Univerza v Ljubljani
Filozofska Fakulteta
Oddelek za Arheologijo

Documenta Praehistorica XXX

Neolithic studies

UNIVERZA V LJUBLJANI — FILOZOFSKA FAKULTETA

ODDELEK ZA ARHEOLOGIJO

Documenta Praehistorica XXX

EDITOR
Mihael Budja

10TH NEOLITHIC STUDIES

ISSN 1408-967X

LJUBLJANA 2003

DOCUMENTA PRAEHISTORICA XXX

10th NEOLITHIC STUDIES / NEOLITSKE ŠTUDIJE 10

Editor/Urednik:
Mihael Budja, miha.budja@uni-lj.si
http://www.ff.uni-lj.si/arheologija/neolitik/documenta.html

English advisor/Jezikovni pregled:
Philip James Burt

Published by/Založila:
Filozofska fakulteta, Oddelek za arheologijo

Technical editor and DTP/Tehnično urejanje in DTP:
CAMBIO d.o.o., Ljubljana

Printed by/Tisk:
Tiskarna Hren, Ljubljana

Number printed/Naklada:
1000 izvodov

Natisnjeno s podporo Ministrstva za šolstvo, znanost in šport.

Documenta Praehistorica je vključena v naslednje izbrane indekse:
COBISS; SACHKATALOG DER PUBLIKATIONEN ZUR ALTERTUMSKUNDE - DAI- Germania ISBN 3-8053-1660-7;
DYABOLA, Sachkatalog der Bibliothek der Röm.-germ. Kommission Mainz - http://www.db.dyabola.de/;
COPAC http://www.copac.ac.uk/; OPAC http://www-opac.bib-bvb.de/

Contents

We dedicate this jubilee XXX. volume of Documenta Praehistorica – the 10th Neolithic Studies anthology to the memory of Professor Josip Korošec and Professor Tatjana Bregant the former editors of the periodical. The anthology comprises papers mostly presented at the ninth international Neolithic Seminar that took place at the Department of Archaeology, University of Ljubljana in November 2002.

UDK 903(4-5)"633/634":572.1/.4
Documenta Praehistorica XXX

A new model for the spread of the first farmers in Europe

Ron Pinhasi
Department of Biological Anthropology, University of Cambridge, UK
ron.pinhasi@chello.at

ABSTRACT – *The appearance and dispersion of the first farmers in Europe has been the subject of heated debate among anthropologists, archaeologists, and linguists for over a century. There is no consensus regarding two main aspects: (1) the extent to which the transition to farming was an indigenous process, and (2) the historical pattern in terms of the timing and tempo of the dispersion events. Morphological variability and affinities are assessed among Mesolithic and Early Neolithic populations of the Near East, Anatolia and Europe. Statistical results reveal regional and temporal differences in the dispersion process among these populations. Based on these results, a new model is presented for the spread of farming in Europe.*

IZVLEČEK – *Pojav in širjenje prvih kmetovalcev v Evropi je že več kot stoletje predmet vročih razprav med antropologi, arheologi in lingvisti. Zaenkrat še ni soglasja glede dveh glavnih vidikov: (1) do kakšne mere je bil prehod v kmetovanje domoroden proces in (2) kdaj se je začelo in kako hitro se je kmetovanje razširilo. V članku ocenimo morfološko raznolikost in sorodnost mezolitskih in zgodnje neolitskih populacij Bližnjega vzhoda, Anatolije in Evrope. Statistični rezultati kažejo, da so med temi populacijami v procesu širjenja regionalne in časovne razlike. Na temelju teh razultatov predstavimo nov model razširjanja kmetovanja v Evropi.*

KEY WORDS – *craniometric analysis; biological distances; morphological variability; Mesolithic; Early Neolithic; Europe; Levant; Anatolia*

INTRODUCTION

There is a view prevailing among archaeologists, anthropologists, geneticists, and linguists that skeletal studies of population affinities are a legacy of the past. Such scholars tend to point out that past studies of this sort were associated with the study of human races and eugenics and are thus better off being put away. Another prevalent assumption is that as bone growth and development is strongly affected by various environmental factors such as climate, diet, and activity, it can tell us nothing about genetically based biological variability among populations.

These assumptions are just as outdated as the study of human races. The application of skeletal techniques to the study of human populations is a resourceful and unique avenue to the study of our past. Each discipline has its drawbacks and misconceptions. Some of these are the outcome of the type of data under examination, others are the result of misconceptions and prejudiced assumptions accumulated throughout the history of a particular scientific discipline.

The field of biological anthropology has a particularly infamous history. One of the outcomes of decades of racist research is a tendency among researchers from other related disciplines to question the validity of biological anthropology as a scientific discipline. The abolition of the concept of races and present emphasis on the uniformity of the human species is, in a sense, a positive consequence. However, such an approach disregards the fact that there exist both phenotypic and genotypic differences among human populations. Emphasising the fact that past and present human populations share biological similarities undermines the notion that each of these populations possess some unique biological variability. The fact that the concept of human races should be discarded does not imply that there are no significant differences in biological variability across space and time.

There exist relatively large Neolithic skeletal collections from localities in Europe and the Near East. Most of these skeletons are from well-stratified, radiocarbon dated archaeological contexts. These contexts therefore provide the researcher with comparatively accurate spatial and temporal attributes. Archaeological data provides invaluable information about past humans' behaviour and human-environment relationships. The archaeological record of Mesolithic and Neolithic populations is particularly rich and the analysis of these data in the context of human evolution is of great potential.

Renfrew (*1992*) pointed out that perhaps the greatest advantage of cranial data is its time span. Thus, anthropometric analysis can be grounded on the one hand in the archaeological background which provides the relevant historical context, and modern genetics on the other, which provides a reference to both past biological variability and past population structure and affinities (e.g. maps of clinal distributions of genetic traits).

At present there is a lack of consensus regarding the following aspects:

❶ The extent to which the transition to farming was an indigenous process, involving some admixture between incoming farmers and local hunters, or a population replacement process.

❷ The historical pattern in terms of the timing and tempo of the dispersion events.

The first stage of the project involved the analysis of archaeological data from approx. 2200 sites/contexts. The data was analysed in regard to its spatial and temporal attributes (i.e., radiocarbon dates, and geographic location in longitude/latitude) as well as for archaeological culture (*Pinhasi 2000*). Emphasis was placed on observing the temporally based distribution of Mesolithic vs. Neolithic occupation across Europe by using Arcview GIS application. Maps of settlement patterns by chronological period are depicted in Figures 1–7.

The analysis of archaeological data yielded the following results:

- The density of Mesolithic occupation at the time of the appearance of farming varied greatly between regions.
- The timing and density of Neolithic occupation also varied between regions.
- The dynamic pattern of Mesolithic colonization will tend to obscure any clinal trends that are presently attributed to the Neolithic 'wave of advance'.
- Any arriving farmers would have met very competitive and interactive conditions with a divergent potential for gene flow.
- The variability in population densities had a genetic effect on immigrant Neolithic farmers, and this should be modelled at a regional level.

Five models for the spread of farming in Europe were developed, partially on the basis of the results obtained, and partially on the basis of other prevalent theories (*Ammerman & Cavalli Sforza 1984; Zvelebil & Rowley-Conwy 1984; Zvelebil 1986; Zvelebil & Zvelebil 1988; Zvelebil & Dolukhanov 1991; Zilhão 1993; Dennell 1985*). The first part of this paper will expose these models and specify the corresponding expectations of each model in regards to the 'neolithisation' process across Europe.

Three main aspects of 'Neolithisation' will be examined in this paper. The first aspect begins with the assessment of the relationships among the Mesolithic groups in order to examine whether some of these groups are similar enough (morphologically) to be regarded as a single biological population. The section proceeds to examine affinities during the Early Neolithic period. The questions being addressed are as follows. What type of morphological affinities can one detect among the Early Neolithic populations? Are some groups similar enough to be regarded as belonging to a single population? This question is therefore identical to the one for the Mesolithic. However, morphological affinities must be interpreted in the specific context of the specified models. Particularly, the question of greatest relevance is whether a pattern of morphological affinities is compatible with a demic dispersal.

The second aspect is the specification of a plausible area of origin from which the first farmers spread to Europe, and whether a linear correlation between distance from source area and morphological differentiation exists, as suggested by the findings of Menozzi & Cavalli-Sforza (*1978*). The two centres exa-

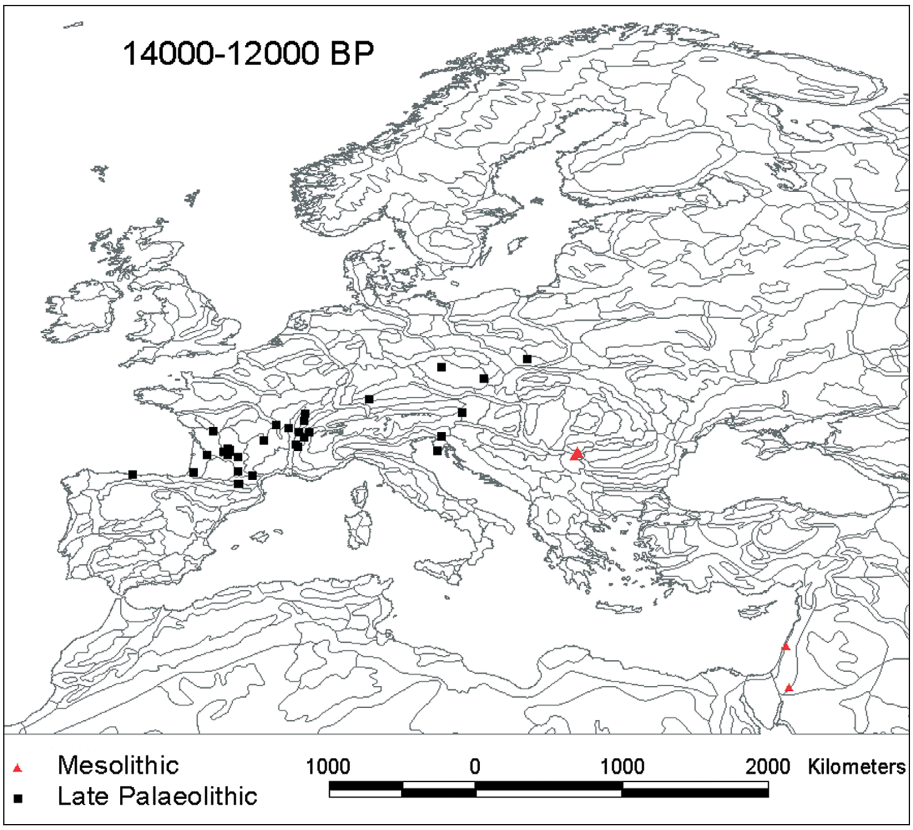


Fig. 1. Settlement pattern during the period 14 000–12 000 BP.

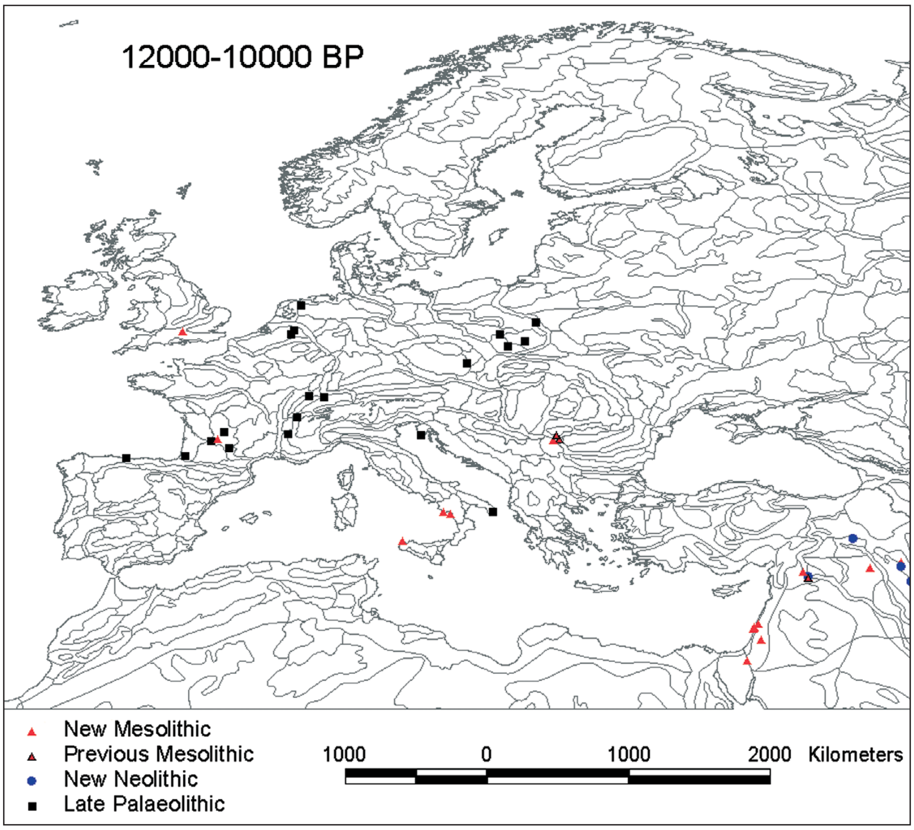


Fig. 2. Settlement pattern during the period 12 000–10 000 BP.

