape and convexity. The beak (umbo) (Fig. 3.1a) is in the center, and curved inward. The hinge is made of teeth rows (Fig. 3.1c) arranged in straight lines on both sides. The hinge plate is arched. Above it and below the beak is a flat field of triangular shape called area (Fig. 3.1b). On

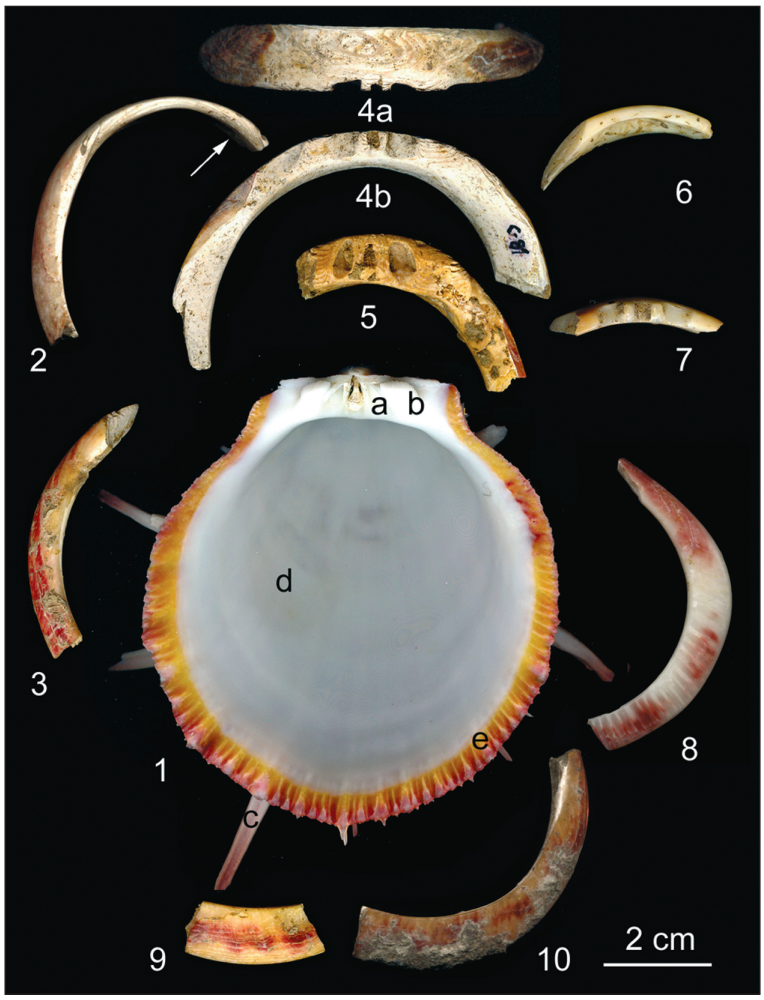


Fig. 2. Spondylus shell and representative bracelet fragments. 1. Spondylus sp., recent, inner side of the left valve, a. socket, b. cardinal tooth, c. spine, d. adductor scar, e. ventral margin; 2, 7 and 10. bracelet fragments excavated by Vasić; 3. bracelet fragment excavated in 1982; 8. bracelet fragment excavated in 2001; 4, 5, 6 and 9. bracelet fragments excavated in 2002; 2. the arrow points to the preserved bottom of the umbonal cavity.

the inner side of valves, adductor scars (Fig. 3.1d) are circular and positioned near the anterior and posterior margins. The inner margin is crenulated (Fig. 3.1e). Fine costate ornamentation and brown mottling characterize the outer shell.

***Glycymeris*: bracelet description.** A common type of bracelet is made when a valve is cut along its maximal diameter, including the umbilical part. The shape obtained is a bracelet with a circular outline and a triangular bump on one side (Figs. 3.3, 4, 7; Fig. 4). The beak is grounded and the triangular field flattened. Often a perforation is drilled in the middle of this area (Fig. 3.4–5). The umbonal cavity is observable on the inner side of the band (Figs. 3.2, 4–5). Sets of hinge teeth are sometimes observable, but usually only notches remain in their place, since this part of the valve is mostly ground down. The transversal section of the bracelet band changes in relation to the part of the valve from which it is made: the bracelet portion made of the ventral part of the valve is oblate, i.e. elliptical, with the larger diameter perpendicular to the arm of the wearer (Fig. 3.8–10), while toward the lateral portion of the valve it changes first in circular outline, then in elliptical, with the larger diameter parallel to the arm (Fig. 3.6). Fragments made of the ventral portion of the valve often bear traces of crenulations of the inner margin. They may be in the shape of clearly outlined connected triangles (Fig. 3.8), when the rubbing of the valve was not very intensive, or in the shape of parallel notches (Fig. 3.9), resulting from grinding away the inner sculpture of the shell. Some fragments preserve the outer shell layer, which is characterized by a light brown, sometimes brown-purple, color, and fine reticule (Fig. 3.10).

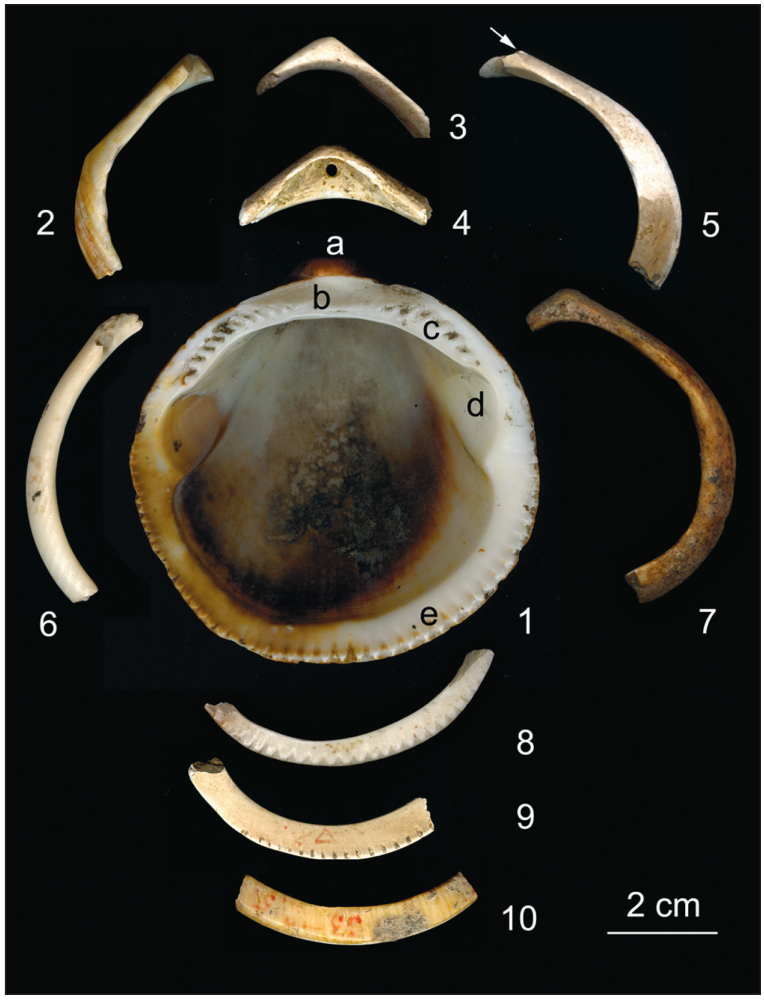


Fig. 3. Glycymeris shell and representative bracelet fragments. 1. Glycymeris glycymeris, recent, inner side of the right valve, a. beak, b. area, c. teeth, d. adductor scar, e. crenulated inner margin; 2–10. bracelet fragments excavated by Vasić; 5. the arrow points to the remnant of the umbonal cavity; 2 and 6. mirror view.

To distinguish between *Spondylus* and *Glycymeris* items, we find recognizable the following natural features:

❶ **Valve outline**. When complete bracelets are in question it is easy to make a distinction: *Glycymeris* products have a triangular bump on one side, a circular outline and a quite symmetrical and regular form (Figs. 3.7, 4). *Spondylus* bracelets are usually more massive (Fig. 2.4), oval or elliptical in outline (Fig. 2.2), and often have an asymmetrical and irregular form.

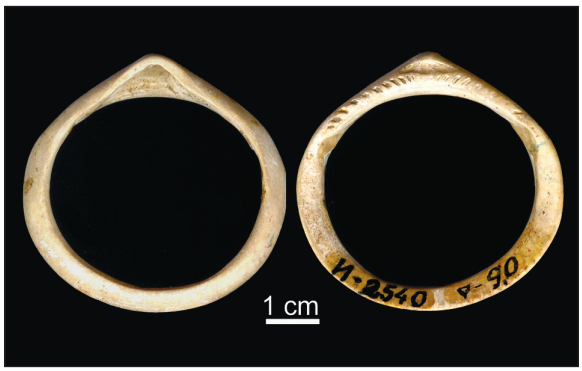


Fig. 4. Glycymeris bracelet from Vinča, Vasić's excavation, depth 9 m.

depth (m)	Spondylus	Glycymeris
1	o	
1,5	o o o	
2	o o o o o o o o o o o o o	o
2,5	o o o o o o o o o o o o o o o o o o o o	o o o
3	o o o o o o	
3,5	o o o o o o o	o o o o o
4		o
4,5		o o
5		o o o
5,5	o o o	o o
6	o o o o	o o o o o o o
6,5		o o
7	o o o o	
7,5	o	o o o
8		o o o o o o
8,5	o	o o o o o o
9		o o o o o
9,5		

Fig. 5. Spondylus and Glycymeris ornaments from 1908–1934 excavations distributed by depth.

❷ Shell morphology – hinge area. When the hinge, or part of the hinge arch with its teeth is preserved on the bracelet fragment, it is possible to distinguish small, regular denticules of *Glycymeris* (Fig. 4), and the large and few teeth and dental sockets of *Spondylus* (Fig. 2.4–5, 7). In *Glycymeris* bracelet fragments made of the umbilical part of the valve, there is a recess positioned below this area (Fig. 3.2, 4–5), while *Spondylus* bracelet fragments made of the umbilical part of the valve are usually of regular circumference and the bracelet lies along the arm by its entire width. A recess positioned below the hinge arch sometimes exists in *Spondylus* bracelets, too, but its shape is irregular and often appears as a sort of scar on the inner part of the bracelet band (Fig. 2.6).

❸ Shell morphology – middle valve and adductor scars. *Glycymeris* bracelet fragments made of the middle part of the valve show an even and regular change of bracelet band circumference from the vertical to the horizontal, while they are usually of quite irregular circumference band change in *Spondylus* fragments. When the adductor scar is preserved in a bracelet fragment made of a *Glycymeris* valve it has a regular circular outline, close to the valve margin and below the hinge arch (Fig. 4). The adductor scar is shallower, undifferentiated in outline, and positioned away from the hinge area and margin of the valve in *Spondylus*. Consequently, it is rarely preserved in bracelet fragments, and more often in amulets (Fig. 7.1b).

❹ Shell morphology – ventral valve. Fragments made of the ventral part of a valve, when not overly rubbed, are rather easy to distinguish. In *Glycymeris* bracelet fragments there are characteristic rows of triangles on the valve margin (Fig. 3.8). When the item is polished, only notches remain from the original triangles (Fig. 3.9), or they disappear completely. Similar notches are found also in the ventral margin of the inner side of the valve in *Spondylus* fragments. In *Glycymeris* fragments, these notches are evenly distributed, while in *Spondylus* they are more irregular, but confusion is still possible.

❺ Inner structure. This helps in some instances, but may cause confusion and may be unrecognizable in small and intensively modified fragments. Generally, growth lines are more regular and evenly distributed in *Glycymeris*, while in *Spondylus* they are often uneven and sometimes waved, especially near the ventral margin of the valve.

❻ Color. Although it is often looked to first to help differentiation, color may also confuse. An intense purple color indicates *Spondylus*, but not all *Spondylus* fragments are intensely colored, and some fragments lack such color completely, and are rather milk-white or yellowish. Also, some *Glycymeris* fragments show traces of a brown, reddish, and sometimes even purple color.

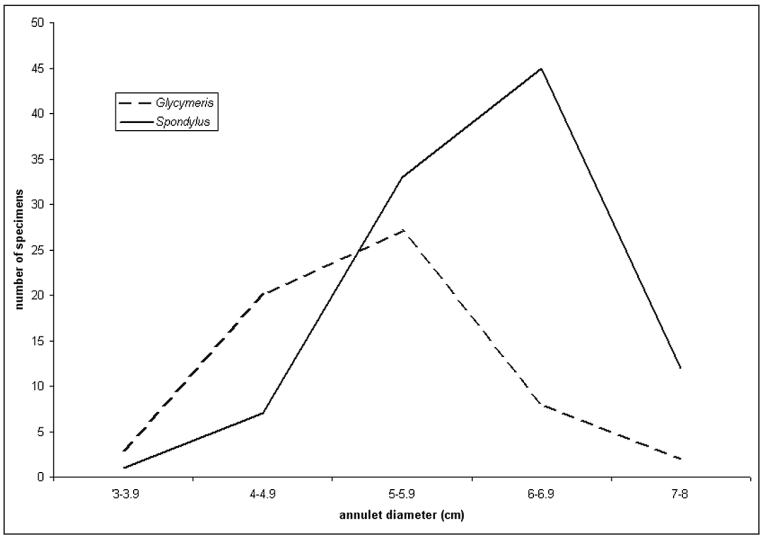


Fig. 6. Inner diameter of bracelets from Vinča. Measurements have been taken of specimens preserved with a length of more than 5 cm.

Vinča shell ornaments

The number of marine shell artifacts from the Vinča site to be presented here is 307 (Tab. 1)[9]. Most of these ornaments are made of recent marine bivalves, but there are also four pieces made of fossil shell, all belonging to the Miocene genus *Limnocardium*. Fossils that are not recognizably modified in order to make an ornament, shells of other marine organisms, like *Dentalium*, and mollusks of non-marine origin are not presented here.