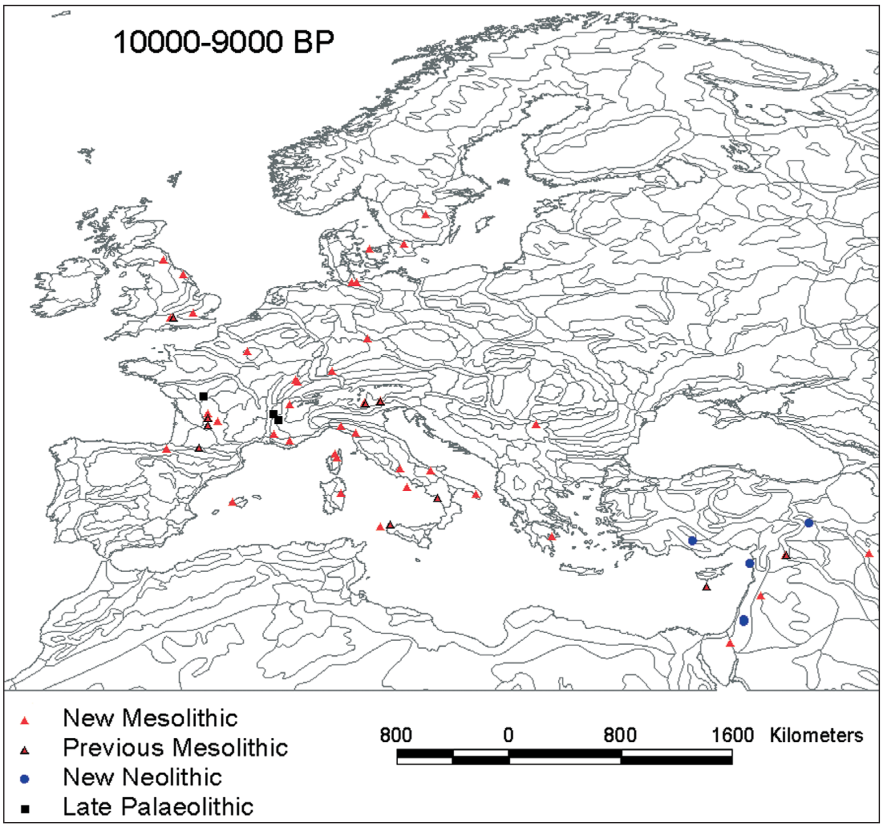


Fig. 3. Settlement pattern during the period 10 000–9000 BP.

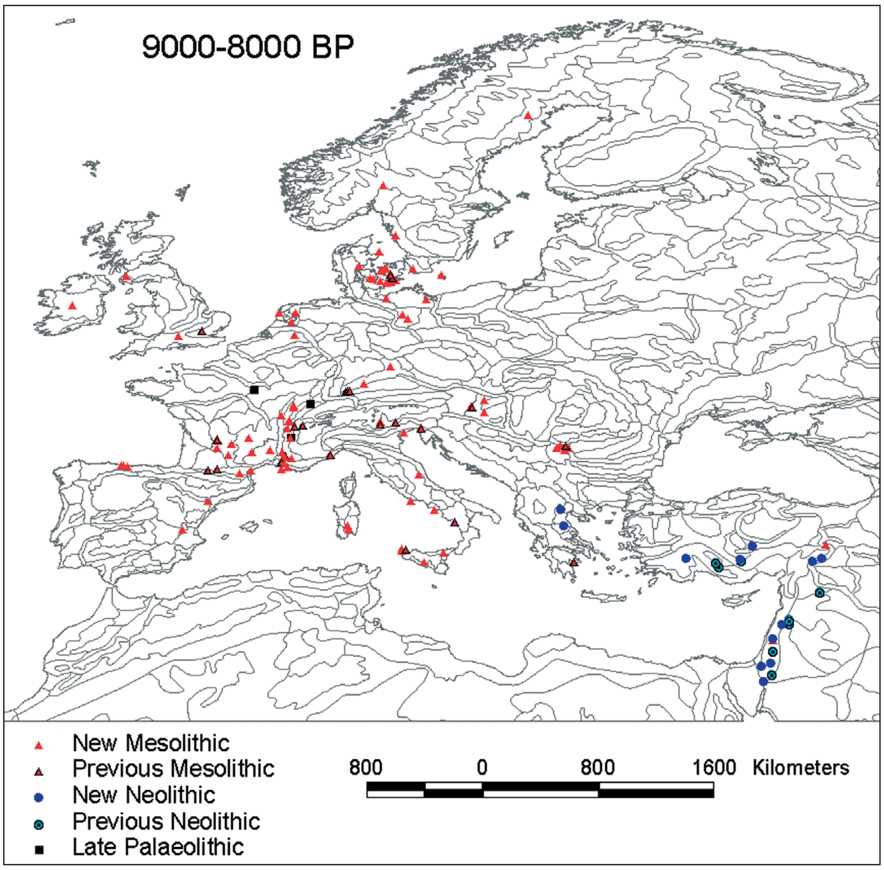


Fig. 4. Settlement pattern during the period 9000–8000 BP.

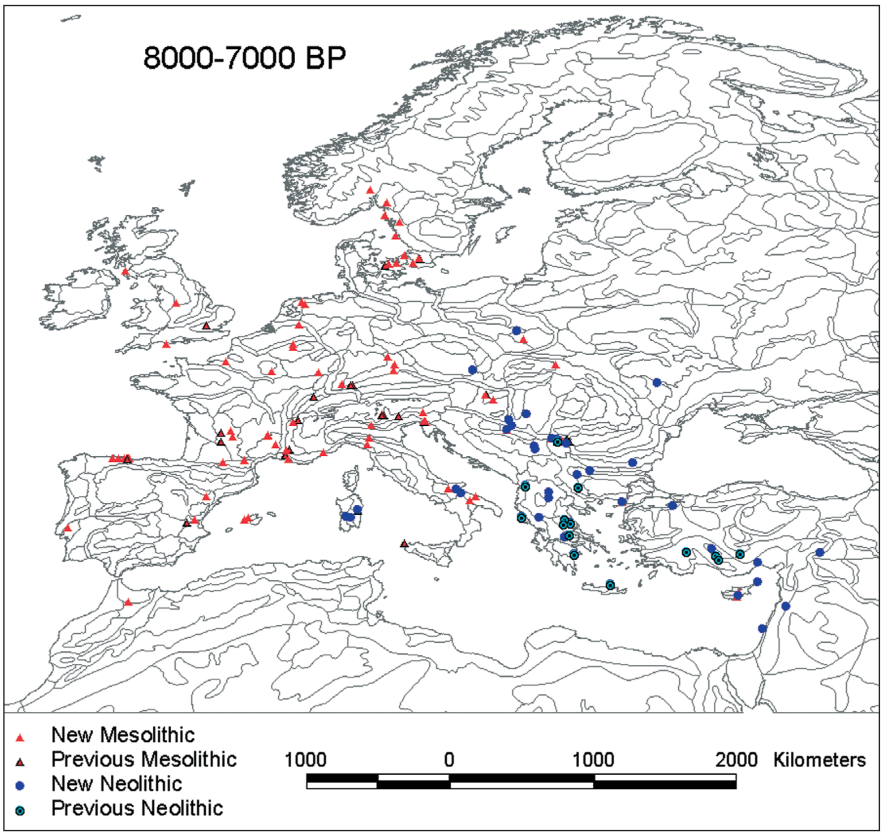


Fig. 5. Settlement pattern during the period 8000–7000 BP.

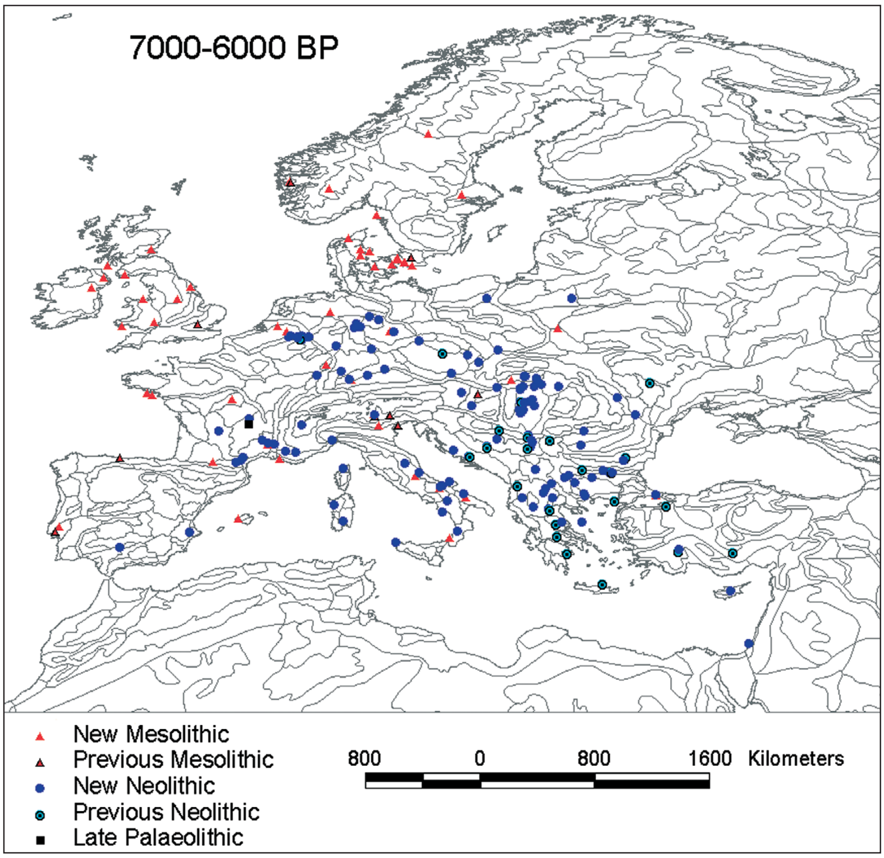


Fig. 6. Settlement pattern during the period 7000–6000 BP.

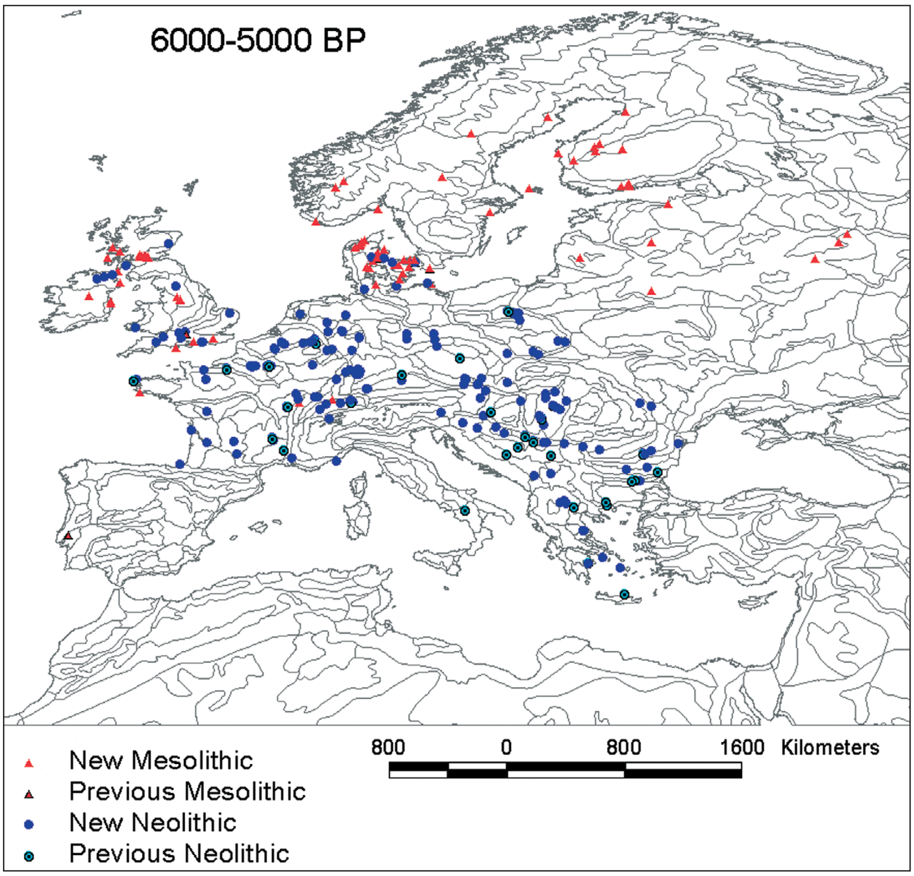


Fig. 7. Settlement pattern during the period 6000–5000 BP.