Among recent marine bivalves, two genera are identified: *Spondylus* and *Glycymeris*. 169 items were made of *Spondylus*, and 94 of *Glycymeris* shells. Identification of the bivalve genus was not possible in 41 cases, due to the high degree of modification obliterating morphological features. There were 19 specimens belonging to a separate bivalve genus of massive valves, but small dimensions (mean 10 x 8 mm); the majority of which (17) are found in the collection of the National Museum in Belgrade, strung through a double perforation in each on a single rope, and with a label indicating they were found at a depth of 3.80 m.

Spondylus and *Glycymeris* items are present throughout the duration of the settlement at Belo Brdo, although their number varied considerably. This is shown by the distribution of finds collected during the excavation campaigns from 1908 to 1934, when the whole cultural layer to a depth of 9.5 m was explored, from the latest to the earliest horizons. *Glycymeris* items are abundant in the lower part of the settlement sequence. Of 46 finds for which depth is known[10], 16 specimens originate from a depth of 9.5–8 m. Above 4 m, there are only 9 *Glycymeris* items. Conversely, there is only one *Spondylus* find from the earliest phase of the settlement. They appear in larger numbers only when the number of *Glycymeris* finds begins to gradually decrease, while they are most numerous above 4 m.

In the second and the third phases of research, the upper layers of the sequence were excavated (Vinča D). Among 72 items collected, 60 were made of *Spondylus* shells, 8 of *Glycymeris*, and 3 items were unidentifiable. It would be important to establish whether chronological differences in the frequency of *Spondylus* and *Glycymeris* products simply characterize the Vinča site, or if it is indicative of the overall use of marine goods in the region. On the basis of the current state of published data from the other sites of the Vinča culture, it is not possible to confirm this pattern of chronological change, since these two genera were not differentiated in any of the existing reports. Still, it is highly probable that in the central and northern Balkans, *Glycymeris* items were present along with those of *Spondylus*, as evidenced by bracelet finds from the necropolis at Botoš (*Petrović 1997.33*) and the settlement of Potporanj-Kremenjak (*Rašajski 2002.29*).[11]

At present, one can only compare the frequency of *Spondylus* and *Glycymeris* finds from sites in the coastal regions of the Aegean and Black Seas. For example, in Sitagroi (Greece), items of both genera appear in the course of phases I–V of the settlement, but are only numerous in phases II and III (*Shackleton 2003.361–362; Nikolaidou 2003.333*).[12] The important observation is that items made of both bivalve genera are approximately equally represented in phase II, while a strong preference for *Spondylus* became established in phase III (*Shackleton 2003. 362*).

Excavation	*Spondylus*	*Glycymeris*	Recent bivalves indet.	*Fossil Limnocardium*
1908–1934	109	86	38	2
1978–1986	6	2	2	0
1998–2003	54	6	1	1
Sum	169	94	41	3

Tab. 1. The number of the marine shell ornaments by taxonomic identification.

Bracelets are the dominant type of ornament among marine shell finds at the Vinča culture sites; they constitute almost 90% of all ornament types.

The identification of annulets as bracelets needs some explanation. They

9 The analysed finds are stored in the Archaeological collection of the Phylosophical faculty in Belgrade, National museum in Belgrade (1908–1934 excavations), and Museum of Vinča near Belgrade (1978–1986 and 1998–2003 excavations). In addition, a part of the collection from the first research campaigne (1908–1934) is stored at the Birmingham Museum and Art Gallery; approximately 30% of artifacts in Birmingham are made of *Glycymeris* (after *Shackleton 2003.364*).

10 Depth data are written on the specimens; in few cases number is not readible.

11 They are described as *Spondylus* bracelets, but distinct features of *Glycymeris* shell are observable on the illustrations.

12 Phase II is dated 5200–4600 cal. BC, phase III 4600–3500 cal. BC, which means that those two phases correspond roughly to complite Vinča sequence.

might have been used not only as bracelets, but also as hair ornaments and on cloth garments, or anklets. Indeed, the diameters of annulets are sometimes so small that they might have been worn by children, or put on the arm in childhood and never taken off (*Gaydarska et al. 2004.24*). However, their common usage as bracelets is shown through grave goods, mainly in the region of the Black Sea (*Todorova 2002; Avramova 2002*), and indirectly in figurines with bracelet representations (*Kalicz and Szénászky 2001.42, Fig. 14*). Some of the latter are also found at Vinča (*Vasić 1936.XXVII*).

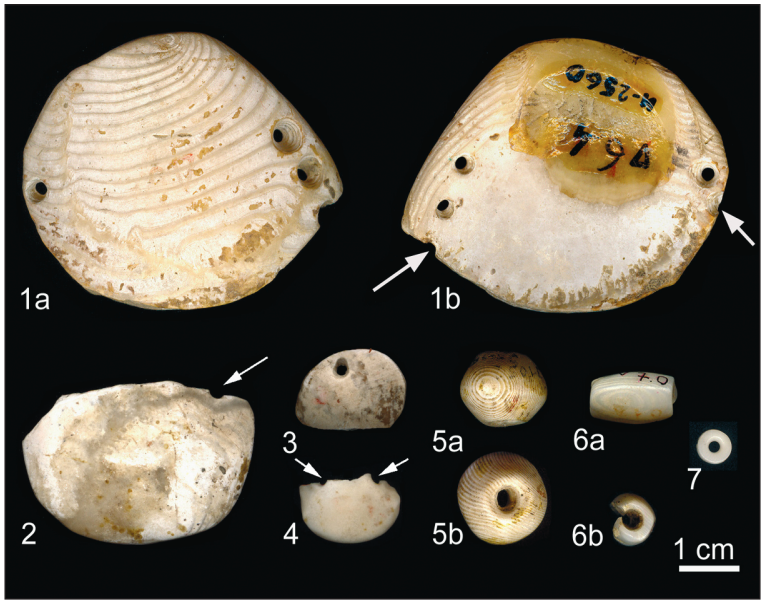


Fig. 7. Pendants, garments and beads from Vinča, Vasić's excavation: 1. Spondylus pendant, made of the central portion of the valve. Arrows point to openings that remained at the breakage line; 2. Spondylus pendant/garment, an arrow points to a single opening remained at the breakage line; 3. pendant/garment, probably Spondylus; 4. button, probably Spondylus, arrows point to openings at the breakage line; 5. biconical Spondylus bead; 6. barrel bead, probably Spondylus; 7. discoid bead.

Most of the amulets from Vinča have an interior diameter greater than 4 cm (Fig. 6) and were most probably worn around as bracelets. The greater number of *Glycymeris* bracelets have an interior diameter of 5–6 cm, and only one reaches 8 cm. The bracelet with the smallest diameter (3.9 cm) is also the only complete example (Fig. 4).

Most *Spondylus* bracelets have a rather large diameter. Only eight items have a reconstructed interior diameter smaller than 5 cm (Fig. 6). In most specimens, bracelet bands are of variable volume, sometimes very massive, exceeding the width of the band by of almost 2 cm in several items, and thickness of 1 cm in one item.

Other *Spondylus* ornaments were also found: buttons, beads, and probably garments (Fig. 7). The morphological features of the bivalve genus are not observable in buttons and beads, but the internal texture, as well as the massive volume of the shell, point to *Spondylus*, and not *Glycymeris*. In a garment the adductor scar outline and position indicate *Spondylus* (Fig. 7.1b). The garment is perforated, and it is broken in the line of two marginal openings. The break was lightly rubbed, so it was used, or it was intended to be used after the breakage.

Perforations on bracelet fragments show that they were used as pendants, garments, or, possibly, parts of composite bracelets, probably after breakage. There are 41 bracelet fragments with a single perforation, and seven with two or more perforations. In the majority of perforated *Glycymeris* pieces, the opening is positioned below the umbo (Fig. 3.4), or, when it was broken at the umbo, towards the end of the piece, but still within the umbonal cavity (Fig. 8.3–6, 9, 10). Similarly, fragmented *Spondylus* items are often perforated at the remnant of the umbonal cavity (Fig. 8.7, 12, 16). More rarely, other parts of bracelet band are also perforated (Fig. 8.8, 11, 13–15). It is not always certain whether perforations were made before or after breakage, because openings for hanging pendants could be made on the bracelets; or annulets of small diameter might be perforated for wearing as pendants or brooches on garments. Examples of such annulets are known from Botoš (*Petrović 1997.33*). Probably the majority of these openings were made after breakage in order to prolong the use of the ornament. This is indicated by their symmetrical (Fig. 8.12–13) or brunt position (Fig. 8.1–11, 14–16), and by attempts at drilling observed on at least four items. Items with two openings also confirm a second modification of broken artifacts, especially when openings are positioned at two opposite ends. In one example, the two openings are on different planes, one parallel to the band of bracelet, and another perpendicular to it (Fig. 8.13a–b). They could be linked by strings to make a composite bracelet, or worn as brooches. Efforts to polish breakages were not made on these twice modified artifacts, except in one case (Fig. 8.14).

Ornaments made from raw materials other than shell are also found at Vinča, (probably with the intension of imitating shell) and include stone (*Vasić 1932.38, Pl. 15, Fig. 62; Antonović 1992.17–18, Pl. 8.5; 2003.68, Fig. 46.5*), bone and pottery (*Srejović and Jovanović 1959*). Stone bracelets are made mostly of white stone, resembling the milk-white color of the inner side of *Spondylus* shells. The most important in this respect is a marble item (*Vasić 1932.38, Pl. 15, Fig. 62; Antonović 1992.17–18, Pl. 8.5; 2003.68, Fig. 46.5*) very similar to the *Spondylus* garment shown in Fig. 7.1. The traces of red color on its surface were possibly left to imitate the *Spondylus* shell color.



Fig. 8. Fragments of bracelets with perforations. 1. Spondylus bracelet fragment, a remnant of the umbilical depression is visible on the inner side, an arrow points to an opening; 2. Glycymeris bracelet fragment, an arrow points to an opening; 3. Glycymeris bracelet fragment, opening observable at the breakage; 5, 6, 10. Glycymeris bracelet fragments, arrows point to openings positioned within the umbonal cavity; 7. Spondylus bracelet fragment, opening observable at the top of the fragment (7a); 8. Spondylus bracelet fragment, opening observable at the top of the fragment; 9. Glycymeris bracelet fragment, arrows point to two openings positioned within the umbonal cavity and at the line of breakage, and two lower, unfinished perforations; 11, 15. Spondylus bracelet fragments, ventral portion of the valve; 12. Spondylus bracelet fragment, two symmetrical perforations are observable; 13. Spondylus bracelet fragment, two openings are observable at the opposite ends of the fragment, axes of the openings perpendicular to each other; 14. bracelet fragment with one broken perforation and one unfinished perforation on one end, and pointed opposite end; 16. Spondylus bracelet fragments, remnant of the umbilical depression and opening observable.

A bone bracelet (Fig. 9.2) may be regarded as a replica of a shell bracelet, since its shape imitates the shape of a *Glycymeris* bracelet shell, where a bracelet band changes its position in relation to the arm from perpendicular to parallel. It is made from the bone of a large mammal and is highly polished. In this same way, another bone item (Fig. 9.1) is very similar to shell annulets modified a second time into pendants.

A single fragment of a clay bracelet was found at a depth of 9.2 m (Fig. 9.3). Bracelets of other materials, but similar to shell bracelets, are found at other sites of the Vinča culture: at Anza (*Gimbutas 1976*), Divostin (*McPherron 1988.329–330*), Botoš (*Chapman 1981.456–457, Tab. 19–20*), Selevac (*Tringham and Krstić 1990*) and many other sites (see *Chapman 1981*).

Spondylus and *Glycymeris* exchange routes

European finds of *Spondylus* shell are traditionally considered to have originated from the Mediterranean Sea (*Childe 1927; 1957; Theocharis 1973; Willms 1985; Séfériadès 1995; 1995b; 2000; Müller 1997.8; Kalicz and Szénászky 2001.46; Dimitrijević and Tripković 2003*). Shells, as well as occasional finds of ornaments, have been found in the coastal areas of the Aegean and Adriatic Seas as early as the end of the 7th millennium BC (*Müller, Herrera and Knossalla 1996.84–85; Müller 1997*). In addition, strontium isotope analyses of samples of *Spondylus* shells from several sites (*Renfrew and Shackleton 1979; Shackleton and*



Fig. 9. Bone and clay ornaments: 1. bone pendant perforated at one end; 2. bone bracelet, 3. clay bracelet.

Elderfield 1990) point to the Mediterranean origin of these shells, and are usually taken to confirm their Aegean biotope.[13]

However, the highest concentration of *Spondylus* finds is found along the Black Sea coastal zone and upstream of the Danube River in central Europe. This fact, presented for the first time more than 50 years ago (*Clark 1952; Vencl 1959*), even today suggests to some archaeologists the possibility that these shells originate from the Black Sea (*Chapman 1981; Todorova 2000; 2002*). This explanation is not unfounded, since the strontium isotope analyses previously undertaken can indicate only that the *Spondylus* shell cannot be found in the Black Sea today (*Renfrew and Shackleton 1979; Shackleton and Elderfield 1990*), while the possibility remains that *Spondylus* existed here during the Neolithic and Eneolithic periods. In the course of the 6th and 5th millennia, the temperature of the Black Sea was higher than it is today (*Todorova 1995.56; 2002; 2000. 416–417*), and new strontium isotope analyses of an enlarged sample of finds suggest the existence of at least two biotopes of the *Spondylus* and *Glycymeris* shells (*Todorova 2002.184–185, Abb. 209*). One of these biotopes is most definitely in the Mediterranean Sea. But, where is the other biotope?

The collection of marine shells from Vinča shows that, apart from bracelets, pendants and beads made of *Spondylus*, large quantities of bracelets made of *Glycymeris* shells were also imported into the central and northern Balkans. Are the objects of *Glycymeris* and *Spondylus* shells at the type-site of the Vinča culture of the same origin? It seems that these genera were used in different periods, and it is possible that they were not part of the same exchange network. The role of *Glycymeris* shells in European prehistory is not well known, and these finds are not easily distinguished from those made of *Spondylus*. At the same time, the pattern of their distribution corresponds to *Spondylus*: unworked shells and artifacts can be found in the coastal stretch of the Adriatic and the Aegean Seas, while only artifacts are found in the Black Sea zone. By analyzing finds made of both species, as well as by analyzing other exotic goods, we should be in a position to determine their origin with more certainty.

Where is the place of origin of many artifacts made of marine species of shells that one finds at Vinča and other sites of the central and northern Balkans? And is there a noticeable difference in the frequency of *Spondylus* and *Glycymeris* finds? At most of the sites in the middle-Danube region, mostly only *Spondylus* finds have been found (*Chapman 1981; Willms 1985; Dimitrijević and Tripković 2003*). On the other hand, on the basis of the collection of finds from Vinča, *Glycymeris* jewelry is plentiful, clearly outnumbering single specimens such as those detected at the Neolithic sites of Gura Baiucului, Botoš and Potporanj. Detailed future analyses of existing collections from other sites will surely reveal the presence of *Glycymeris* at many Neolithic sites, which is at the moment hinted by specimens from Anza (*Gimbutas 1976.251, Fig. 215.6*) and possibly Battonya – Parázstanya (*Kalicz and Szénászky 2001.32, Abb. 4.1, Abb. 8.1, Abb. 9.1*).

In sum, apart from *Spondylus*, jewelry (primarily bracelets) made of *Glycymeris* shells were exported in large quantities into Europe. However, at Vinča one might notice a diachronic change in the use of *Spondylus* and *Glycymeris*, which can certainly be expected at other Vinča culture sites in the future. It may come as a surprise that the settlers of Vinča imported bracelets made of *Glycymeris* at the end of the 6th millennium BC, which differs from the available evidence of the Aegean areas. For instance, in Sitagroi and other Aegean sites, mainly bracelets made of *Spondylus* were produced at the end of the 6th and through the end of the 5th millennium BC (*Nikolaidou 2003; Müller 1997*). Hence, in the light of these facts one can question the exclusively Aegean origin of the Vinča finds. What is the solution to this contradiction?

13 One of those samples originates from the site of Vinča.

A distribution map of goods that are of marine origin in the central and northern Balkans reveals that *Spondylus* finds are completely absent in the area of the Vinča culture's southern distribution (Fig. 10). The settlement of Anza in Ovče Polje (FYR of Macedonia), which is connected with northern Greece through the Vardar valley, is currently the northernmost site of the Vinča culture where large quantities of marine shells were found (*Gimbutas 1976*). In contrast, very extensive excavations in Valač (*Tasić 1960*), Žitkovac (*Tasić 1958*), Predionica (*Glišić 1964*), Fafos I and II (*Jovanović 1961*), Gradac (*Stalio 1972*), Crnokalačka Bara (*Tasić and Tomić 1969*) and many other sites did not uncover any marine shells (see Fig. 10).[14] Other types of exotic goods, such as obsidian, which are frequently found at Vinča culture sites in the Danube region, are absent also from the collection of the aforementioned sites (*Tripković 2004; Glišić 1968*). These facts should not lead to a premature conclusion about the complete seclusion of the southern Vinča culture sites from the exchange networks of the time; it is possible that future research in these areas may alter this pattern. However, it is certain that most of the artifacts that are of marine origin found at Vinča and other sites in the Danube region were not distributed through this southern route. Not only in the Neolithic, but also in later periods, the areas of southern Serbia and Macedonia, apart from technology and pottery decoration, do not show evidence that there was close communication with the area of the Danube region. Despite previous suggestions about contacts through the Morava-Vardar valleys (*Benac, Garašanin and Srejović 1979.22; Garašanin 1998*), the absence of exotic goods, including obsidian, shows that some barriers may have existed for the diffusion of exotic goods along this route.

An alternative possibility that could explain how this type of supply reached the communities of the Vinča culture in the Danube region might be contact with communities on the eastern Adriatic coast. This contact can be traced back to the Early Neolithic, i.e. the Starčevo-Impresso culture (*Benac 1973; Perić 1996*). Neolithic inhabitants of the Adriatic coast who possibly used prestigious jewelry made of these shells were very likely involved in exporting and distributing these objects into the middle-Danube region. One of these communities was revealed at the site of Obre II in central Bosnia, a settlement of the Butmir culture. Numerous *Spondylus* objects were found there, from unworked shells to final products (*Benac 1971*). Undeniable archaeological evidence exists which proves that communities from this area had contact with communities of the Vinča culture in the central Balkans and southern Pannonian Basin, as well as with Sopot-Lengyel culture communities between the Sava and the Drava Rivers (*Perić 1995; Marijanović 1980.29; Dimitrijević 1979.301–303; Benac 1979.452*). Reinforcing this point, one may notice that in the course of the 6th and 5th millennia BC, the northern Balkans, including a large part of the Pannonian Plain, was an area of intensive communication, if judged on the basis of the distribution of exotic goods. Here, the exchange of exotic goods characterizes all of the aforementioned cultures (*Tripković 2004*).

However, these observations certainly do not solve the problem regarding the origin of *Spondylus* and *Glycymeris* finds in the Vinča culture. They point to the differences between southern and northern areas of the Vinča culture, and undermine the hypothesis that these finds came exclusively from the Aegean region. It is already a certainty that the import of these goods was in a large part made possible through contacts with Butmir communities in the western regions of the Balkans, directly or through intermediaries (*Dimitrijević and Tripković 2003*). However, this can only be a partial solution to the problem. While the existence of two different culture zones with specific types of *Spondylus* artifacts is positively documented (*Müller 1997*), there remains the possibility that the old hypothesis, that the origin of at least some of the *Spondylus* (and *Glycymeris*) finds was the Black Sea, may be confirmed in the future.

Conclusion

The marine shell collection at Vinča is the largest in the region of the central and northern Balkans. Although fossil shells are locally available, it was concluded that the majority of ornaments were made using recent shells obtained through trade with contemporaneous Neolithic communities. Two bivalve genera, *Spondylus* and *Glycymeris*, were identified, revealing an approximate proportion of 60:40. These are easily recognizable when complete valves are compared, but difficult to distinguish in highly mo-

14 At some sites in Velika Morava Valley, Divostin (No. 24 on the map – *McPheron 1988.330, Fig. 11.5*) and Drenovac (not mapped – *Chapman 1981.380, Fig. 143.18*) several shell items were recorded, but neither species nor fossil/recent origin were specified (see *Dimitrijević and Tripković 2003.58*).

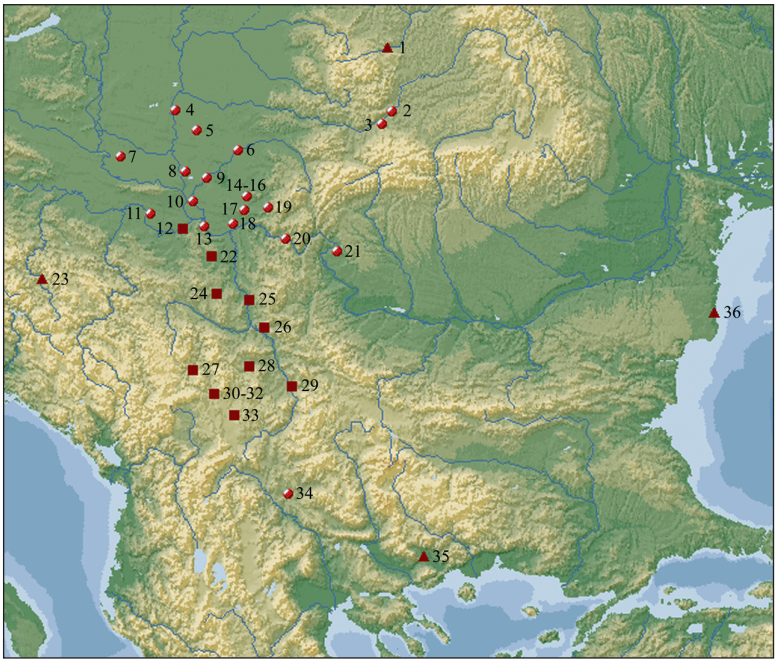


Fig. 10. Distribution of Spondylus/Glycymeris artifacts in the Central and North Balkans: ● – Vinča culture sites, Spondylus/Glycymeris reported; ■ – Vinča culture sites, Spondylus/Glycymeris not reported; ▲ – Non Vinča sites mentioned in the text. 1 – Gura Baciului; 2 – Alba Iulia; 3 – Tartaria; 4 – Novi Kneževac; 5 – Kikinda; 6 – Parta; 7 – Mostonga; 8 – Aradac; 9 – Botoš; 10 – Opovo; 11 – Gomolava; 12 – Jakovo; 13 – Vinča; 14 – Vršac, Kozluk; 15 – Vršac, At; 16 – Vršac, Potporanjske granice; 17 – Potporanj; 18 – Gaj, Čolak; 19 – Racasdia; 20 – Liubcova; 21 – Ostrovul Corbului; 22 – Selevac; 23 – Obre II; 24 – Divostin; 25 – Supska; 26 – Crnokalačka Bara; 27 – Naprelje; 28 – Pločnik; 29 – Gradac, Zlokućani; 30 – Žitkovac; 31 – Valač; 32 – Fafos; 33 – Predionica; 34 – Anzabegovo; 35 – Sitagroi; 36 – Durankulak.

dified items where shell morphology cannot be determined. This fact may be one of the reasons marine shell artifacts were identified as a priori *Spondylus* at many European sites and therefore their exchange pattern oversimplified. We presented distinguishing parameters for shell identification, particularly to differentiate ornaments manufactured from the *Spondylus* and *Glycymeris* genera, as well as those made of recent and fossil shells.

The distribution of *Spondylus* and *Glycymeris* items at Vinča is diachronic: *Glycymeris* items are more frequent in the earlier phases, while *Spondylus* items are more numerous in the later settlement phases. The variance in the types of ornaments is limited: bracelets, beads, pendants and garments were made from *Spondylus*, while from *Glycymeris* shell, only bracelets have been found. There are no indications of manufacturing within the settlement. Consequently, marine shell ornaments were probably brought to the settlement as final products. However, secondary modification of fragmented ornaments is evidenced by perforations made on many bracelet fragments. This secondary treatment of the broken ornaments illustrates the value of the raw material from which they were made.

The direction from which items made of *Spondylus* and *Glycymeris* were brought to Vinča and other sites in the middle Danube is not very clear. There are three possible source areas: the Aegean, the Adriatic and the Black Sea. Production, intensive usage and exchange is proven by rich ornament assemblages at many sites within the Aegean region. In addition, this is the only region where shell ornament workshops have been identified. However, exchange routes are not well outlined. In the southern part of the distribution area of the Vinča culture, in the Velika and Južna Morava valleys, and in Kosovo, where many sites have been explored, *Spondylus* and *Glycymeris* items were not found. Also, diachronic distribution of the two genera evidenced at Vinča does not seem to appear at Aegean sites. Another possible Mediterranean source area is the Adriatic. Exchange with the Adriatic region is highly probable, according to well established connections recognized in general features of the material cultures between Neolithic communities in that region and the central Balkans. However, few of the sites with marine goods that have been recorded preclude any further evaluation of the development of the exchange network from this direction. Finally, considering the possibility of the Black Sea origin, the important facts are intensive usage of marine goods in this region and well-outlined exchange routes. A large number of sites with recorded marine goods are clustered along the Danube, from the Black Sea coast to Vinča, and further north and west. Workshops, however, have not been evidenced in this region. Further, the question remains whether *Spondylus* and *Glycymeris* inhabited the Black Sea in the Neolithic at all. Was this sea too cold for their survival?

It is possible, and even probable, that there was more than one source area for acquiring marine

shells in specific periods of time, and that exchange routes changed through time. It is also quite possible that the manufacture and exchange of products made of these two mollusk genera, *Spondylus* and *Glycymeris*, as well as other marine goods, were not simultaneous. Only the accumulation of data from many European prehistoric sites with marine goods will enable the prehistoric exchange network with its roads of communication and trade to become visible.

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Complex settlement and the landscape dynamic of the Iščica floodplain (Ljubljana Marshes, Slovenia)

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ABSTRACT – *This paper addresses the complex interactions between settlement patterns and landscape dynamics in the Iščica floodplain (the Ljubljana Marshes, Slovenia) during the early and middle Holocene. This complex interaction can be observed on many nested spatial and temporal levels. The paper examines landscape and settlement dynamics on the micro-regional scale by exploring settlement patterns and LiDAR (Light Detection and Ranging) imagery, and on the settlement scale by analysis and radiocarbon dating of stratigraphic sequences from the Maharski prekop site.*

IZVLEČEK – *Prisevek se ukvarja z prepoznavanjem kompleksnih interakcij med poselitvcenim vzorcem in dinamiko krajine v poplavni ravnici Iščice (Ljubljansko barje) v zgodnjem in srednjem Holocenu. Kompleksne interakcije je moč opazovati v različnih prostorskih in časovnih merilih. V prispevku analiziramo poselitveno dinamiko na nivoju mikroregije skozi analize in korelacije poselitvenega vzorca in analize LiDAR posnetkov površja in na nivoju najdišča skozi analize in radikarbonsko datiranje stratigrafske sekvence na najdišču Maharski prekop.*

KEY WORDS – *Ljubljana Marshes; Neolithic and Eneolithic; landscape and settlement dynamics; digital surface model*

Introduction

There have been two main episodes in the archaeological research of the Ljubljana Marshes. In the second half of the 19th century the 'pile dwellings' discovery was followed by extensive, but unsystematic documented excavations by Carl Deschmann in 1875. The interpretative scenario that served the institutional promotion of national prehistoric archaeology was based on fashionable 'Kulturkriese' determinism and was visualised as a romantic landscape of pile dwellings situated on the lake margins and overshadowed by alpine peaks.