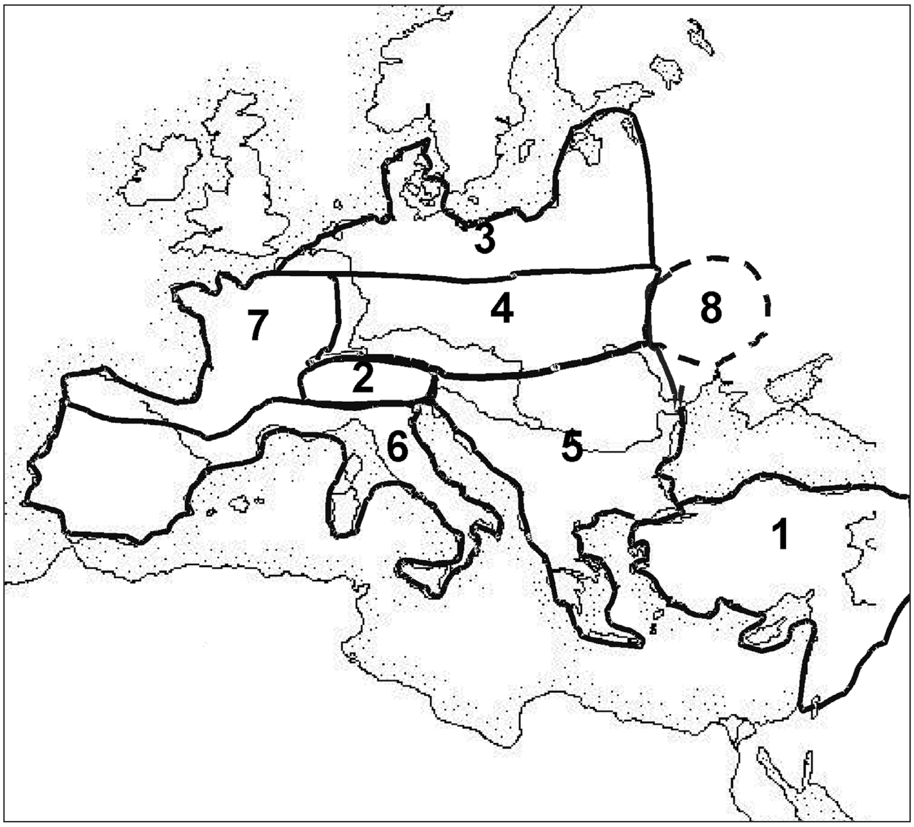


Fig. 8. The division of the studied groups according to geographic regions.

mined are SE Anatolia, represented by the population from Çayönü, and Central Anatolia, represented by the population of Çatal Höyük. The possibility of other locations (Levant, Cyprus) is rejected on the basis of the evidently large distances between the PPNB populations from these regions and the Early Neolithic European populations.

In the last part of this work a regional-based analysis of craniometric data is performed. The underlying hypothesis is that the process of neolithisation differed across space and time and thus needs to be assessed in greater depth (see *Pinhasi 2000; Lahr et al. 2000*). This is achieved by examining the degree of regional continuity between local hunters and incoming farmers in the various regions of Europe as a series of case studies. Temporal variation in spatial units is examined by modelling expected patterns of continuity (i.e., admixture) and discontinuity in various regions. The placement of a given specimen in a specific region was solely based on the geographic location of its associated site. The demarcation of the regions is depicted in Table 1 and in Figure 8.

MODELS FOR THE SPREAD OF FARMING IN EUROPE

Model 1 – Autochthonous transition across Europe

This model proposes that the transition to agriculture occurred as a series of local events that took place in different locations and time across Europe. The model is based on the idea of 'Neolithisation' through a process of cultural diffusion but without any migration or expansions of farming populations. This model fits with the theory of in situ transition and cultural rather than demic diffusion of the Neolithic across Europe (see *Whittle 1996; Dennell 1985* and others). The model is represented in Figure 9.

Under this model, regionally based changes in morphological variation and changes in sexual dimorphism are the outcome of an adaptive response to environmental changes such as changes in diet, activity pattern, climate and mobility, and/or changes in mating networks. Thus, changes are not expected to be external (i.e. gene flow from migrations), but rather internal. In such a case, changes should be more pronounced at the period between stage 1 and stage 2, during which the Early Neolithic cultures appear across Europe. This is because this model places emphasis on a culturally-based transition. The archaeological record attests to the fact that in the case of most of the regions of Europe changes in lifestyle, mobility pattern and mating networks occurred during the initial transition to agriculture (i.e., during the Early Neolithic period). Less 'functional' morphological changes are expected among populations that were already 'fully Neolithic', and little would have changed during the subsequent period in terms of the above-mentioned factors.

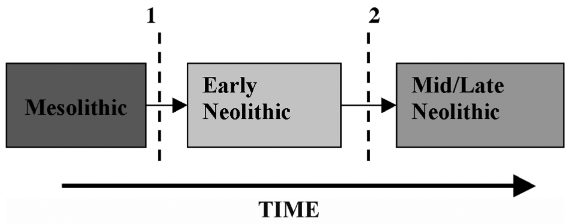


Fig. 9. A model of autochthonous transition across Europe.

Region	Description
1 Anatolia and the Levant	Consisting of modern-day Turkey, Syria, Lebanon, and Israel.
2 The Alpine region	Consisting of present-day Austria and Switzerland, and the Alpine regions of Italy and France.
3 Northern Europe	Consisting of all specimens between longitude 6°E and 26°E, and north of latitude 51°N. It includes the area of present-day northern Belgium and Holland, Northern Germany, Poland, Scandinavia, and the Baltic states.
4 Central Europe	Consisting of Slovakia and the Czech Republic, south and central Germany up to latitude 51°N, and mostly falling between 48°N and 51°N, and east of longitude 6°E.
5 South East Europe	Including mainland Greece and the Greek Islands, Bulgaria, Romania, Serbia, Macedonia, Bosnia, Croatia and Hungary.
6 Mediterranean Europe	Including the Adriatic coastal region of Albania, Bosnia and Croatia, all of Italy (with the exception of the Alpine region), Corsica, Sardinia, and Mediterranean France.
7 Atlantic Europe	Including Great Britain, all parts of France and Belgium west of longitude 6°E and north of latitude 44°N, Majorca, Spain and Portugal.
8 Dniepr Region,	Including the Mesolithic and Neolithic cultures of southern Ukraine.

Tab. 1. Description of the regions analysed.

Model 2 – Incoming farmers with differential degrees of admixture

Model 2a – Differential admixture across space

This model is in congruence with the 'demic diffusion' model. The underlying assumption is that the Neolithic farmers spread across the continent and 'absorbed' differential amounts of genes from indigenous Mesolithic populations (Fig. 10). Note that this model does not differentiate between scenarios which assume varying degrees of demic input from the Mesolithic populations. Thus, the degree of admixture may have been weak or extensive. Nevertheless, the underlying assumption is that the spreading farmers absorbed Mesolithic populations along their path and not a scenario in which the greatest contribution to the Neolithic gene pool came from Mesolithic populations.

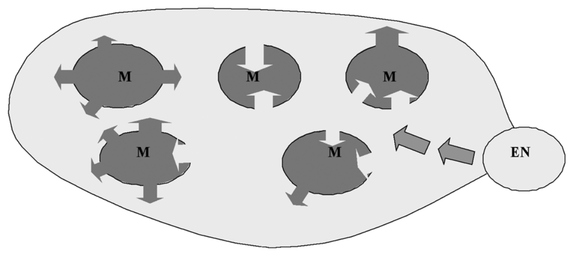


Fig. 10. A model that assumes a process of neolithisation with incoming farmers (EN) with differential degrees of admixture with local Mesolithic populations across space.

Model 2b – Differential admixture across time – "Delayed Admixture"

The second variant of model 2 is one which adds the element of delayed admixture. The underlying assumption is that the Early Neolithic farmers did not admix with the Mesolithic hunters, but rather that an admixture occurred later on during the Middle/Late Neolithic period (Fig. 4). During the Early Neolithic period, the farmers would have undergone a process of 'consolidation', during which they expanded across the continent and intensified and diversified their lifestyle. Subsequently, as the settlement pattern became denser and population density increased, mating networks and acculturation between Neolithic and Mesolithic populations became more prevalent. Consequently the genetic contribution of Mesolithic groups to the Middle/Late Neolithic populations would have been significant.

Model 3 – Complete replacement without admixture

This model assumes a demic diffusion process without any admixture. In figure 12 the Mesolithic populations are represented as moving northwards. Another possibility is their extinction without any genetic contribution. Consequently, all Early Neolithic populations are regarded as being directly affiliated with the Levantine and/or Anatolian Early Neolithic populations and share no affinities with any of the European Mesolithic populations. Changes in the genetic composition of the dispersing populations due to stochastic effects (series of founder effects, isolation, etc.) are ruled out from this model as it assumes sufficient gene flow along the dispersion path.

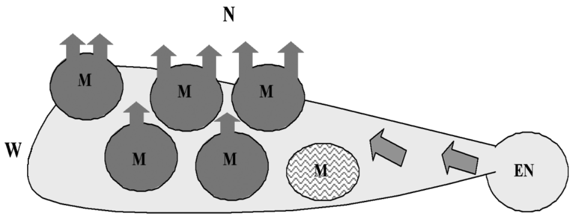


Fig. 12. A model of complete replacement, with some extinction and dispersion of Mesolithic populations northwards. Thatched lines represent extinction.

Model 4 – Admixture as a function of geographic region and distance from the source population

This model is a variant of model 2a (Fig. 13). However, 'differential admixture' is assessed as a function of the geographic region under examination and its

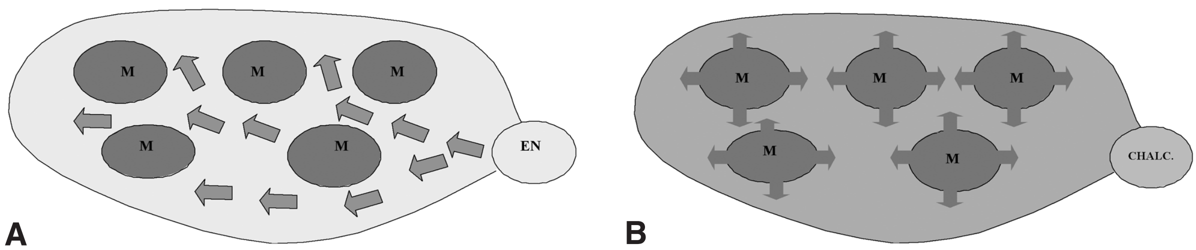


Fig. 11. A model that assumes a process of neolithisation with incoming farmers (EN) with differential degrees of admixture with local Mesolithic populations across time. A: 8000–6000 BP (Early Neolithic). B: 6000–4000 BP (Middle/Late Neolithic).

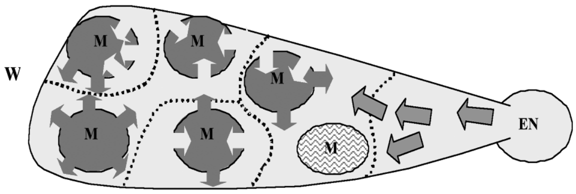


Fig. 13. Differential contribution of Mesolithic populations to incoming farmers across space and time. Contribution varies by region and with corresponding admixture levels varying in a scale between no contribution to intensive admixture.

distance from the Near East/Anatolia. The model therefore places emphasis on examining the 'Neolithisation' process according to regions rather than as a pan-European phenomenon. Therefore, any theory which proposes a complex geographically based scenario with a differential admixture due to the impact of geographic/spatial factors is congruent with this model.