A hundred years later, intensive interdisciplinary fieldwork and excavations were undertaken in the Iščica floodplain (*Bregant 1974a; 1974b; 1975*). The excavations were focused on the Maharski prekop and Parte sites. While the results showed a complex settlement organisation and stratigraphic sequence, intensive landscape dynamics, a couple of early and middle Holocene palaeosoil formations (*Stritar 1975. 143; Stritar and Lobnik 1985.67–70*), a millennium-long ^{14}C continuity of settlement, and evidence of agricultural activities in situ (cereal pollen) (*Šercelj 1975.121 and Tab. 2*), interpretative postulates maintained the lake and the pile dwellings as archetypes determining Neolithic and Neolithic landscape and settlement patterns.

The interpretative focus shifted recently to pottery assemblages. Herman Parzinger and Anton Velušček suggest recognizing in the patterns of pottery decoration and morphological attributes a typo-chrono-

logy of settlement structures, a sequencing of 'cultural' phases and the duration of settlement (*Parzinger 1984; 1993; Velušček 2001; 2006*). Dendrochronological research in the region resulted in several floating chronologies (*Čufar et al. 1997; 1998; Velušček and Čufar 2001; Velušček et al. 2000*); however, the results had little impact on archaeological interpretations.

The interpretation of the archaeological palimpsest at the Ljubljana Marshes was based on the study of fragments of data without reference to the wider context. We believe that this reductionist approach failed to acknowledge the complex landscape and settlement dynamic of the Marshes. Instead of the study of isolated fragments of data, we advocate a more holistic, landscape based approach, where fragments of the archaeological record can only be understood in relation to each other and to the landscape itself.

Bringing the pieces together: settlement organisation and the dynamics of the Iščica floodplain

The Iščica floodplain is one of the most intensively, however unsystematically, researched parts of the Ljubljana Marshes. Over 130 years of archaeological research has contributed a great amount of archaeological and environmental data which offer only a fragmentary image of settlement patterns (Fig. 2). We suggest that in order to approach the settlement dynamics of the Iščica floodplain, this vast corpus of available data should be put in context.

Almost 10 000 vertical piles have been documented in the Iščica floodplain. This number is the result of large-scale digging activities and a number of test-pits. In 1870 Carl Deschmann (Dragotin Dežman) excavated several large areas of approximately 12 000m^2. Unfortunately, he provided scant field work documentation.[1] There are, however, his manuscripts: reports and daily notes of digging and descriptions of finds available in the Slovenian National Museums. After Deschmann's digs only a few large-scale excavations were completed. Josip Korošec opened a subsurface window of 160m^2 at the Resnikov prekop in 1962 (*Bregant 1964a; Korošec 1964*).[2] Tatjana Bregant excavated at Maharski prekop, where she opened up an area of 1220m^2 in the 1970s (*Bregant 1974a; 1974b; 1975*), and at Parte, where 640m^2 were excavated in the late 1970s and early 1980s (*Harej 1978; 1981; 1987*). She introduced sophisticated excavation procedures and interdisciplinary approaches, and provided a detailed site archive (see below).

The most common type of field work in the microregion was the digging of test trenches and pits in order to test for the presence of pile dwellings. Staško Jesse opened a number of trenches in the vicinity of Maharski and Resnikov prekop (*Jesse 1954*). Tatjana Bregant, introduced a large-scale systematic test-pit project between Parte and Kepje, and smaller ones around Resnikov (*Bregant 1964b*) and Maharski prekop (*Bregant 1975*). Parallel to archaeological fieldwork systematic coring programmes were conducted by palynologists (*Šercelj 1975; 1981; Culiberg and Šercelj 1978*) and soil scientists (*Stritar 1975; Stritar and Lobnik 1985*).

The radiocarbon and the dendrochronological data indicate that the south-eastern part of the Marshes was already settled in the tenth millennium BP. The earliest series from Breg and Babna Gorica (10 200 cal BP to 7500 cal BP) are followed by data from Maharski prekop (7500 cal BP) and Resnikov prekop (6700 cal BP) and series of dates from Maharski prekop and Parte (5800 cal BP to 4200 cal BP onwards) (see Tab. 1).

The chronological gap s between 7500 and 6500 and between 6500 and 5800 cal BP may be a consequence of the current state of research. Most of the radiocarbon dates were sampled in the 1970s and 1980s and dated by conventional radiometric methods. They were published either incompletely (missing lab codes) or even misleadingly, since conventional radiocarbon ages were not reported. This confusion is evident in the use of mutually exclusive dates for the same sample (*Dimitrijević 1979.179; Velušček 2006.Fig. 14*). We have compiled all the available conventional radiocarbon dates in Table 1.

Over a hundred years of field activities in the microregion were concentrated in three distinctive clusters: around Resnikov prekop and Mostišče (the area around Maharski prekop), and between Kepje and Parte (Fig. 1).

The large number of discrete data-sets and the assumption that every test trench represents an isola-

1 The only remaining site plan is plan of excavations in 1875 (*Vuga 1989*).
2 In the vicinity of the Korošec's trench Anton Velušček (*2006*) excavated two test trenches of 12 and 9 m^2 in 2005.

Labcode	Conventional radiocarbon age (BP)	Material	Context	Reference
Breg pri Škofljici				
Z–1421	6630 ± 150	charcoal	Test trench 84/II, layer 3a	Srdoć et al. 1987.140
GrA–10015	9100 ± 50	charcoal	Test trench 96/II, layer 17	
GrA–10012	8790 ± 50	charcoal	Test trench 96/II, layer 11	
GrA–9860	8710 ± 50	charcoal	Test trench 96/II, layer 8	
GrA–10018	9180 ± 50	charcoal	Test trench 97, layer 11 (stone platform)	
Babna gorica				
GrA–9857	6200 ± 50	charcoal	Layer 17, (charcoal layer)	
Resnikov prekop				
Z–345	5718 ± 23	wood	Excavations 1962, pile 33	Srdoć et al. 1987.354
Hd–24038	5850 ± 150	wood	Excavations 2005, pile 5	Čufar and Korenčič 2006.124
Maharski prekop				
Z–278	4633 ± 117	wood (*Quercus*?)	Excavations 1972, grid square 12?, pile 40	Srdoć et al. 1975.152
Z–305	4345 ± 113	wood (*Fraxinus*)	Excavations 1973, grid square 15, pile 1	Srdoć et al. 1975.152
Z–314	4964 ± 99	wood		Srdoć et al. 1975.152
Z–315	4701 ± 104	wood (*Sorbus*)	Excavations 1972, grid square 15, pile 4	Srdoć et al. 1975.152
Z–351	5080 ± 110	wood (*Sorbus*)	Excavation s1974, grid square 42, pile 156	Srdoć et al. 1977.465–475
Z–353	4330 ± 120	wood	Excavations 1974, test trench 4	Srdoć et al. 1977.465–475
AA–27182	4680 ± 55	Charcoal	MP1 sediment exposure, charchoal layer 61-63 cm	Gardner 1999.Tab. 5.1
Beta–219606	4740 ± 40	bone (*Ovis*)	Grid square 42	
Beta–219607	4720 ± 40	bone (*Ovis*)	Grid square 42	
Beta–219608	4710 ± 40	bone	Grid square 42	
Beta–219609	6570 ± 40	bone	Grid square 34	
Beta–219610	4750 ± 50	bone	Grid square 34	
Beta–219611	4740 ± 40	bone	Grid square 32	
Parte				
Z–539	3920 ± 100	wood	Excavations 1978, pile 16	Srdoć et al. 1977.133–134
Z–540	4010 ± 100	wood	Excavations 1978	Srdoć et al. 1977.133–134
Z–646	4160 ± 100	wood	Excavations 1979, pile 1	Srdoć et al. 1977.412–413
Z–647	4010 ± 100	wood	Excavations 1979, pile 2	Srdoć et al. 1977.412–413
Z–716	4200 ± 100	wood	Excavation 1979, pile 9	Srdoć et al. 1977.412–413
Z–982	4200 ± 110	wood	Excavations 1982, pile 325	Srdoć et al. 1977–450

Tab. 1. The conventional radiocarbon dates from Breg pri Škofljici, Babna gorica, Resnikov prekop, Maharski prekop and Parte.

ted pile dwelling have led many researchers into the reductionist illusion of many small, isolated sites populating the Neolithic and Eneolithic landscape.

However, if we assume that discrete sites which are spatially close and broadly contemporary are only visible fragments of single settlements, then only three larger settlement complexes can be identified in the micro-region: at Resnikov prekop, at Maharski prekop, and in the area between Parte and Kepje. Even this image is incomplete, because of unsystematic fieldwork (see above) and the taphonomy of the landscape (see below). We may hypothesise single, large and dispersed settlement rather than three complexes, with the settlement foci shifting across the landscape in relation to changes in the landscape (*Budja 1995; 1997; Mlekuž 1999; Budja and Mlekuž 2001*) and the internal social dynamics of the groups inhabiting the floodplain. We should not forget that the floodplain was not utilised for settlement

only, but also for agriculture. The landscape was therefore a shifting mosaic of hamlets, fields and pastures, structured by the pattern of the floodplain features.

Landscape dynamics

A peaceful paysage of pile-dwellings situated at the edge of the lake surrounded by mountains served as an interpretative model for interpreting Neolithic and Eneolithic settlement patterns and the palaeoenvironment on the Ljubljana marshes from the beginning of archaeological research there. Geomorphologists gave this image a definite structure in a model of simple and uniform hydroseral succession from lake to peat bog (*Melik 1946;* see also *Šercelj 1966*). Archaeologists, although faced with a more complex reality in the field, used this model of a stable landscape in archaeological interpretations, and have perpetuated the interpretative model formed in the mid-19th century. An interpretative vicious circle was formed when archaeological data was used to support environmental data and vice versa.

However, there are alternative scenarios which treat the Ljubljana Marshes as an inherently dynamic landscape (*Šifrer 1983*) and these serve as a point of departure for alternative interpretations of landscape change. As a consequence, a network of palaeochannels and their association with settlements was identified from aerial photographs, and processes that link palaeochannel migration with changes in the settlement pattern have been recognised (*Budja 1995; 1997; Mlekuž 1999; Budja and Mlekuž 2001*).

In order to further investigate the dynamics of the landscape, we conducted a LiDAR survey of the Iščica floodplain. An area 1300 x 600m around the Maharski prekop site was chosen for the LiDAR survey.

LiDAR (Light Detection and Ranging, or Laser Imaging Detection and Ranging, also known as ALSM, Airborne Laser Swath Mapping) is a technology that determines distances to an object or surface using laser pulses.[3] The results of LiDAR are very detailed, and precise digital surface models in which even the smallest changes in topography are discernible.

The LiDAR image of the area around Mahrski prekop shows a comprehensive image of the geomorphology of the project area, particularly highlighting palaeochannels and earlier river courses, which can be seen as linear depressions in the landscape. The palaeochannels are not contemporaneous. Some channels are cut by younger ones, thus establishing a stratigraphic sequence. There are also differences in the shape, width, orientation and relative depth of the palaeochannel depressions. Consequently, at least four distinctive phases of fluvial activity can be discerned based on the relative stratigraphic positions of palaeochannels, their shapes and orientations (Fig. 2).

The first phase is characterised by thin straight channels oriented almost perpendicularly to the modern network. Their visibility in the landscape, the fact that they were not destroyed or covered by later activity, their form and orientation, show that they were formed under specific hydrological conditions. Straight channels are often the result of low discharges, small and suspended loads, low slopes, low channel width/depth ratios, and little or no bank erosion (*Knighton 1998.65–70; Brown 1997.205–237*).

The second phase was mostly destroyed by the activity of the third phase, and is marked by relatively wide sinuous channels which run in the same directions as recent streams. It might represent an early stage of the formation of the recent hydrological network. Transitions from straight to sinuous and meandering channels on constant slopes imply increasing discharge and higher width/depth ratios of the channels (*Knighton 1998.65–70*).

The third phase can be attributed mainly to lateral channel movement and the bank erosion of the modern Iščica and Želimeljščica streams before regulation works. These features are the most visible and cover the largest area. The most distinctive feature of the third phase channels are the sinuous forms of the larger streams and the meandering patterns of minor streams, and distinctive channel levees.

The fourth phase is a modern network, the result of flood-control and irrigation works, and consists of straight channels.

The change from straight to sinuous and meandering channels shows that there were significant changes in the hydrological regime of the streams drai-

3 The airborne mounted LiDAR sends out a scanning laser beam from the aircraft, which is reflected back to the sensor by the Earth's surface and the features on it. The time this takes is used to calculate the exact distance from the aircraft. The surface height is derived from knowing the aircraft's exact location and attitude, which are obtained from differential GPS and inertial navigation system measurements (*Challis 2006*).

ning the Iščica floodplain. These can be attributed to increased discharge and, consequently, higher bank erosion and bed-load transport during the Holocene.

The palaeochannel sequence can be directly dated. The first phase palaeochannel was excavated on the Maharski prekop site and proved to be contemporary with the site. The dates of piles which are part of the structure associated with active channel (interpeted as 'revetment' by the excavator), fall between 5800 and 4800 cal BP. The third phase palaeochannel eroded most of the stratigraphic integrity of the Resnikov prekop site. Radiocarbon dates from the on-site palinological sequence date the channel infill deposits to around 2300 cal BP and therefore give a *terminus ante quem* for the active channel (*Andrič 2006*).

A large portion of the area was disturbed by the fluvial activity which formed the landscape into a mosaic of isolated terraces separated by palaeochannels. Most of archaeological remains are located on these 'islands', or more precisely, on natural exposures (i.e. river and palaeochannel banks (Fig. 2). This has an important consequence for site recovery. Thus, sites without permanent structures are more likely to be completely destroyed or archaeologically invisible (buried) than sites with permanent structures (i.e. piles) which are more likely to be recovered. Therefore in the settlement pattern, sites with vertical piles exclusively are represented, given the lack of any other type of site.

However, even piles are not immune to bank erosion. The location of 'pile clusters' in the convex segments of the channels (where bank erosion is strongest and most recent) and their absence in the concave segments (Figs. 1, 2) demonstrate that bank erosion is a strong taphonomic agent which could not only erode original stratigraphic contexts, but also destroy more permanent features such as vertical piles.

The Iščica floodplain was a complex landscape, greatly shaped by fluvial activity. We argue that the hydrological regime changed during the middle Holocene, and that the earliest phase of palaeochannels was contemporaneous with the settlement at Maharski prekop. Evidence of fluvial activity which predates those observed in the LiDAR images can be found near Babna gorica Hill, around 2km northeast. In the 1.5m deep section excavated on the edge of the floodplain several episodes of fluvial activity and flooding can be observed in stable isotope sequence (Fig. 3).

The carbon and nitrogen isotope record, as well as C/N ratios in section[4] shows some characteristic isotope transitions, indicating the presence of different types of organic material (Fig. 3). The upper part of the soil was fairly uniform, with average $\delta^{13}C$ and $\delta^{15}N$ values of $-28.9 \pm 0.2‰$, and $4.2 \pm 0.4‰$, respectively, while the C/N ratio ranged between 34.7 and 47.3, indicating the presence of vascular plants and corresponding to a terrestrial organogenic horizon (*Meyers & Teranes 2001; Jedrysek and Skrzypek 2005*). The presence of dry land and buried wood fragments was observed at a depth of 55cm, where a layer of charcoal was found, dated to 7200 cal BP. At this depth the low $\delta^{13}C$ value as well as a slightly higher C/N ratio, was determined. The layer between 61 and 66cm had an isotopic signature similar to the upper part of the soil, indicating the presence of a terrestrial organogenic horizon. Larger changes were observed at a depth of 66cm and lower. The isotopic composition of carbon changes to lower values, ranging between -29.3 and $-30.2‰$, indicating the possible presence of aquatic plants and a wet layer. However, the C/N ratios increased up to 114.6. The most plausible explanation for such a high C/N ratio is the presence of a coarse sediment fraction and the possible presence of river activity. Similar changes in the isotopic composition and C/N ratio and therefore the presence of river flow were observed at a depth of 55cm. The presence of river activity rather than a lake environment could be additionally supported if we compare the data with the sediment core taken at 'Na Mahu'. In this location lower $\delta^{13}C$ values were observed at different depths in parallel with low C/N ratios approximately 7, indicating the presence of *lacustrine algae* (*Andrič et al., submitted*).

The sequence demonstrates intensive and complex fluvial and flood activity before 6700 cal BP, with a

4 Organic carbon content (OC) and isotopic composition of organic carbon were determined after treatment with 1M HCl to remove carbonate material, while content of total nitrogen (TN) and isotopic composition of total nitrogen were determined without acidification. Weight percentages of OC and TN were analysed by a Carlo Erba elemental analyzer (model EA 1108). The precision of measurements was ±3%. The $\delta^{13}C$ and $\delta^{15}N$ of OC and TN fractions were determined using a Europa 20-20 continuous-flow stable isotope analyser with ANCA-SL preparation module. Isotopic ratios were expressed in δ-notation in parts per mil (‰). For carbon, the standard is the V-PDB carbonate, while for nitrogen the standard is atmospheric (air) nitrogen. The overall analytical precision was ±0.2‰ for $\delta^{13}C$ values and ±0.3‰ for $\delta^{15}N$ values.

sequence of 'wet' and 'dry' episodes. In this case, even the presence of 'lacustrine' calcareous silt, traditionally an indicator of a stable lake, can be interpreted as a result of erosion and deposition by fluvial activity.

Maharski prekop in context

Large scale excavations of the Maharski prekop site by Tatjana Bregant from 1970 to 1977 are the largest excavation of a settlement in Ljubljana Marshes so far. However, test trenches excavated in the vicinity of the site, pile clusters in the Iščica river and in the modern Maharski ditch, and cores and sediment exposures from the immediate environs of the site, suggest that settlement extended much further across the floodplain than has been excavated. In 1953 Staško Jesse excavated a test trench in the immediate vicinity of the site, as well as 4 trenches towards the east. In three of them he found piles, stone features and pottery (*Jesse 1954*). Tatjana Bregant excavated six test trenches in the area around Maharski prekop and found archaeological material in three of them, all of them located on "slightly elevated terrain" (*Bregant 1975.8–12*), or natural exposures on the edges of phase 3 channels (as can be seen on the LiDAR map (see the discussion of taphonomy above). Around 100 m to the SE, in the River Iščica, two pile clusters were documented (*Čufar et al. 1998*). They are known as Spodnje mostišče 1 and 2 in the archaeological literature. Bregant made a series of boreholes northwest of the site, where she found pottery fragments, charcoal and wood fragments (*Bregant 1975.9*). Layers of charcoal are visible in the sediment exposure in the modern ditch, where vertical piles can be found in the bottom of the ditch (*Gardner 1999.165–167*). All these subsurface windows therefore provide only a fragmentary picture of the settlement around the Maharski prekop (Fig. 4).

All these subsurface windows are broadly contemporaneous and overlap with the duration of the settlement area excavated by Bregant. The radiocarbon and dendrochronological dates of Maharski prekop, Spodnje Mostišče 1 and 2, and test trench 4 are evidence of settlement in the area between 5800 and 4300 cal BP.

In addition, available environmental data attest to land use and a human presence in the area. As demonstrated by Adam Gardner (*1999*), the floodplain around the Maharski prekop site was forested through the early occupation period, but the forest was progressively thinned towards the end of the settlement. In the MP1 palinological sequence (sediment exposure in the bank of the drainage ditch around 50m from the excavated area) cereals are present at least from 6000 cal BP. Around 5500 cal BP a massive increase in charcoal deposition (visible as a thick charcoal layer) records firing events related to human activity in the vicinity of the exposure. This event also marks a sharp decline in arboreal pollen and an expansion of herbaceous taxa, including cereals. Around 5500 cal BP, the area in the vicinity of the Maharski prekop was cleared and used for agricultural activities. The presence of cereal pollen (see also *Šercelj 1975.121*) clearly demonstrates the presence of fields in the vicinity of the site.

LiDAR imaging reveals a network of palaeochannels covering the area around Maharski prekop. One of the palaeochannels (dated to phase one, see above) was excavated on the Maharski prekop site, proving that it was contemporaneous with the site. Moreover, we have evidence of a human response to the bank erosion in the form of a series of piles at the edge of the channel, intepreted as a revetment that protected the site from bank erosion. LiDAR imaging reveals that there are even more palaeochannels in the vicinity of the site. However, taphonomy processes related to the bank erosion of the third phase palaeochannels destroyed most of the area south of the site and the southern part of the site itself.

These palaeochannels, presumably contemporary with the settlement, reveal a microtopography suitable for settlement, which although prone to seasonal flooding, offered an attractive resource for floodplain agriculture. Therefore, we can imagine Maharski prekop as a dispersed settlement with several settlement foci located on the channel levees and surrounded by fields. Some foci were settled for a very short time – less than 100 years in the case of Spodnje mostišče (*Čufar et al. 1998.85–86*) – but some (Maharski prekop) were occupied continuously for almost a millennium, or even two millennia, as recent radiocarbon data demonstrate (Tab. 1).

The spatial organisation of the site

Only large scale excavations offer an opportunity for better understanding the spatial structure of the sites. Thanks to the large area excavated by Tatjana Bregant, it is possible to assess the organisation of space within the Maharski prekop settlement. Bregant interprets it as a single phase 'pile-dwelling', with several raised platforms where small houses

were located (*Bregant 1975.17–30*). Human activity was performed exclusively on the platforms, which had clay floors and stone features.

The archaeological record is, in her opinion, the result of destruction, disintegration, or the burning of platforms and the consequent inclusion of clay floors and stone features in the cultural layer. She hypothesised that the stratigraphic relations between clay house floors and stone features are the results of the different weights of features which sank to different depths after the collapse of the platform (*Bregant 1975.14–17*).

This interpretation is not realistic. First, the weight of the features built on the platforms would have been enormous and require extremely strong structures to support them. We calculated that the dolomite sandstone feature alone (see below), which she believes was originally deposited on the platform (*Bregant 1975.14*) would have weighed at least 18 000 kg. Ironically, it is located in an area with a low concentration of piles (there are only around 10 piles in the area covered by the feature). Second, no remains of platforms were found. Given the excellent preservation of organic material, one would assume that the remains of the platforms would be preserved (sealed in their original stratigraphic condition) under house floors and stone features, but this is not the case. Very few superstructural wooden elements were found, indicating that they were burnt or washed away, and there was nothing above them which would have sealed them in the sediment matrix. In the only case where horizontal piles were found in what was presumably their original position, they are located above the clay house floor and can be interpreted as part of a house superstructure.[5] Another very problematic point is the obvious stratigraphic superposition of clay floors (see below), which indicate that houses were periodically renewed.

Departing from contradictions and building upon Bregant's site documentation, we are able to offer an alternative interpretation of the site.

First, we have to consider the taphonomy of the site. This was obviously located at the active channel which runs to the east of the excavated area (see above, Figs. 1, 2, 4). A distinctive cut in the 'cultural layer' is visible in the sections, the result of the bank erosion of the stream. In the southern part of the excavated area, further destruction can be observed in the lower density of piles and lack of a 'cultural layer'. This erosion can be identified on the LiDAR map as a third phase channel (Fig. 2). However, the central, western and northern parts of the site were not damaged by channel erosion.

One of them most obvious features on the site are vertical wooden piles preserved by water-logging (Fig. 5). There were 2332 vertical piles recorded on the site, which means that average vertical pile density is almost two piles per square meter. However, piles are obviously not scattered across the site at random. A linear arrangement of piles can be observed over most of the undisturbed part of the excavated area. Piles are organised in parallel rows, three at a time; they are about 8–10m long and spaced 1.7–2.4m apart. Mean pile diameter is 5.8cm (standard deviation 3.8cm, N = 1743), although piles with diameters up to 26cm can be found. Larger diameter piles are often split (28% of all piles). Only three woods, oak (*Quercus*), ash (*Fraxinus*) and rowan (*Sorbus*) comprise more than of 90% of identified taxa (*Šercelj 1973; 1975*). Piles can be very long; some recovered piles were driven up to 3m into the silt (*Bregant 1974b.43*).

Other distinctive features (Fig. 5) are two or three dense linear concentrations of piles running along the channel on the eastern side of the excavated area. Piles in these structures are generally of much smaller diameters than those in the central part of the excavated area (mean 3.2cm, standard deviation 1.4 cm, N = 467), and split piles are almost non-existent (5%). The type of wood used for these is much more diverse than in the central part of the site (*Šercelj 1973; 1975*). Some piles from the easternmost row are not embedded in the 'cultural layer' and are inclined towards the channel, which obviously eroded the 'cultural layer'. The excavator interpreted these structures as a revetment (*Bregant 1975.17–20, Fig. 1*), which seems reasonable, considering the evidence of the palaeochannel (see above).

Common features on the site are concentrations of stones (*Bregant 1974a.12; 1974b.41; 1975.14–15*) (Fig. 6). Stones form distinctive clusters or features that are commonly found at the peripheral ends of pile rows; stones are sometimes distributed along lateral rows of piles and are often associated with charcoal. Querns are often components of these features.

5 A similar situation can be found at Parte (*Harej 1981.Priloga 1*).

Another notable feature are clay surfaces, often burned (*Bregant 1974b.12; 1975.14–15*) (Fig. 6). They can be up to 20cm thick, and cover large areas between rows of piles. Charcoal, wood debris, parts of superstructure, pottery and bones often rest directly upon those surfaces. The direct stratigraphic superposition of stone features and querns on the clay floors can be observed in some cases, indicating that they were used and deposited on the surfaces of clay floors. Therefore, clay floors can be interpreted as occupational surfaces both inside and outside houses, trampled and preserved by fire.

Charcoal lenses are often embedded in the "cultural layer", sometimes in stratigraphic relation to the clay occupational surfaces. Their presence indicates burning events.

If all this data is integrated into a wider picture, it is difficult to interpret it as the remains of pile-dwelling. We believe that the archaeological record reveals the remains of a group of houses with sizes of around 8–10 x 3.5–4.5m arranged parallel to each other.[6] Each house is made of three rows of structural timbers, with a central row of centre-posts supporting a roof ridge pole; the lateral rows are wall posts. The floors were plastered with clay, and the stone features are probably the remains of thermal structures in the front/back of the house, or possibly paved surfaces. Houses were oriented with the longer side parallel to the channel. However, there is at least one house which is oriented perpendicularly to the others (Fig. 7).

We have already pointed out that Maharski prekop has been interpreted as single phase, short occupation site (*Bregant 1974a; 1974b; 1975; Velušček 2001.77*). No attempt was made to associate piles with the stratigraphic contexts. However, we suggest that piles can be – at least tentatively – phased and related to the features. The layers of charcoal associated with house floors indicate that most of the houses were destroyed by fire. When fire razed the superstructures, only parts of the posts below the occupational surface survived. Thus the heights of the piles indicate the levels of occupational floors at the time when the houses were destroyed. Since the original surface of the settlement is irregular, we can not directly compare the heights of the remaining piles, but we can relate them to the surface of the cultural layer, interpolated from the published sections. On this basis we can establish a provisional phasing of the piles. Piles under the surface of the cultural layer are therefore older than piles extending above the cultural layer. Thus two phases of the settlement, older and younger, can be identified.[7] We can see that piles from both phases are not distributed randomly (Fig. 8); instead, piles from the same phase tend to be clustered in groups that we have identified as houses (see above, Fig. 7). As a consequence, these support our interpretation of pile-rows as the remains of houses, and enable us to phase the houses themselves (Fig. 8).