MATERIALS

The skeletal material consisted of the following:

❶ Data collected during fieldwork. These data comprised of:
   a. Cranial measurements.
   b. Mandible plus lower dentition measurements.

❷ Data collected from the literature and from the ADAMS database, Department of Anthropology, University of Geneva, Switzerland.

Description of the data is provided in Table 2 (a = Personal data, b = ADAMS, c = published data).

METHODS

All measurements were taken from the skull, mandible and teeth of each individual. In the case of the majority of the analyses performed, only a subset of the total set of variables was utilised. The subset of measurements utilised in the following analyses is described in Table 3.

The sex of specimens studied by the author was evaluated by using three systems.

❶ A general assessment of sex based on the criteria outlined in the book Standards for Data Collection from Human Skeletal Remains, by J. E. Buikstra and D. H. Ubelaker (*1994*).

❷ An assessment of sex by means of a plasticine cast of the endocranial part of the external auditory meatus (*Joachim Wahl, Landesdenkmalamt Baden-Württemberg, pers comm.*).

❸ An assessment of sex following the method developed by Graw and co-authors (*1999*).

Age estimation was based on the age assessment in the available registry books at the given institution, as well as an assessment of age based on the skull carried out by the author. The two main criteria for the assessment of age were the degree of cranial suture closure (specifically basi-occipital-sphenoid synchondrosis, as described in *Acsádi and Nemeskéri 1970*), taken together with the presence of fully erupted second molars. This 'system' is in many respects inaccurate (see discussion in *Schwartz 1995. 206–211* regarding age assessment techniques using the skull). However, it is adequate to exclude the majority of sub-adult specimens. Thus, the overwhelming majority of skulls being measured were those of adult specimens.

STATISTICAL METHODS

The following is a brief description of the statistical methods utilised in the following sections.

Univariate methods

a. Kruskal-Wallis test

The Kruskal-Wallis ANOVA by ranks test assumes that the variable under consideration is continuous and that it was measured on at least an ordinal (rank order) scale. It tests the null hypothesis that the different samples in the comparison were drawn from the same distribution or from distributions with the same median. Thus, the interpretation of the Kruskal-Wallis test is basically identical to that of parametric one-way ANOVA, except that it is based on ranks rather than means. This procedure is more robust (albeit less sensitive) as it uses a rank order scale, and therefore can be applied to small sample sizes.

b. Analysis of boxplots

The analysis of boxplots is a straightforward procedure. The common boxplots (in SPSS) compare ranks rather than means and thus depict differences in group medians. It also allows the comparison of interquartile ranges per variable.

Bivariate methods

Following the univariate procedures, part of the data was scrutinised using bivariate analyses. In each of

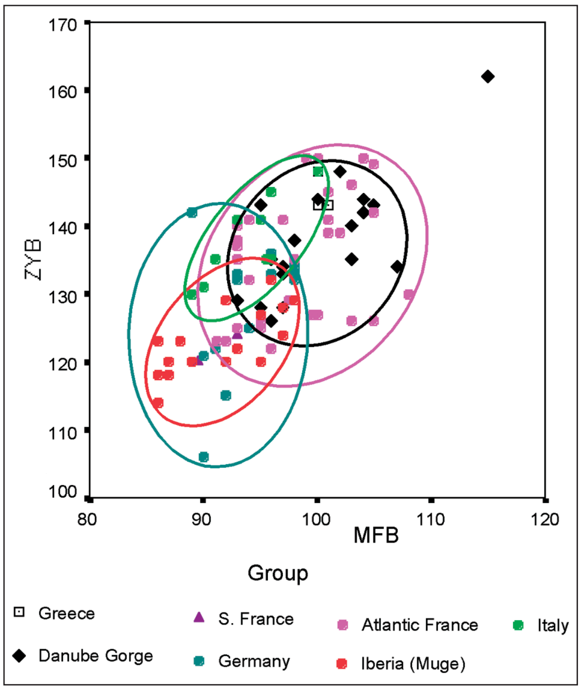


Fig. 14. Minimum Frontal Breadth vs. Zygomatic Breadth for individual Mesolithic specimens, by group.

the bivariate analyses, the individual data for a pair of variables (measurements) were plotted in a scatterplot. Using these scatterplots, the position of single finds and the variability of groups can be visually assessed. The simplicity of the scatterplot procedure is that it does not amplify between-group variability or distort the output.

Multivariate methods

a. Discriminant analysis

This statistical procedure is in fact a set of closely related procedures under one broad term (*Klecka 1980*). The procedure is applied when there exist two or more samples from potentially different populations and the researcher wishes to distinguish among them. Discriminant function analysis has two main applications:

❶ Interpretation of the ways in which the groups differ from each other. Is one able to discriminate between the groups on the basis of certain characteristics? How well do the groups discriminate, and which characteristics are the most powerful discriminators (*Klecka 1980*).

❷ Classification: to predict group membership from a set of predictors, the derived equations (canonical functions) combine the groups' characteristics in a way that will allow one to identify the group to which each case most closely approximates (in terms of the relation of the individual case values for a set of traits and the average value of those traits for each of the groups). The case under examination may be of either a known or an unknown group (*Tabachnick and Fidell 1996*), thus allowing both the comparison of the accuracy with which certain traits allow identifying the group of origin of known cases, and the potential classification to known groups of ungrouped cases.

b. Principal Components Analysis

Principal components analysis (PCA) is a powerful exploratory technique in which a large number of variables are reduced to a smaller number of factors (*Tabachnick and Fidell 1996*). The multivariate technique of principal components analysis is usually applied for the purpose of data reduction and de-correlation of the variables. However, in this work, principal components analysis is mainly applied as an exploratory tool in the search for underlying patterns/structures of relationships between discrimination and association of past populations and corresponding specific morphological features.

c. Squared Mahalanobis Distances

The generalised distance, D2, developed by Mahalanobis, provides an effective measure for estimating group differences between biological populations. The Mahalanobis distance statistic is often applied in the analysis of prehistoric populations (*Van Vark*

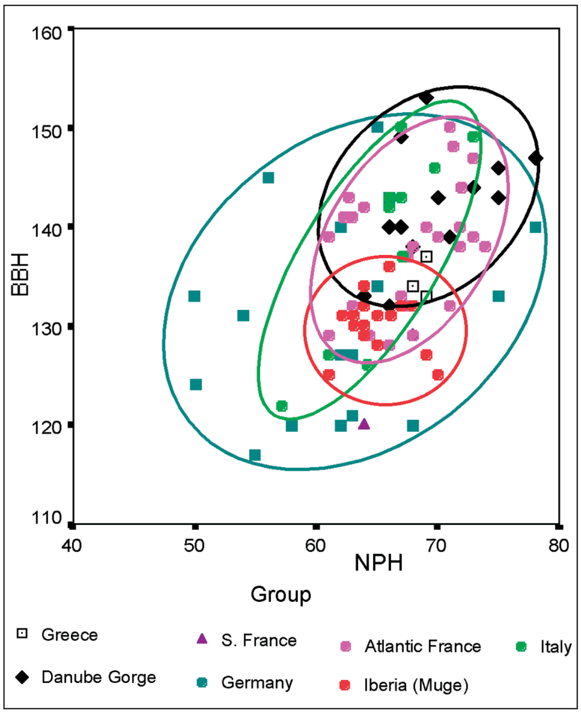


Fig. 15. Nasion-Prosthion Height vs. Begma Height for individual Mesolithic specimens, by group.

and Schaafsma 1992; Howells 1973; 1989; Keita 1990; 1992). It is regarded by many anthropologists and biologists as being the standard and most effective measure of distance between two or more populations when the observed data are quantitative (*Bedrick et al. 2000*). It has been used by various researchers in the study of affinities within and between prehistoric populations (see for example, *Bräuer & Rimbach 1990; Van Vark et al. 1992*). The Mahalanobis distance is an effective measure when variables are correlated, and it includes both variances and correlations (*Campbell 1984*). According to Van Vark and Schaafsma (*1992*), Mahalanobis distances calculated from skull measurements can be used in order to trace historical events such as population influx, admixture, and drift. Thus, while morphometric similarities among groups/individuals are not the same as genetic relatedness, there exists a significant correlation between the two. It follows that Mahalanobis distances between samples of ancient populations are to a certain extent genetically based, and their interpretation in terms of between-population genetically based affinities is valid (*Van Vark and Schaafsma 1992*).

PART 1 – ASSESSING POPULATION AFFINITIES BY PERIOD

Affinities between the Mesolithic populations of Europe

The bivariate graphs investigate the relationship among the European Mesolithic groups. The question in mind is whether one can detect any affinities/patterns between groups.

The bivariate graph (Fig. 14) indicates that, with the exception of one specimen, the Danube Gorge material falls within the range of variation of the French and the Italian Mesolithic. The Iberian and French/Danube/Italian samples have a relatively small overlap (the largest Iberian with the smallest French/Danube/Italian), while the German remains also show comparatively small values of min frontal breadth. The under-representation of individuals from southern France and Greece does not permit the drawing of inferences regarding the morphological variability and association of these groups.

The pattern observed in the scatterplot on Figure 15 is a much greater overlap among all groups, with the German variation encompassing almost all other variation. Individuals that belong to the Danube Gorge group are relatively clustered as is the case for Muge and Greece. In contrast, we see that the specimens of the German Mesolithic and Italian Mesolithic groups are more scattered.

The scatterplots suggest some regionally-based discrimination between the European Mesolithic groups, with a considerable element of intra-sample variability. We therefore do not see a clear-cut morphological differentiation. Scatterplots do not apply distance algorithms that intend to maximise among-group differences while minimising the effects of intra-sample variance (such as the squared Mahalanobis distance). One, therefore, may conclude at this stage that the Mesolithic groups of Europe are morphologically diverse. No visible patterns of affinities were observed.

Affinities between the Early Neolithic populations of Anatolia, the Levant, south-east and central Europe.

In this section we examine morphological relationships among the Early Neolithic populations of Anatolia, Levant and south-east and central Europe. The main issue that we opt to tackle may be phrased as follows.

What is the relationship among the Early Neolithic groups from the Levant, Anatolia and the Early Neolithic groups from the various parts of Europe?

We are now looking for more definite answers regarding the population relationships during the period of the appearance of the first farmers in Anatolia and the Levant, and subsequently in south-east and central Europe. We expect to detect:

❶ Some similarities between many of the Early Neolithic European groups.

❷ Some of the Early Neolithic European groups are morphologically similar to one or more of the Levantine, and/or Anatolian groups (in the case of Demic Diffusion).

Univariate analysis

Table 4 shows the groups (the Natufian sample and Early Neolithic) and corresponding codes used in the analyses.