Phasing of the occupation of the settlement can be refined through analysis of the stratigraphic sequence (Figs. 9, 10, 11, 12).

The excavator identified a very simple stratigraphic sequence, which starts with calcareous lacustrine silt, a 'pre-settlement' gyttja (organic detritus mud) layer, a cultural layer which in composition is very similar to the pre-settlement layer, a layer of gyttja and a layer of yellowish clay, followed by a 'sub-humus' and 'humus' topsoil layer (*Bregant 1974a.8–10; 1974b. 39–42; 1975.12–17*). This sequence directly reflects Melik's view of a gradual transformation from lake to swamp and peat-bog (*Melik 1946*), placing settlement in a period of the progressive drying up of the lake and the formation of the swamp (*Bregant 1974b.13, 22; 1975.12–17, 48*). However, as we have seen in the case of Babna gorica (see above), the situation is not that simple.

The same can be said of the 'cultural layer'. The excavator identified a single 'cultural layer', which she believes indicates only one phase of occupation. However, the 'cultural layer' is not uniform. Instead, she documented several changes in composition (sometimes even referred to as layers) and a number of features which are part of the 'cultural layer'. Stratigraphic relations between these features can be recognised, and the stratigraphic sequence established.

In the northwest part of the settlement several phases of occupation can be detected (Fig 10). The earliest phase is evidenced by the occupation debris directly on the pre-settlement surface and is covered

6 This interpretation is supported by the dendrochronological analysis of building phases on the Parte-Iščica pile cluster, where several phases of houses (albeit of smaller dimensions) were detected (*Velušček et al. 2000.88-96*).

7 Interestingly, Deschmann in two of his notes describes the overlapping clusters of vertical piles and the sequence of layers and 'cultural' deposits of 2,7m thickness in between (*Smole 1983.149, 155*).

by an 'intense black' layer.[8] Upon this feature lie patches of fine sand and fragments of burnt clay floor, indicating a flood event which eroded the occupation surface. The 'cultural layer' above indicates stable occupation. However, on top of the cultural layer were new clay floors associated with thin layers of charcoal. Thus we have evidence of several phases of occupation interrupted by fires and floods.

A similar stratigraphic complexity can be observed in the central part of the settlement, where two distinctive strata separated by a thin lens of charcoal can be observed (Fig. 11). A cut was dug in the 'cultural layer' and filled with dolomite sandstone 'plates' mixed with charcoal. This feature covers a large area and can be traced on several sections. Its volume is estimated at approximately 15m^3. The material was obviously brought from elsewhere, probably from Grmez Hill on the edge of the Marshes. A clay floor was built directly on the surface of this feature (*Bregant 1975.14–15*).

The presence of clay floors has already been noted above. However, the relative heights of the clay floors within the cultural layer indicate that they were not contemporaneous. In some cases, direct stratigraphic superposition of house floors can be observed. Thus, in the southern part of the excavated area, we have evidence of the superposition of two clay floors separated by a thin layer of occupational debris (Fig. 12). This may indicate the periodic rebuilding of surfaces. The final phase of occupation can be detected in the series of clay floors built on top of the cultural layer which were covered with wood debris and charcoal, indicating that the site was abandoned after fire.

An important observation is that clay floors do not appear throughout the 'cultural layer'. Instead, they can be traced only in the upper parts of the 'cultural layer'. No clay floors were found directly on the pre-settlement surface, where other features can be found (see above, Figs. 10, 11). This indicates that houses represent only later phases of the settlement and that earlier settlements may not have been associated with houses. We have shown that clay floors and piles can be associated as they are parts of the same structures (houses, see above). The radiocarbon data available (Tab. 1) are mostly for wooden piles and are therefore biased towards latter phases of the settlement. Most of the new radiocarbon dates for bones fall within this chronological framework. However, a radiocarbon datum for bone from grid square 34 obviously document earlier settlement of the area. The existence of earlier phase settlement was proposed on the basis of pottery scatters deposited on the pre-settlement surface (*Budja 1995.170; 1997.82*).

Conclusions

Earlier interpretations of the Ljubljana Marshes were based on the study of isolated fragments of data without reference to the wider context. This reductionist approach failed to acknowledge the complex dynamics of the Ljubljana Marshes landscape.

We have presented evidence to show that the Iščica floodplain was a complex landscape, greatly affected by fluvial activity. LiDAR images of the micro-region clearly demonstrate a pattern of stratified palaeochannels that structured the landscape. Evidence of similar fluvial activity which predates those observed in the LiDAR imaging can be found near on the edge of the floodplain, around 2km north-east, where the stratigraphic and stable isotope sequence document several episodes of fluvial activity and flooding.

Dynamics are also visible in the settlement pattern, where, instead of many small isolated sites, we can speak of a large dispersed settlement shifting according to changes in the landscape and the social processes of the group inhabiting it.

We have challenged the idea that 'pile dwellings' were short-term, single phase settlements. Instead, the analysis of Maharski prekop stratigraphic evidence and new radiocarbon data shows that it was a multi-phase settlement, with an early phase occupation without permanent wooden structures, and latter phases of settlement with group of houses located on dry ground beside the active stream.

ACKNOWLEDGEMENTS

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8 The scatters of Resnikov prekop pottery type were found in this stratigraphical position (directly on the pre-settlement surface) on the site (*Bregant 1974a.52; 1975.41; Velušček 2001.Sl. 29*).

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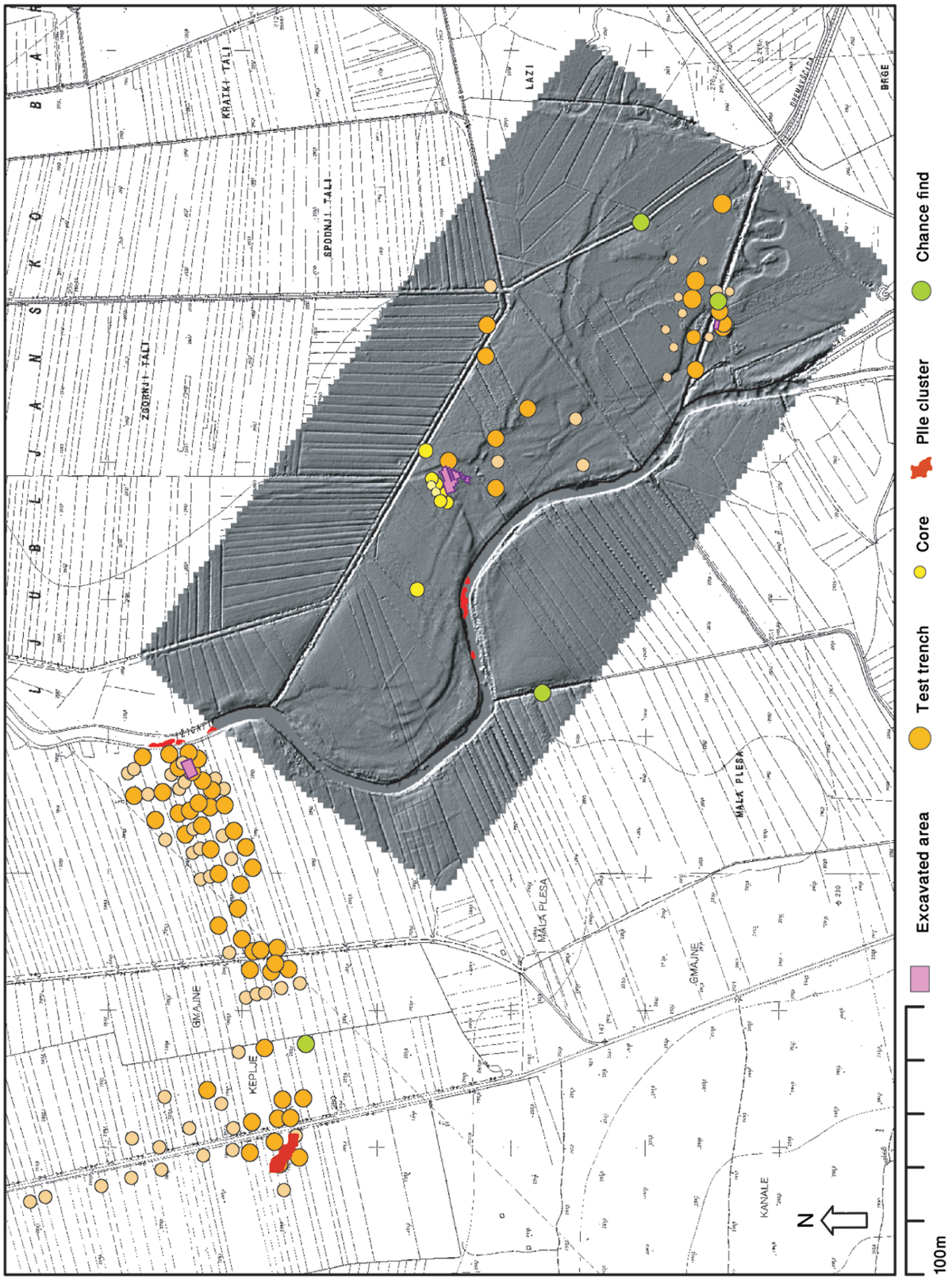


Fig. 1. Study area with map of archaeological excavations and test-trenches superimposed over LiDAR shaded map. Note the clustering of archaeological fieldwork around Resnikov kanal, at Mostišče and between Kepje and Parte.

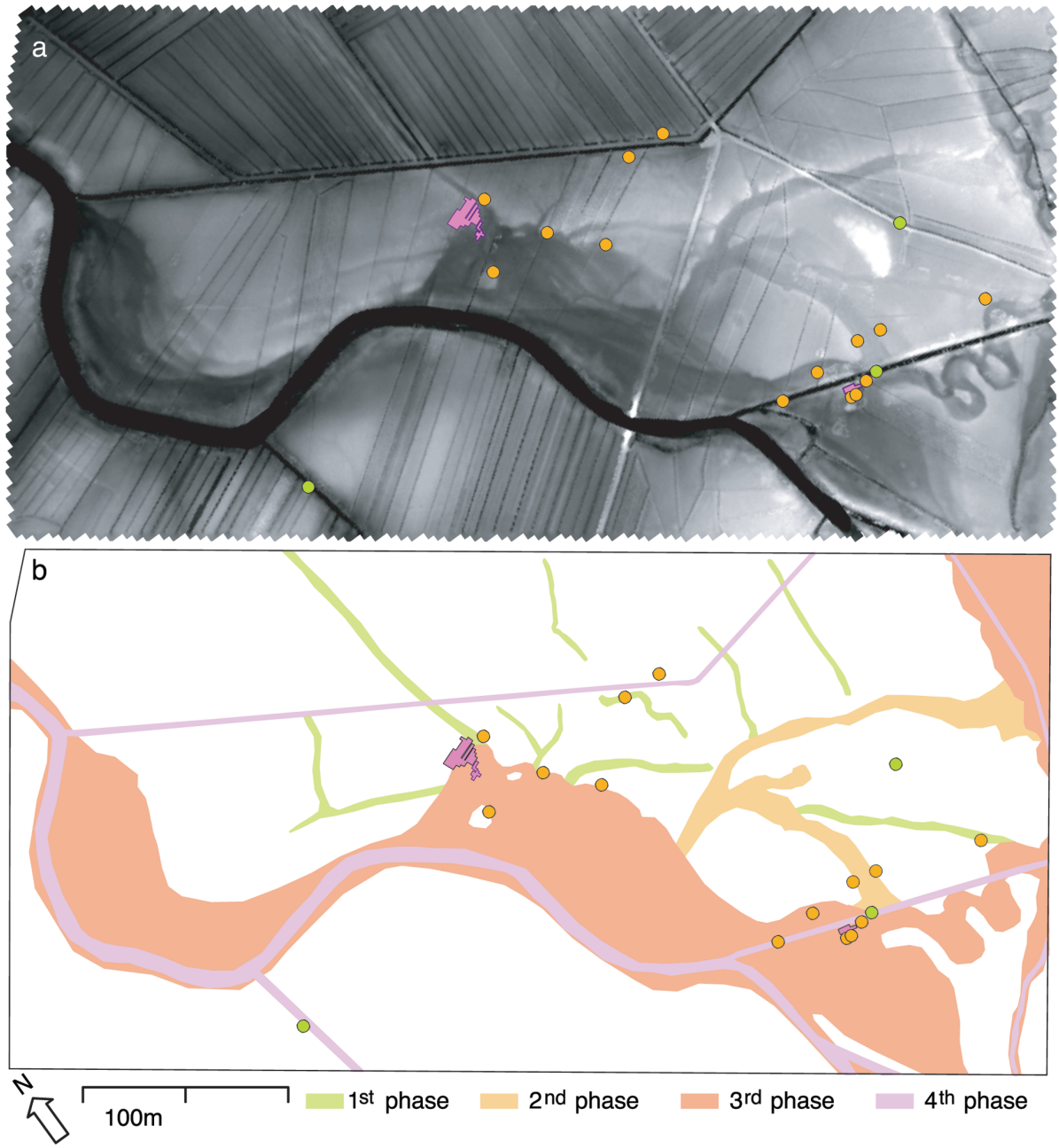


Fig. 2. LiDAR image (a) and its interpretation (b). At least three phases of superimposed palaochanels can be observed. The landscape is structured by an interlocking pattern of palaeochannels; most of the archaeological sites are located on the exposed edges of the undisturbed land.

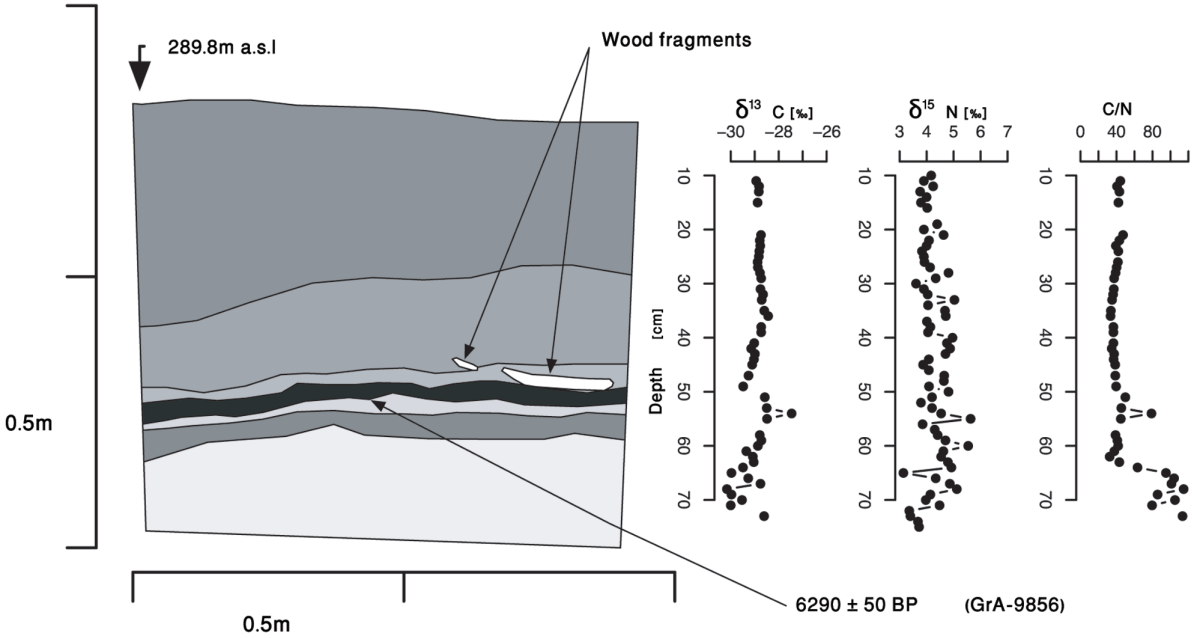


Fig. 3. Babna gorica test section with isotope date.

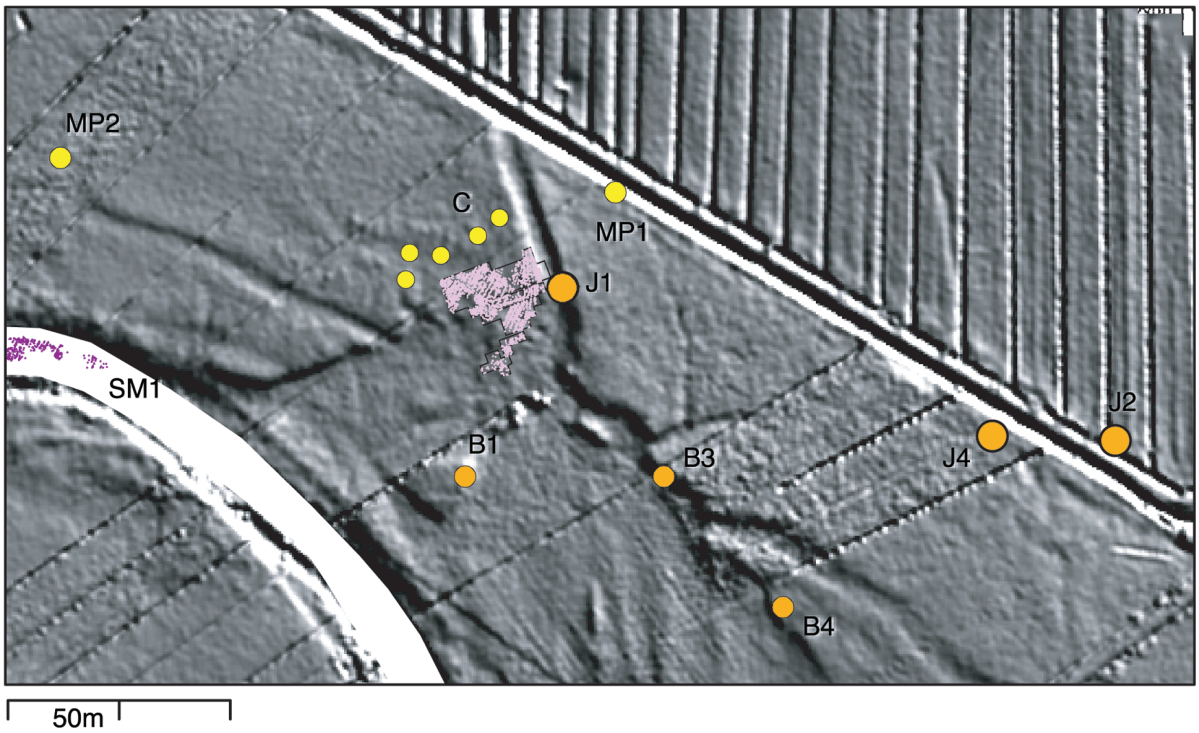


Fig. 4. Mostišče area on the LIDAR image. Maharski prekop is located just next to the palaeochannel. Note the network of palaeochannels in the area and destruction by the palaeochannel dated to the third phase. J1–J4 – Staško Jesse's test trenches (1954). B1–4 – test trenches by Tatjana Bregant (1975), C – Bregant's cores (1975), MP1–2 – pollen cores by Gardner (1999) and SM1 – Spodnje Mostišče pile cluster in modern Iščica.

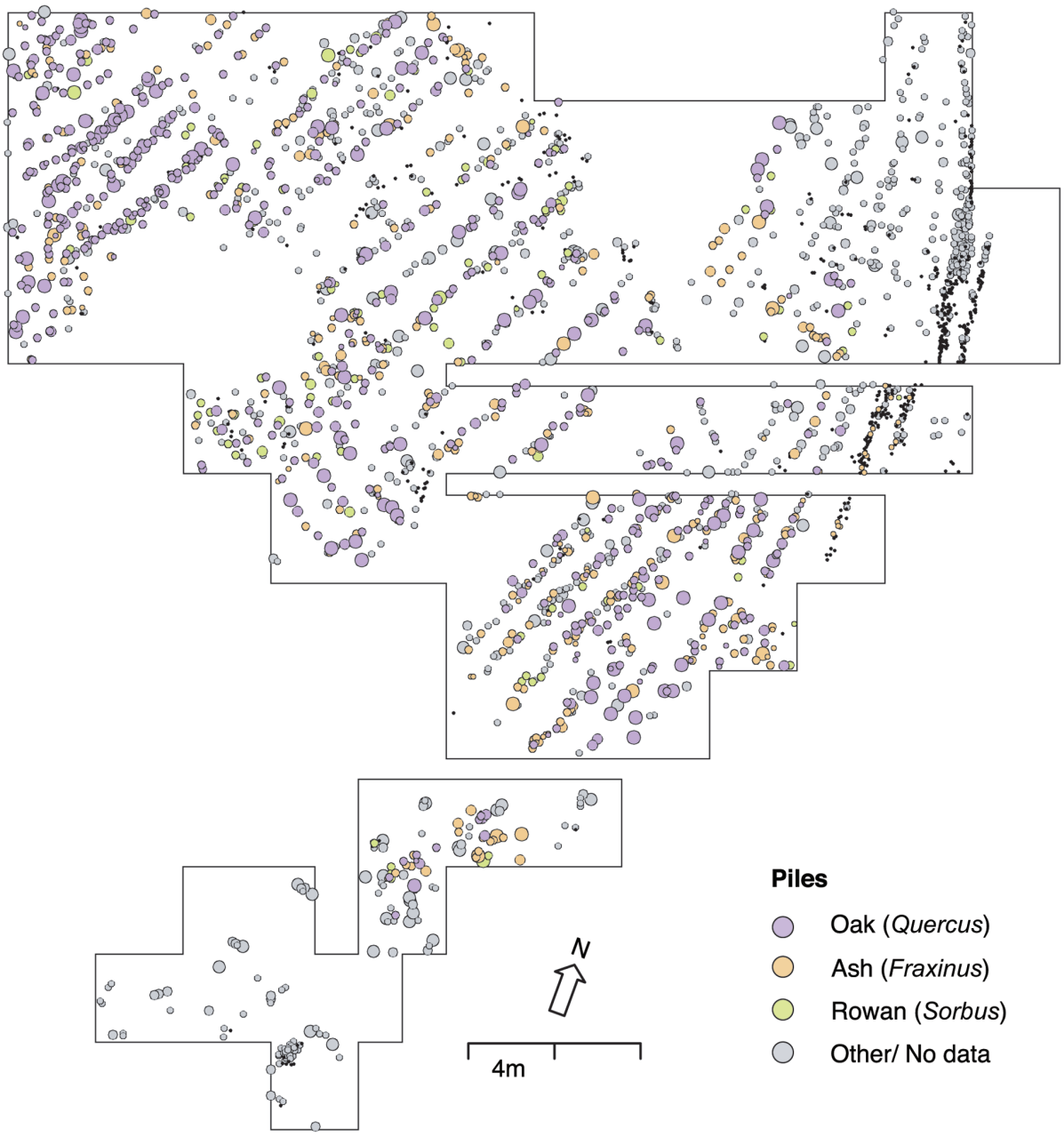


Fig. 5. Maharski prekop. Distribution of piles. Map is based on excavator's original documentation and published report (*Bregant 1975.1–107, Priloga 2–4*).

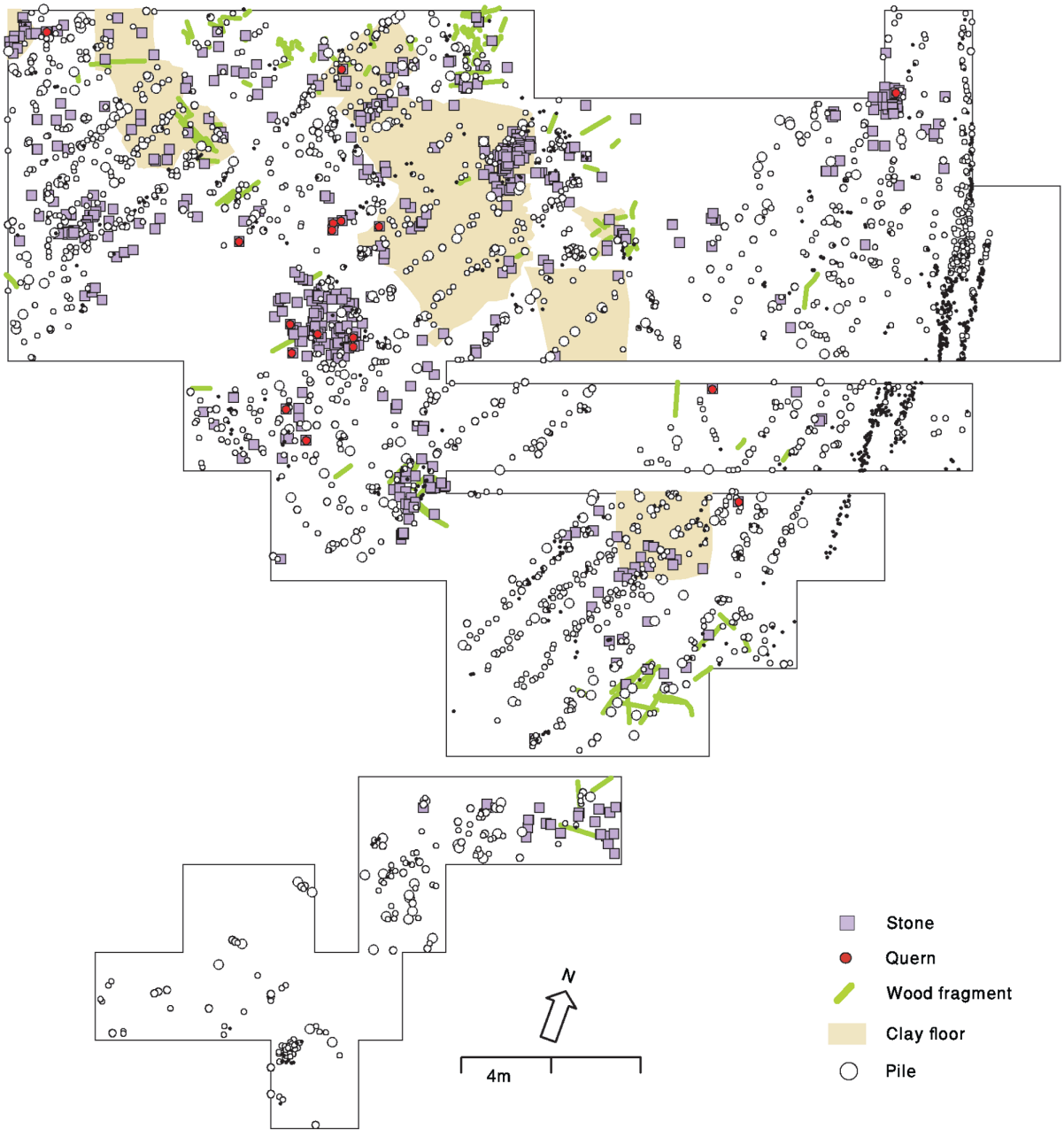


Fig. 6. Maharski prekop. Distribution of stone features, querns, clay floors and wood fragments. Map is based on excavator's original documentation and published report (*Bregant 1975.1–107, Priloga 2–4*).