A Kruskal-Wallis Anova rank analysis was carried out in order to assess whether significant differences between the groups for the following set of variables exist: GOL, XPB, ZYB, NPH, NLH, NLB, and OBH. This non-parametric method is preferable over

Lat	Long	Location	N	Date	Arch Period	Zone	Database	Collection/Reference
35.87	38.4	Abu Hureyra	5	10 790	PPNB	1	a	1
32.76	35.36	Ain-Mallaha (Eynan)	3	11 547	Epipaleolithic	1	a	1
30.23	35.53	Basta	3		PPNB	1	a	3
34.12	35.65	Bayblos	2		Chalcolithic	1	c	*Kurth 1973*
37.1	32.13	Çatal Höyük	49	7499	Neolithic	1	c	*Ferembach 1981*
38.23	39.65	Çayönü	8	9360	PPNB	1	a	1
31.42	35.06	Erq-El-Ahmar	2	11 000	Epipaleolithic	1	a	1
32.67	35	Fallah- Nahal Oren	9	10 046	Epipaleolithic	1	a	1
32.9	35.22	Hayonim	4	12 010	Epipaleolithic	1	a	1
32.00	35.00	Jericho	9		Chalcolithic	1	c	*Kurth 1973*
32.8	35.33	Pkein	29		Chalcolithic	1	a	1
48.47	20.52	Aggtelek	1		Neolithic	5	a	7
47.30	19.03	Agostonpuszta	1		Eneolithic	5	a	7
47.00	17.00	Ajaki Kokornaki	2		Eneolithic	5	a	7
47.18	19.12	Alsónémedi	5	4500	Badeni	5	a	7
41.39	21.58	Anza	3		EGEAN	5	b	ADAMS
47.32	19	Aszód-Papiföldek	6	5669	Neolithic	5	a	7
37.99	23.73	Athens	1		Neolithic	5	c	*Boev 1973*
46.83	17.98	Balatonendried	1		Neolithic	5	a	7
46.7	21.26	Békés-Povád	4		Szakálhát	5	a	7
39.60	22.50	B'Koybeleiki	2		Neolithic	5	a	17
48.00	21.00	Bodrogkersztur	1		Eneolithic	5	a	7
47.30	19.03	Budakalász	21		Badeni	5	a	7
47.30	19.08	Budapest	1		Neolithic	5	a	7
47.30	19.06	Budapest-Andor	1		Badeni	5	a	7
44.12	26.46	Cascioarele, Locus 1	1	5598	Neolithic	5	a	5
44.18	28	Cernavoda	21		Hamangia	5	b	ADAMS
46.3	24.12	Cipa	1		Cris	5	b	ADAMS
47.25	18.95	Csepel Sziget	3		Neolithic	5	a	7
46.4	20.31	Csóka	1		Neolithic	5	a	6
46.22	20.25	Desyk-Olajkut	2	6570	Körös	5	a	6
46.12	20.15	Deszk	2		Cris	5	b	ADAMS
43.23	24.95	Deveta_kata Pe_tera	1		Early Neolithic	5	b	ADAMS
46.94	20.78	Endröd	1	6566	Neolithic	5	a	6
39	22.3	Franchthi Cave	3		Early Mesolithic	5	b	ADAMS
44.35	23.91	Gîrlsti	2		Neolithic	5	a	5
44.08	26.63	Gumelnita	1	5557	Gumelnita	5	a	5
46.48	23.36	Gura Bacului	1	6650	Cris	5	b	ADAMS
46.64	21.32	Gyula	1		Neolithic	5	a	7
37.42	22.18	Hageorgitika	1		Neolithic	5	b	*Boev 1973*
46.36	20.18	Hódmezövásárhely	1	6450	Körös	5	a	6
46.39	20.39	Hódmezövásárhely	3	6190	Late Neolithic	5	a	6
46.39	20.39	Hódmezövásárhely–B.	1		Körös	5	a	6
46.4	20.31	Hódmezövásárhely–G.	4	6050	Late Neolithic	5	a	6
43.00	27.00	Janka	8	5700	#NAME?	5	b	ADAMS
43	24	Jasa Tepe	1	6600	Karanovo 2	5	b	ADAMS
42.36	25.54	Karanovo	2	6600	Karanovo 1	5	b	ADAMS
42.36	25.24	Kasanlak	1	6500	Karanobvo 2	5	b	ADAMS
34.54	33	Khirokitia	21	7350	PPN	5	b	ADAMS
47.5	20.5	Kisköre-Gát	7	5942	Neolithic	5	a	7
47.00	19.50	Kkotac Tanya	2		Eneolithic	5	a	6
46.41	20.31	Kotacpart	7	6450	Körös	5	a	6
46.23	18.21	Lengyel	1		Neolithic	5	a	14
44.3	22.06	Lepenski Vir	16	7300	Mesolithic	5	b	ADAMS
44.33	22.03	Lepenskivir	23		Starcevo	5	b	ADAMS
45.00	18.00	Mogyorós	1		Neolithic	5	a	6
40.65	22.3	Nea Nikomedeia	13	8180	Early Neolithic	5	c	*Angel 1973*
47.73	18.37	Neszmély	1		Neolithic	5	a	7
46.38	18.57	Paradicsompuszta	1		Lengyel	5	a	7
48.14	20.67	Paszar	1		Eneolithic	5	a	7
47.00	19.30	Puszaistvánháza	3		Eneolithic	5	a	7
43.54	26.00	Rusé	3	5200	Mound Culture	5	b	ADAMS
45.54	25.18	Sf.Gheorghe Bedehaza	1		Cris	5	b	ADAMS
42.4	23.18	Sofia	2		Early Neolithic	5	b	ADAMS
47.06	21.54	Solca	1		Cris	5	b	ADAMS
44.49	20.42	Starcevo	1		Starcevo	5	b	ADAMS
47.47	18.42	Sturovo	5		Zeliezovce	5	b	ADAMS
46.29	20.26	Szegvár-Tüzköves	1	6000	Neolithic	5	a	7
47.67	19.08	Szentendre	1		Neolithic	5	a	7
38.52	23.98	Tharounia	1		E. Neolithic	5	a	17

Lat	Long	Location	N	Date	Arch Period	Zone	Database	Collection/Reference
39.68	21.68	Theopetra	1		E. Neolithic	5	a	17
39.68	21.68	Theopetra	1		Mesolithic	5	a	17
47.17	26.33	Tirpesti	4	6240	Gumelnita	5	a	5
47.87	21.12	Tiszapolgar-Basatanya	8	5060	Eneolithic	5	a	7
47.00	18.00	Tököl	2		Bell Beaker	5	a	7
47.00	16.00	Tordèkes Koponya	1		Lengyel	5	a	7
44.23	27	Varasti	43	5360	Gumelnita	5	a	5
46.94	20.23	Vészto-Mágori Halom	7	6200	Körös	5	a	6
46.52	18.26	Villánykövesd	7		Lengyel	5	b	ADAMS
44.48	20.36	Vinca	9		Starcevo	5	b	ADAMS
44.31	22.01	Vlasac	56	7700	Mesolithic	5	b	ADAMS
39.30	22.80	Volos	3		Neolithic	5	a	17
43.48	7.30	Abri de Pendimoun	1.00		Cardial	6	c	*Riquet 1973*
40.06	–2.48	Alcazar del Rey	3.00		Neolithic	6	a	14
41.12	1.00	Arboli	1.00		Bell Beaker	6	c	*Alcobé 1973*
38.33	16.12	Arene Candide	1.00		Cardial	6	c	*Riquet 1973*
38.33	16.12	Arene Candide	3		Early Mesolithic	6	b	ADAMS
42.37	13.37	Arma dell'Aquila	3.00		Cardial	6	c	*Riquet 1973*
43.06	0.24	Arudy	1.00		Late Mesolithic	6	b	ADAMS
37.9	13.48	Buffa Cave	1		Neolithic	6	b	ADAMS
43.48	7.3	Castellar	1		Cardial	6	b	ADAMS
43.24	5.12	Chateauneuf	2.00		Cardial	6	b	ADAMS
40.06	8.3	Condeixa	60		Cardial	6	b	ADAMS
44.12	8.18	Finale Ligure	3		Cardial	6	b	ADAMS
37.18	–2.06	Gerundia	1.00		Almeria	6	c	*Riquet 1973*
37.24	–2.54	Gorafe	2.00		Almeria	6	c	*Alcobé 1973*
43.18	2.54	Grotte de Bize	1.00		Middle Neolithic	6	c	*Riquet 1973*
43.24	5.12	Grotte Sicard	2.00		Cardial	6	c	*Riquet 1973*
37.18	–3.12	Gudaix	1.00		Neolithic	6	c	*Alcobé 1973*
43.12	2.18	Iziar	2.00		Mesolithic	6	b	ADAMS
42	13.3	La Punta	1		Early Mesolithic	6	b	ADAMS
43.24	4.46	Llanes	1.00		Mesolithic	6	b	ADAMS
43.03	13.04	Maddalena di Muccia	1		Cardial	6	b	ADAMS
40.54	17.24	Monopoli	2		Cardial	6	b	ADAMS
39.12	8.42	Muge	24	9000	Late Mesolithic	6	b	ADAMS
39.06	8.42	Mugem arruda	10		Late Mesolithic	6	b	ADAMS
38.37	8.58	Mugem moita	15		Late Mesolithic	6	b	ADAMS
47	7	Niederhergsheim	1		Campaniform	6	c	*Riquet 1973*
47.12	7	Oberentzheim	1		Campaniform	6	c	*Riquet 1973*
42	13.3	Ortucchio	3	12 500	Mesolithic	6	b	ADAMS
43.24	6.54	Peillon	1		Mesolithic	6	b	ADAMS
41.38	2.18	Sabassona	1		Cardial	6	c	*Alcobé 1973*
41.09	1.12	Salamno	3.00		Bell Beaker	6	c	*Alcobé 1973*
42.54	2.54	Salces	4		Cardial	6	b	ADAMS
38	14.36	San Fratello	4	12 000	Mesolithic	6	b	ADAMS
42	13.3	San Teodoro	4		Mesolithic	6	b	ADAMS
38.24	–9.06	Sesimbra	2.00		Almeria	6	c	*Alcobé 1973*
39.06	–0.12	Tabernes de Valdigno	2.00		Neolithic	6	c	*Alcobé 1973*
42.06	3.09	Toroella	1.00		Bell Beaker	6	c	*Alcobé 1973*
40.24	3.42	Urtiaga	2	11 500	Mesolithic	6	b	ADAMS
41.18	1.09	Vilavert	1.00		Neolithic	6	c	*Alcobé 1973*

Key to location of collections:
1 Department of Anatomy and Anthropology, University of Tel Aviv, Israel.
2. Department of Anthropology. Hacetepe University at Beytepe Campus, Turkey.
3. Göttingen University, Department of Anatomy, Germany.
4. British Museum, London, England.
5. Francis Rainer Institute of Anthropology, Bucharest, Romania.
6. József Attila University, Department of Anthropology.
7. Natural History Museum, Department of Anthropology, Budapest.
8. Jena University, Germany.
11. State Archaeological Institute, Munich, Germany.
12. University of Vilnius, Fac. of Medicine, Dept. Anatomy, Histology & Anthropology.
13. Institute of History, Department of Archaeology, Tallinn, Estonia.
14. Panum Institute, Copenhagen, Denmark.
15. Natural history Museum, Prague., Czech Republic.
17. Department of Animal and Human Physiology, University Athens, Greece.

Table 2. Summary table of data.

Measurement Acronym	Measurement Description	Source	Presence in ADAM
Cranial measurements			
GOL	Maximum cranial length	Howells, 1973	yes
BBH	Basio-bregma height	Howells, 1973	yes
XFB	Maximum frontal breadth	Howells, 1973	yes
XPB	Maximum parietal breadth	Howells, 1973	yes
ZYB	Bizygomatic breadth	Howells, 1973	yes
MFB	Minimum frontal breadth (WFB)	Howells, 1973	yes
NPH	Nasion-prosthion length	Howells, 1973	yes
NLH	Nasion height	Howells, 1973	yes
NLB	Nasion breadth	Howells, 1973	yes
OBH	Orbital Height	Howells, 1973	yes
OBB	Orbital breadth	Howells, 1973	no
Mandibular measurements			
RAMH	Projective height of mandibular ramus	Martin, 1957	yes
GONANG	Gonial Angle	Martin, 1957	yes
MAXL	Projective length of mandible	Martin, 1957	yes
RAMB	Minimum width of ramus	Martin, 1957	yes
GONB	Bigonial breadth	Martin, 1957	no
CONDB	Bocondylar breadth	Martin, 1957	no
ANTH	Symphysis height (id-gn)	Martin, 1957	no
ANTTHIC	Anterior thickness	Martin, 1957	no
Dental measurements			
LCMD	Lower Canine mesiodistal dimension	Hillson, 1996	no
LCBL	Lower Canine buccolingual dimension	Hillson, 1996	no
LP3MD	Lower Third Premolar mesiodistal dimension	Hillson, 1996	no
LP3BL	Lower Third Premolar buccolingual dimension	Hillson, 1996	no
LP4MD	Lower Fourth Premolar mesiodistal dimension	Hillson, 1996	no
LP4BL	Lower Fourth Premolar buccolingual dimension	Hillson, 1996	no
LM1MD	Lower First Molar mesiodistal dimension	Hillson, 1996	no
LM1BL	Lower First Molar buccolingual dimension	Hillson, 1996	no
LM2MD	Lower Second Molar mesiodistal dimension	Hillson, 1996	no
LM2BL	Lower Second Molar buccolingual dimension	Hillson, 1996	no
LM3MD	Lower Third Molar mesiodistal dimension	Hillson, 1996	no
LM3BL	Lower Third Molar buccolingual dimension	Hillson, 1996	no

Table 3 – list of cranial and mandibular variables utilised.

Anova due to the small and uneven sample sizes of the groups. Results are described in Table 5. The analysis by rank indicates that the groups are significantly different at the p = 0.005 level.