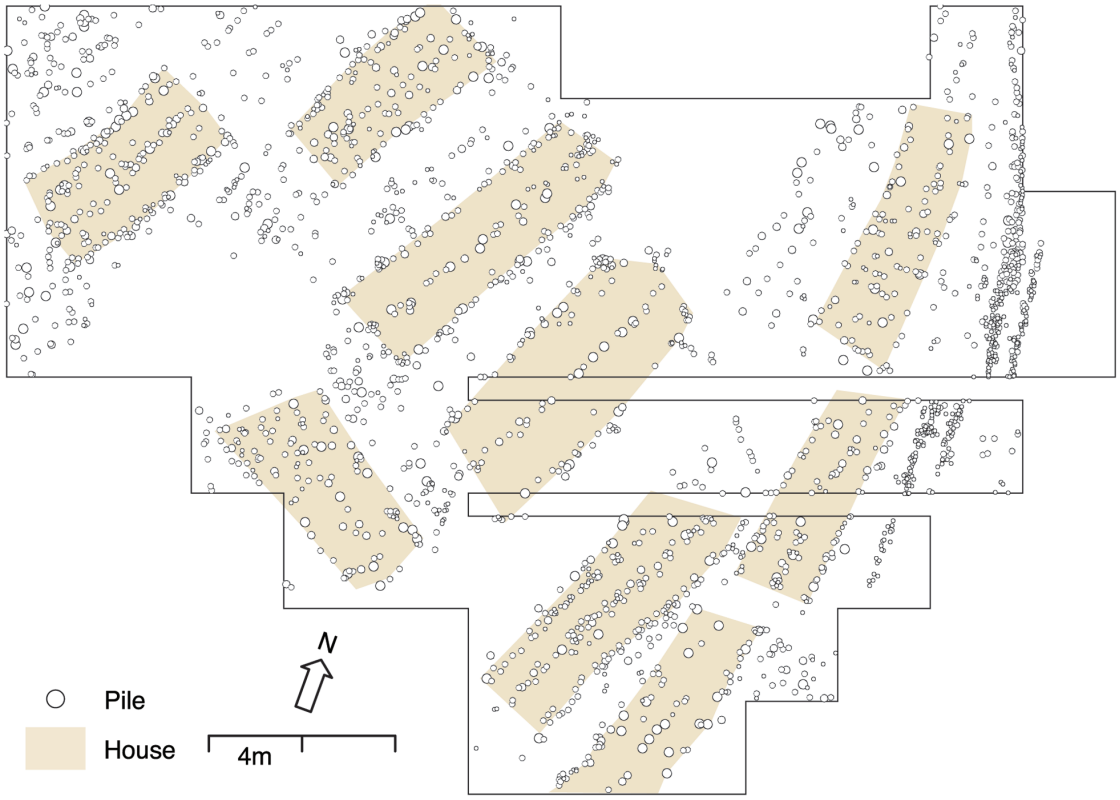


*Fig. 7. Maharski prekop. Reconstructed house plans based on the distribution of piles and other features. Map is based on excavator's original documentation and published report (*Bregant 1975.1–107, Priloga 2–4*).*

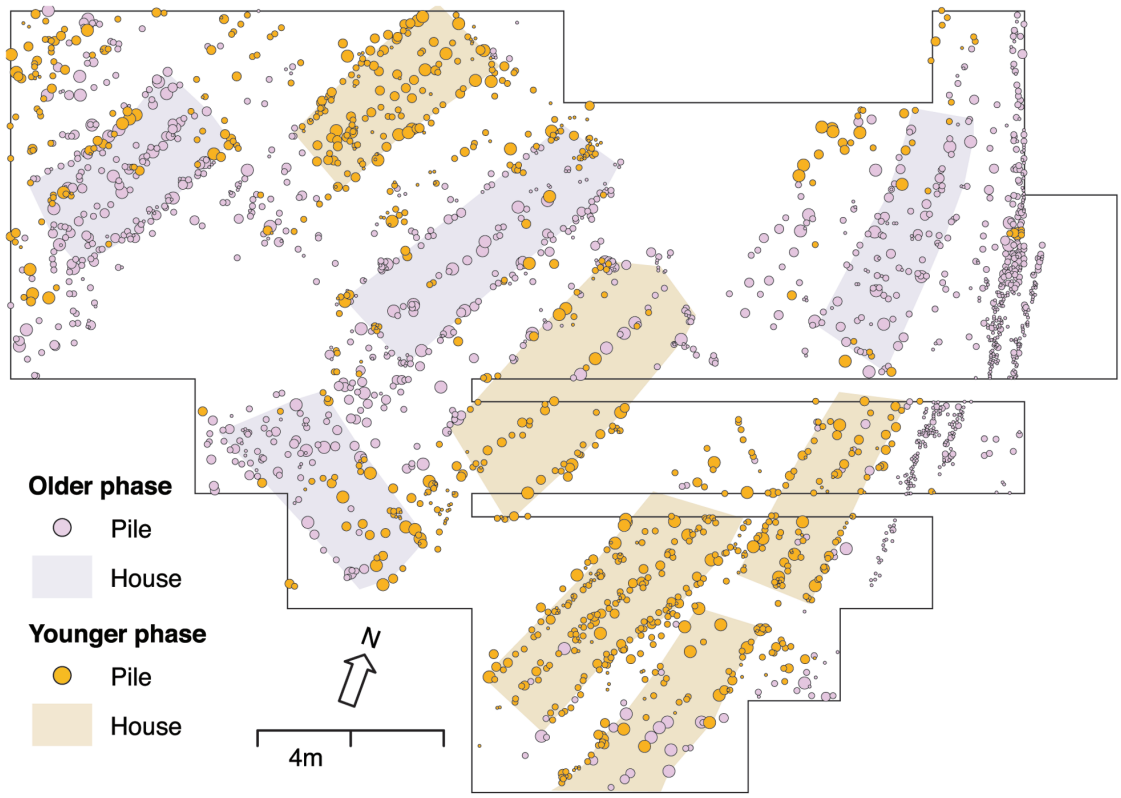


*Fig. 8. Maharski prekop. Phasing of piles and houses based on the relative heights of the piles. Map is based on excavator's original documentation and published report (*Bregant 1975.1–107, Priloga 2–4*).*

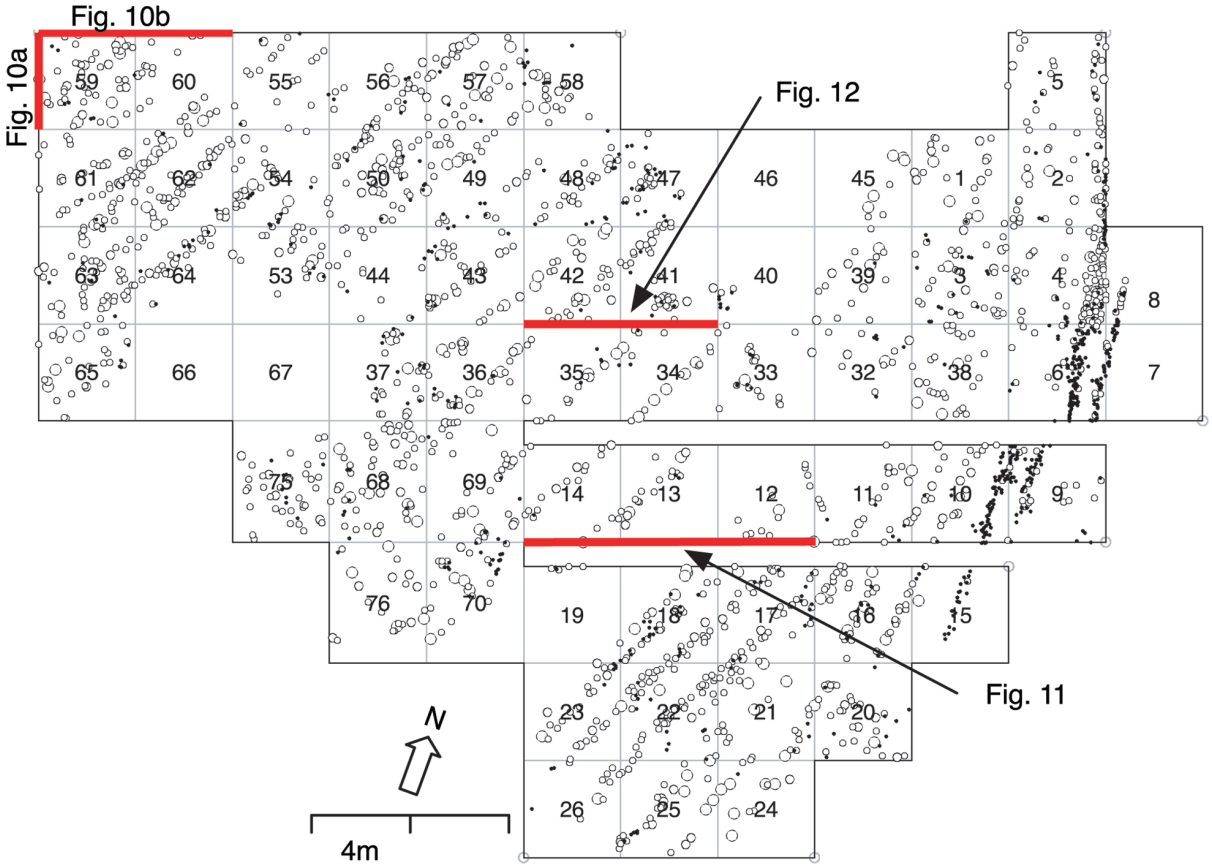


*Fig. 9. Maharski prekop. Positionof the sections discussed in the text in the Bregant's grid system. Map is based on excavator's original documentation and published report (*Bregant 1975.1–107, Priloga 2–4*).*

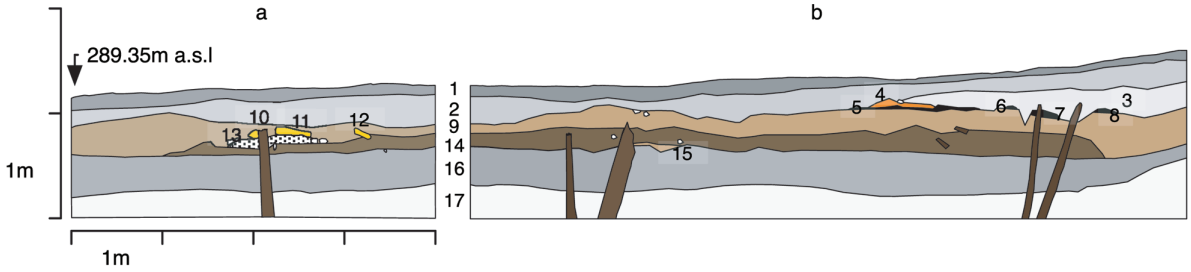


Fig. 10. Maharski prekop. Stratigraphic sequence in the north-western part of the settlement. 1 – topsoil; 2 – 'subhumus'; 3 – clay; 4 – burnt clay floor; 5, 6, 7, 8 – charcoal; 9 – cultural layer; 10, 11, 12 – burnt clay floor; 13 – fine sand; 14 – 'very dark cultural layer'; 15 – 'cultural layer'; 16 – pre-settlement 'gyttja'; 17 – calcareous silt. Figure is based on excavator's original documentation.

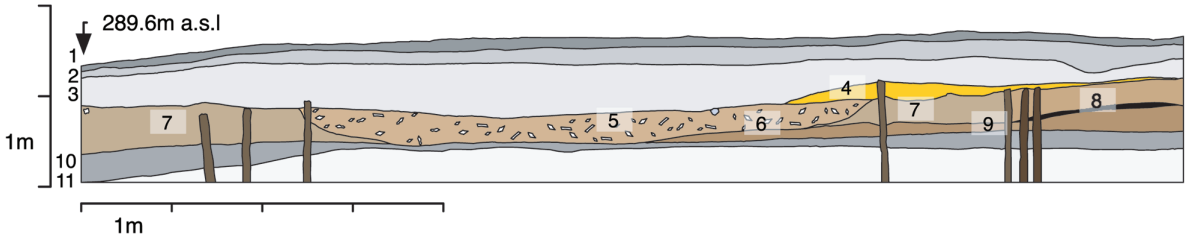


*Fig. 11. Maharski prekop Cut, filled with dolomite sandstone plates, superimposed by the house floor in the central part of the excavated area. 1 – topsoil; 2 – 'subhumus'; 3 – clay; 4 – clay floor; 5 – dolomite sandstone 'plates' mixed with charcoal; 6 – cut; 7 – 'cultural layer'; 8 – charcoal; 9 – 'cultural layer'; 10 – pre-settlement 'gyttja'; 11 – calcareous silt. Figure is based on excavator's original documentation and published report (*Bregant 1975.1–107, Priloga 2–4*).*

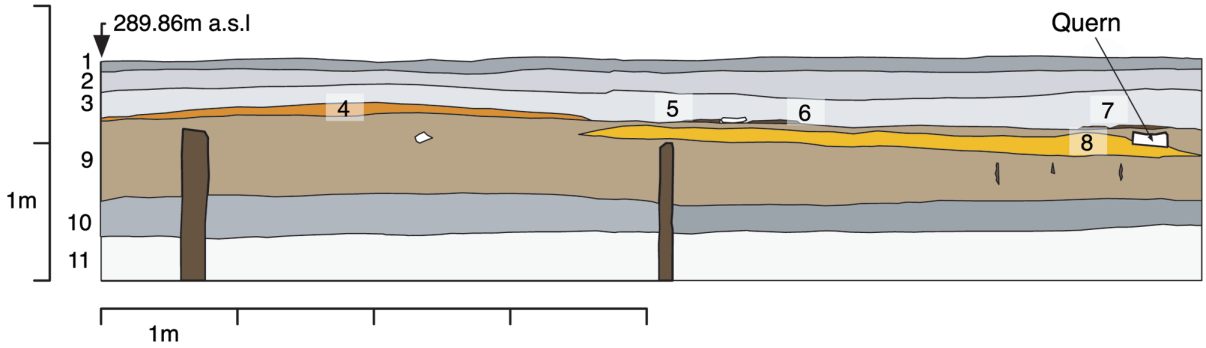


Fig. 12. Maharski prekop. Superposition of clay floors in the central part of the excavated area. 1 – topsoil; 2 – 'subhumus'; 3 – clay; 4 – burnt clay floor; 5, 6, 7 – charcoal; 8 – clay floor; 9 – 'cultural layer'; 10 – pre-settlement 'gyttja'; 11 – calcareous silt. Figure is based on excavator's original documentation and published report (*Bregant 1975.1–107, Priloga 2–4*).

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