Figure 16 contains boxplot diagrams of the above groups by variable. The left column comprises boxplots of group medians and inter-quartile ranges, while the right column comprises means and standard deviations and standard error (the boxed area). This arrangement allows one to compare the distribution and variance of scores per measurement, and group and to detect possible 'distortions' due to outliers. Group 2 (Çayönü) has the largest variance for GOL, XPB, and NPH, while group 3 (Abu Hureyra) has the largest variance for ZYB, NLH, NLB and OBH. The variance of other groups is much smaller. The Levantine Natufian group has a significantly greater mean for GOL and ZYB. The European Early Neolithic groups (5–8) and Çatal Höyük display similar means and variances for GOL, XPB, ZYB and NPH. In the case of nasal dimensions (NLH and NLB) and Orbital Height (OBH) some differences between these groups exist, as the Cardial (Impressed) Mediterranean Neolithic group has lower means. There is a significant degree of heterogeneity among the specimens of Southeast Anatolia (Çayönü) and Northeast Levant (Abu Hureyra), which is apparent from the examination of their rank and inter-quartile boxplots (left column), as well as their means and variances.

In sum, the examination of these boxplots indicates that, all in all, the European groups plus Çatal Höyük (groups 4 to 8) show similarities in means and variance, as well as in medians and interquartile ranges for the variables examined. In contrast, the first three groups (Natufian, Çayönü and Abu Hureyra) differ from this group mainly in the dispersion of the 50% range (and variance in the case of the right column), as well as from each other.

PART 2 – ASSESSING THE GEOGRAPHIC AND BIOLOGICAL DISTANCES OF EARLY NEOLITHIC EUROPEANS FROM POTENTIAL SOURCES

Underlying the demic diffusion model is the assumption of a differential admixture between dispersing farmers and local Mesolithic populations, which would explain the observed SE–NW genetic cline. Thus, the hypothesis assumes that the more distant the original farmers from their centre of origin, the more they admixed with local hunters. Ammerman and Cavalli-Sforza (*1984*) regarded Jericho as the area of origin for the first farmers. This observation is inaccurate. While Jericho is one of the oldest agricultural sites in the region, there exist other contemporaneous populations from the PPNB period in the Levant and Anatolia. These populations display a high degree of heterogeneity, and thus cannot be accepted as a single ancestral population. Moreover, there is a time lag of approximately 2000 years between the first appearance of Neolithic cultures in this region and the appearance of the first Neolithic sites in south-east Europe. There is no reason to assume that the farmers that dispersed to south-east Europe came from Jericho and not from another location/culture. In order to assess the demic diffusion model it is, therefore, necessary to define more accurately a possible region from which the farmers dispersed to Europe. We saw in the previous sections that among the PPNB groups only Çayönü displays some similarities to the early Neolithic European populations. Moreover, in all analyses of Early Neolithic populations, the Çatal Höyük specimens are strikingly similar to the European Early Neolithic groups.

This section examines the relationship of geographic distance from (a) Çatal Höyük, and (b) Çayönü to other European Early Neolithic sites. It does so by estimating the Mahalanobis D2 distances between corresponding group centroids in order to assess the following hypothesis:

H1: Assuming that the site of Çatal Höyük represents the center of origins of the first farmers who dispersed to Europe, the further away the specimens/ site are from this centre, the further they are also in morphological distance.

The methodology applied is the analysis of squared Mahalanobis distances between groups using the following set of variables: GOL, XPB, ZYB, MFB, NPH, NLH, NLB, and OBH. Cases with missing data were excluded (no substitution). Group means and codes are described in Table 6. Geographic distances between groups were calculated using Spheric V. 1.05 software for the calculation of geographic distance between two points on Earth based on their latitude and longitude co-ordinates.

Group	Code	N
Levant Mes. – Natufian	1	9
SE Anatolia – Çayönü	2	3
NE Levant – Abu Hureyra	3	3
Central Anatolia – Çatal Höyük	4	11
Greece Neolithic	5	16
Med. E. Neolithic	6	35
SE Europe – E. Neolithic	7	19
Central Europe E. Neolithic	8	27
	Total	**123**

Tab. 4. Groups and corresponding codes.

Table 7 outlines the groups and their Mahalanobis and geographic distances from Çatal Höyük. Clearly, the site with the smallest geographic distances from Çatal Höyük is Çayönü. Yet, this site has the largest Mahalanobis distance (7.42) from Çatal Höyük. The second largest squared Mahalanobis distance is of Lepenski Vir, which is 1169 km away. The smallest squared Mahalanobis distance is from Nea Nikomedeia (1.16), which is only 938 km from Çatal Höyük. However, the LBK site of Viesenhäuser Hof, which is 2253 km away from Çatal Höyük, has a squared Mahalanobis distance of 1.89. It therefore appears there is no correlation between geographic distance and morphometric distance in the case of the Early Neolithic groups. The most intriguing observation is, in fact, the LBK sites, which are more than 2000 km away from Çatal Höyük and have small squared Mahalanobis distances from this group.

We see no linear relationship between Mahalanobis and geographic distances from Çatal Höyük (Figure 17). The site of Çayönü is only 681 km from Çatal

	Code	N	Sum of Ranks
Levant Mes. – Natufian	1	9	949
SE Anatolia – Çayönü	2	3	136
NE Levant – Abu Hureyra	3	5	108
Central Anatolia – Çatal Höyük	4	18	1424
Greece Neolithic	5	16	1061.5
Med. E. Neolithic	6	35	2041
SE Europe – E. Neolithic	7	19	1386
Central Europe E. Neolithic	8	30	2074.5
Kruskal-Wallis test: H (N = 135) = 20.29882 p = 0.005			

Tab. 5. Results of the Kruskal-Wallis analysis by rank (Natufian and Early Neolithic).

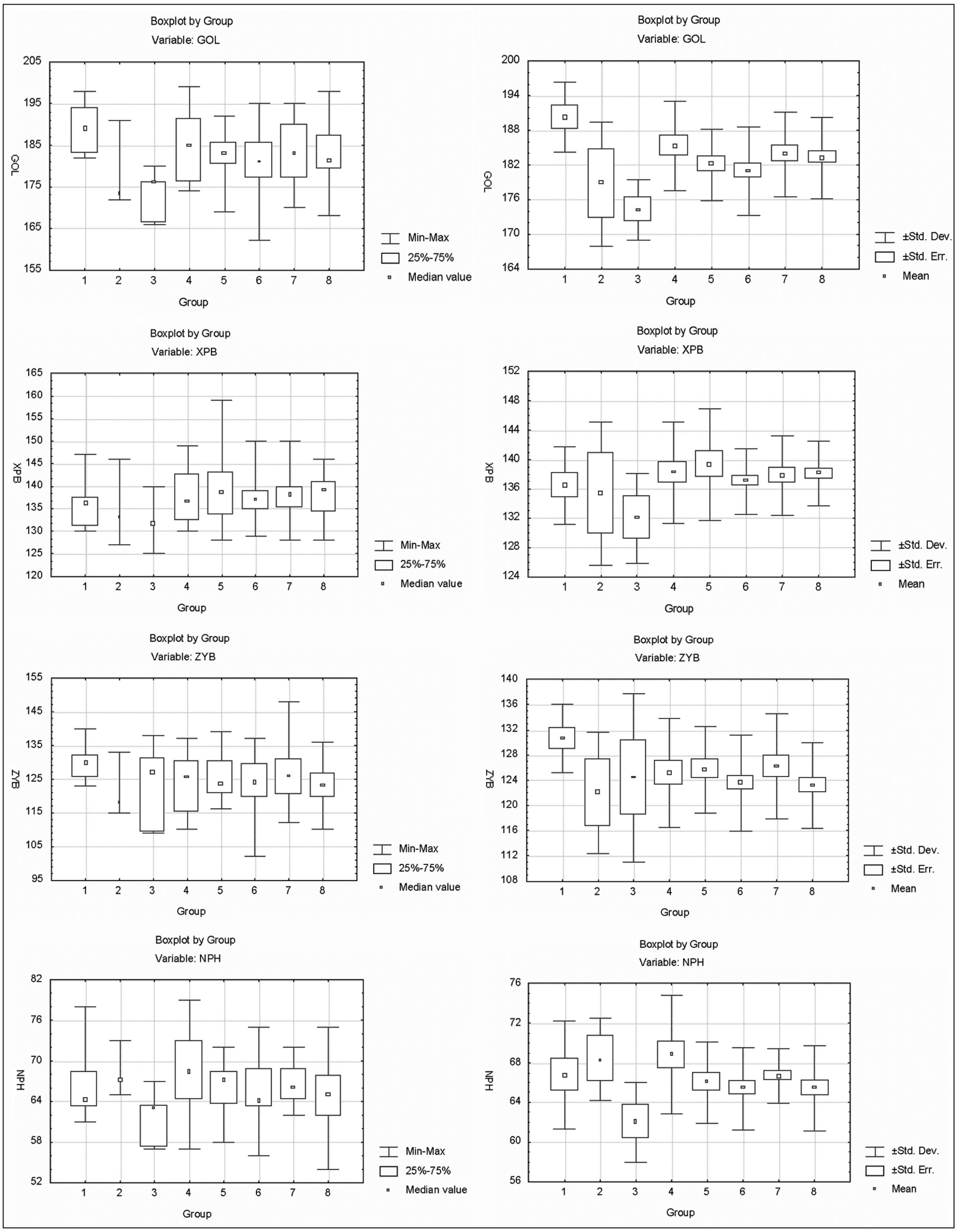


Fig. 16. Boxplots of medians and 25% quartiles (left), means and Standard Error (right) by variables.

Höyük and is geographically the closest. Yet the Mahalanobis D2 distance between Çatal Höyük and Çayönü is 7.42, by far the largest figure. We can therefore reject the above hypothesis. We will then proceed and examine the same hypothesis regarding the site of Çayönü.

H2: Assuming that the site of Çayönü represents the centre of origins of the first farmers who dispersed to Europe, the further away the specimens/site are from this centre, the further they are also in morphological distance.

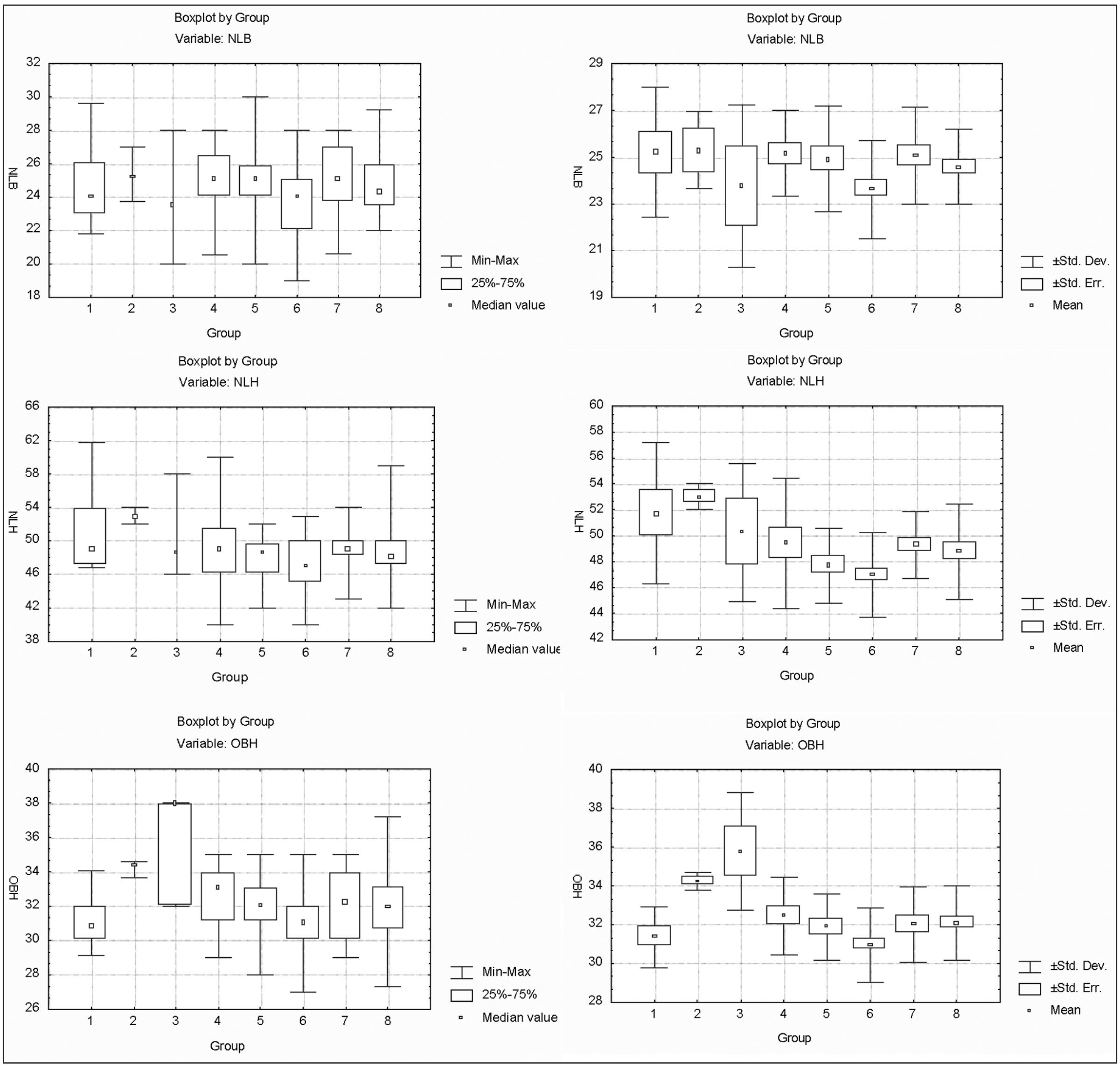


Fig. 16. Cont.

Table 8 presents the morphological (Mahalanobis D2 distances) and geographic distances of European Neolithic specimens to that of Çayönü.

The first observation is that the squared Mahalanobis distances from Çayönü to the other sites are much larger. The largest Mahalanobis distance is to Condeixa (11.5), followed by Lepinski Vir (10.81). We observe no uniformity in scale of distances, as Viesenhäuser Hof, which is 2700 km away from Çayönü, has the smallest squared Mahalanobis distances from this group (3.76). There is clearly no linear correlation between geographic and morphometric distances (Fig. 18).

These results indicate that morphological distances between the European Early Neolithic groups and either Çatal Höyük or Çayönü are not related to geographic or to chronological distances per se. This finding is relevant, keeping in mind that we are looking only at Early Neolithic groups which could be regarded as representative samples of the first European farmers. We may speculate that the lack of association with geographic distance is due to the rapidity or particular route of the dispersal, thus explaining why a German LBK group may be morphologically more similar to an Early Neolithic Anatolian group than to a Danish Group. Moreover, the distances of the Early Neolithic European sites to Çatal Höyük are much smaller than the distances to Çayönü.

PART 3 – ANALYSIS BY GEOGRAPHIC REGION

The regionally-based approach was applied successfully in the case of the archaeological site analyses

	GOL	XPB	ZYB	MFB	NPH	NLH	NLB	OBH	Valid N
Çayönü	178.67	135.33	122.00	94.33	68.33	53.00	25.30	34.23	3
Çatal Höyük	184.95	138.59	125.45	94.73	67.27	48.36	25.00	31.82	11
Lepinski Vir	186.33	142.67	138.33	99.00	70.67	51.33	26.67	32.00	3
Vészto-Mágori halom	187.00	134.17	123.00	96.17	65.33	48.58	24.78	32.15	6
Nea Nikomedeia	180.82	138.82	123.36	94.45	66.45	46.82	25.18	32.00	11
Schwetzinegn	179.80	138.10	123.40	95.66	64.41	46.98	24.74	31.80	10
Sondershausen	187.40	139.20	126.60	98.40	67.52	50.46	23.90	32.82	5
Viesenhäuser Hof	183.67	138.00	122.13	95.14	65.68	49.89	24.70	32.28	12
Condeixa	179.00	137.12	122.69	95.31	65.15	46.12	23.15	30.69	26
All Groups	181.99	137.80	123.89	95.47	66.02	47.95	24.39	31.74	87

Table 6 Group means and codes utilised.

(*Pinhasi et al. 2000*). On the basis of these analyses, it was possible to develop a model in which different degrees of admixture and interaction were hypothesised for the various regions of Europe (*Lahr et al. 2000*).

The model is examined using the available skeletal samples. The statistical procedures applied are PCA and discriminant function analyses. The first technique can be used in an exploratory manner, as no dependent variables need to be specified. The lack of grouping criteria makes it possible to perform analytical runs with relatively small numbers of specimens, and thus to narrow the temporal and geographical range. The second technique is mostly used for classification purposes. Nevertheless, its second value is in the interpretation of the findings. Due to word limits, results presented below include findings from the analyses of regions 1, 5 and 6.

Region 1 – Turkey and the Levant

In the Levant, it is common to distinguish between the Epipalaeolithic period – 13 000–10 500 BP, followed by two pre-pottery Neolithic periods – PPNA and PPNB. The PPNA is the period between ca. 10 500–9300 BP. During this time, villages are found on a rather narrow territory, extending from the Damascus Basin in the north to the Trans-Jordan in the south (*Yakar 1998*). The lithic industry from this period shows discontinuity with the Natufian cultures. In the PPNB period (ca. 9300–7800/7500 BP) villages are on average larger than before, some of them reaching 10–12 hectares (*Yakar 1998*).

Group Name	Mahalanobis distance	Geographic distance (km)
Çayönü	7.42	674.748
Lepinski Vir	4.29	1169.748
Vészto-Mágori halom	1.81	1468.144
Nea Nikomedeia	1.16	938.59
Schwetzinegn	1.75	2333.112
Sondershausen	2.00	2310.736
Viesenhäuser Hof	1.89	2253.615
Condeixa	2.45	2095.071

Tab. 7. A comparison of Geographic and Mahalanobis distances from Çatal Höyük to European Neolithic specimens.

The aims of the analysis are as follows:

❶ To check the position of the specimens from the PPNB sites of Cayönü, Basta and Abu Hureyra in relation to the Natufians, and the Chalcolithic site of Pkein.

❷ To assess the position of the Mesolithic and Early Neolithic specimens from Greece in relation to Khirokitia.

All analyses on specimens from this region were performed on the data set after performing a Norm NORM V. 2.03 (2000) imputation procedure for missing data. The location of specimens utilised is depicted in Figure 19.

Analysis of cranial dimensions

The following set of cranial variables was selected: GOL, XPB, ZYB, MFB, NPH, NLH, NLB, and OBH. The total sample included a set of 106 specimens. Eigenvalues, means, standard deviations, and factor loadings are given in Table 9.

Figure 20 is a scatterplot of the first two components. The facial height variables NPH and NLH, and cranial length variable (GOL) have high positive loadings on the first component. Thus, PC1 describes crania that are either long with tall faces, or short with short faces. The variables MFB, ZYB, and XPB load highly on the second component, while GOL and NPH have small negative loadings. Therefore, PC2

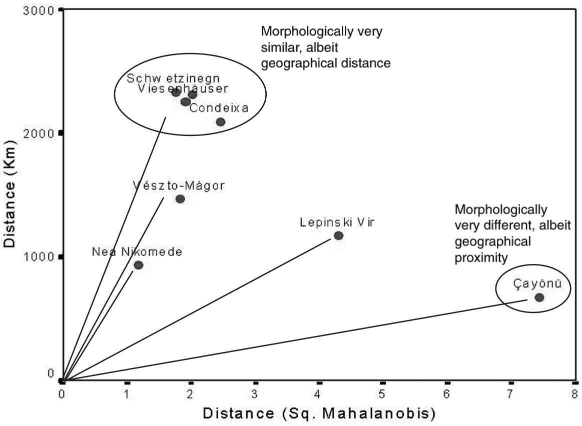


Fig. 17. A scatterplot of Square Mahalanobis distances vs. geographic distances from Çatal Höyük to European Neolithic specimens.

describes crania that are either very broad (in both vault and zygomatic dimensions), and moderately short with short faces, or the opposite shape. Orbital Height (OBH) and MFB have high positive loadings on the third component (especially OBH), while XPB and ZYB load negatively on this component. Thus, PC3 describes crania that are either very broad with short orbits and narrow frontals, or very narrow with tall orbits and broad frontals.

Mandibular variables

The Eigenvalues, means, standard deviations, and factor loadings of the PCA of mandibular dimensions are given in Table 10. The analyses extracted three components, but only the first two have Eigenvalues above 1.

Figure 21 is a scatterplot of the first and second components. The upper part of the scatterplot includes two outliers, one from Çayönü and the other from Abu Hureyra. The Jericho PPNB group have positive PC1 scores and are thus located in the right part of the graph. The largest range of variation is among the Natufians. However, with the inclusion of the two outliers mentioned above, both Abu Hureyra and Çayönü have a large range of variation comparable to that observed for the Natufians. The scatterplot shows poor morphological differentiation between most groups, with the exception of Basta and Abu Hureyra, which are clearly separated. The factor loadings show that all variables load high on the first component, which may thus be interpreted as describing overall mandibular size. Ramus breadth and height have high positive loadings on the second component, while bigonial breadth and condylar breadth load negatively. Therefore, the second component describes two contrasting mandibular shapes – narrow mandibles, with broad and tall rami, and broad mandibles, with narrow and short rami.

Group Name	Mahalanobis distance	Geographic distance (km)
Çatal Höyük	7.42	674.748
Lepinski Vir	10.81	1619.438
Vészto-Mágori halom	7.85	1856.873
Nea Nikomedeia	7.26	1514.494
Schwetzinegn	6.30	2763.415
Sondershausen	6.66	2689.569
Viesenhäuser Hof	3.76	2700.287
Condeixa	11.50	2702.951

Tab. 8 A comparison of Geographic and Mahalanobis distances from Çayönü.

Dental dimensions

The third morphological complex selected is one defined by the dimensions of the lower dental arcade (excluding incisors). A principal component analysis was performed on the same set, including 75 specimens. Eigenvalues, means, standard deviations and factor loadings are given in Table 11.

Figure 22 is a scatterplot of the first and second components. The component loadings indicate that all variables load positive on the first component. The mesio-distal dimensions of the two premolars have the largest positive loadings on the second component. The highest negative loadings are of the bucco-lingual dimensions of the two premolars and the canine. However, these loadings are much smaller in scale.

The specimens from Abu Hureyra are scattered in the upper left part of the scatterplot. The specimens from

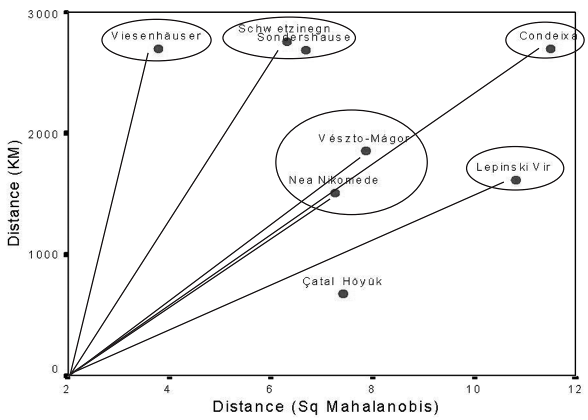


Fig. 18. A scatterplot of Square Mahalanobis distances vs. geographic distances from Çayönü to European Neolithic specimens.

Jericho form a cluster in the middle right part of the graph, next to the specimens from Basta (which, nevertheless, have comparatively smaller dental dimensions), and within the larger clusters of the Natufian and Çayönü groups. Most of the Natufian specimens show comparatively large tooth sizes. In terms of morphology, these results imply that the Abu Hureyra specimens have large mesiodistal premolar dimensions, but within an overall small dentition (negative PC1 scores).

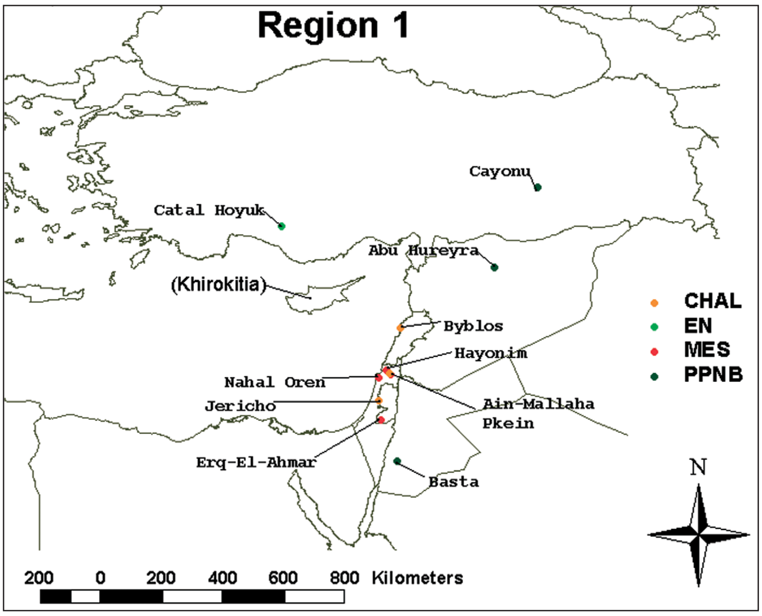


Fig. 19. Location of analysed skeletal samples from Region 1 (by site).

The results of the PCA using cranial dimensions indicate a morphological differentiation between the PPNB specimens from Basta, Abu Hureyra and Khirokitia on the one hand, and the Natufians, Çatal Höyük and Çayönü on the other hand. The second and third analyses displayed no separation between groups, with the exception of the relatively distinct dental dimensions of Abu Hureyra in relation to the other PPNB groups. In all three analyses, the intra- group range of morphological variability of the Natufians overlaps with that of Çayönü, Çatal Höyük, and Jericho PPNB. We may therefore conclude that a considerable amount of intra-group and inter-group morphological variability exists among the PPNB groups.

Discriminant analysis

Following the results obtained from the PCA, we now examine the same data using discriminant analysis. The analysis expands both the temporal and geographic scope, as it includes the Greek Early Neolithic groups and two Levantine Chalcolithic groups. The Levantine Chalcolithic samples represent the populations of the Levant that succeeded the Neolithic in this region. The groups utilised in the first analysis are outlined in the Table 12.

The variables included are GOL, XPB, ZYB, MFB, NPH, NLH, NLB, OBB, and OBH. All groups were included in the discrimination process, with the exception of half of group 3 (Çatal Höyük) and group 4 (E. Neolithic – Greece). Half of group 3 was excluded from the configuration of the canonical functions in order to evaluate the performance of the classification in the next step. Group 4 was excluded in order to determine its affinities in the classification phase.

Results are described in Table 13. Two functions, explaining 92.4% of the variance, had Eigenvalues above 1.

Results indicate that the variables mostly correlated with the first function are GOL and MFB, while OBB is highly correlated with the second function. Wilks's lambda shows that residual discrimina-

a. Means and standard deviations

	Mean	S.D.
GOL	181.29	10.51
XPB	139.89	7.30
ZYB	127.23	8.45
MFB	99.02	12.20
NPH	66.85	5.57
NLH	49.85	4.50
NLB	25.03	2.32
OBH	31.96	2.00

b. Eigenvalues and variance

	Eigenvalue %	Total variance	Cumulative Eigenvalue	Cumulative %
1	2.18	27.28	2.18	27.28
2	1.51	18.89	3.69	46.16
3	1.45	18.15	5.14	64.31

c. Factor loadings

	PC 1	PC 2	PC 3
GOL	0.58	–0.22	–0.15
XPB	–0.07	0.60	–0.58
ZYB	0.43	0.57	–0.49
MFB	–0.07	0.74	0.41
NPH	0.85	–0.21	0.06
NLH	0.84	0.07	0.29
NLB	0.45	0.11	–0.23
OBH	0.13	0.41	0.74

Tab. 9a–c. Results of the principal component analysis of cranial dimensions.

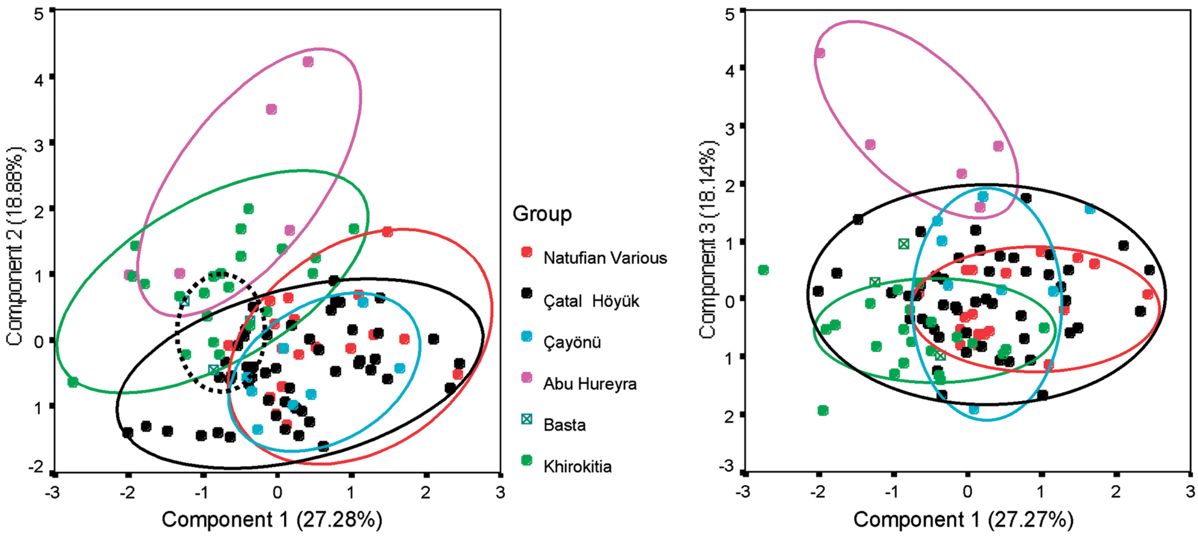


Fig. 20. Scatterplots of the 1st & 2nd and 1st & 3rd components.

tion after the derivation of the first two canonical functions is small (Wilks' Lambda = 0.755). We therefore only examine the scatterplot of the first two functions. Examination of the group centroids and scatterplot of individuals' scores (Fig. 23) indicates that the Natufian specimens (and one Greek Neolithic outlier) are very large, and thus have larger than most Fcn1 scores. Some of the Çatal Höyük specimens, as well as some of the Nea Nikomedeia sample, are particularly small. Jericho-Chalcolithic specimens are the only group with all negative values on Fcn2 (narrow orbits), and thus different from the others (albeit some overlap with remains from Nea Nikomedeia), while those from Çayönü are the only group with only positive values on Fcn2 (homogeneously wide orbits).

Classification

In total, 80.5% of the selected cases were correctly classified (Tab. 14).

Among the interesting aspects of this high classification result, we may observe that:

❶ Most of incorrectly classified Natufian remains (18.2%) were classified as PPNB, while a remaining 9.1% as Levantine Chalcolithic.
❷ All of the misclassified PPNB (Çayönü and Abu Hureyra) remains (25%) had higher probabilities of belonging to the Natufian group. Together with the observation above, this highlights that the Natufian and PPNB samples clearly have two distinct morphologies, which, nevertheless, overlap in a portion of their ranges.
❸ This latter inference can further be extended to the Anatolian Neolithic remains of Çatal Höyük in relation to the PPNB material. The former had 25% misclassified cases, all of which grouped with the PPNB sample.
❹ The material from Nea Nikomedeia is more variable, with some cases classified as PPNB, others as Anatolian Neolithic.
❺ Finally, the Levantine Chalcolithic remains are very distinct from the rest; 100% of them were correctly classified.

The high percentage of correct classification and the scatterplot of the first and second discriminant func-

a. Means and standard deviations

	Mean	S.D.
MAXL	102.45	8.08
RAMB	35.19	3.02
RAMH	58.31	5.28
GONB	95.19	7.52
CONDB	115.87	8.21
ANTH	32.97	4.25

b. Eigenvalues and variance

	Eigenvalue	% of Total variance	Cumulative eigenvalue	Cumulative %
1	2.72	45.40	2.72	45.40
2	1.08	17.93	3.80	63.33
3	0.75	12.42	4.55	75.75

c. Factor loadings

	Factor 1	Factor 2
MAXL	0.69	0.25
RAMB	0.48	0.66
RAMH	0.62	0.37
GONB	0.65	–0.57
CONDB	0.80	–0.32
ANTH	0.76	–0.12

Tab. 10a–c. Results of the principal component analysis of mandibular dimensions.

tions indicate that discrimination between these groups was easily achieved with the given variable set. The most distinctive group is the Chalcolithic Levantine, which had all its specimens classified correctly and is comparatively homogenous. The second distinctive group is Nea Nikomedeia, with 83.3% of correct classification and a rather homogenous distribution of cases. The Natufians are variable. Although distinctive enough to have the majority of specimens correctly classified, some Natufian specimens approximate the morphology of the PPNB or the Chalcolithic.

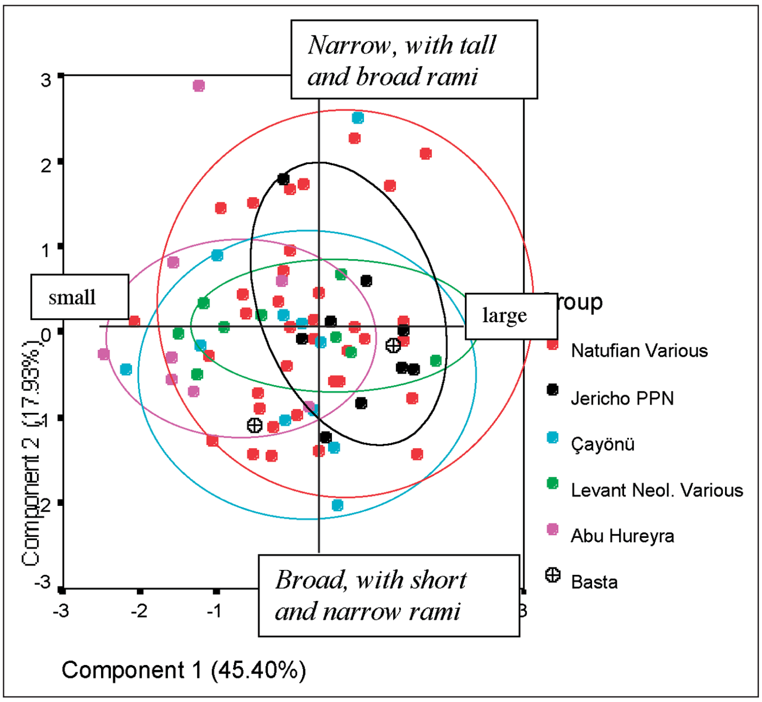


Fig. 21. A scatterplot of the first and second components (mandibular dimensions).

Summary

The first two functions of the PCA of the cranial dimensions indicated the existence of three clusters: one of the Natufian, Çayönü, and Çatal Höyük; a second, of Khirokitia, and a third, of Abu Hureyra. The PCAs based on the teeth and mandibular dimensions showed little differentiation between the groups.

The first discriminant analysis indicated a successful discrimination among most groups. In particular, the Natufians and the Jericho Chalcolithic group were separated from the rest with their high positive scores on the first function. The results show a lack of discrimination between Çatal Höyük, Körös, Nea Nikomedeia and Early Neolithic Greece.

The PPNB specimens from Basta and Çayönü are in an intermediate position between the Natufians and the Early Neolithic European groups. Çatal Höyük is clearly much closer to the Early Neolithic specimens from Greece (see the first discriminant function analysis) than to Cayönü. We can, therefore, confidently conclude that Çatal Höyük is much closer to the European Early Neolithic groups than to any of the other Anatolian/Levantine PPNB groups. Once again, we observed extensive heterogeneity within and between Levantine PPN groups and the lack of affinities between these groups and the SE European groups.

The analyses also demonstrate a lack of continuity between the Early Neolithic of the Levant and the Chalcolithic groups. The latter could easily be discriminated from most of the PPN and southeast European Neolithic groups. The position of Khirokitia as an outlier was once again confirmed. If

a. Means and standard deviations

	Mean	S.D.
LCMD	6.88	.58
LCBL	7.71	.76
LP3MD	6.85	.51
LP3BL	8.00	.57
LP4MD	6.99	.52
LP4BL	8.28	.55
LM1MD	11.03	.64
LM1BL	10.99	.59
LM2MD	10.65	.66
LM2BL	10.71	.65
LM3MD	10.57	.85
LM3BL	10.23	.80

b. Eigenvalues and variance

	Eigenvalue	% of Total variance	Cumulative eigenvalue	Cumulative %
1	6.22	51.85	6.22	51.85
2	1.54	12.85	7.76	64.70

c. Factor loadings

	Factor 1	Factor 2
LCMD	0.76	–0.15
LCBL	0.73	–0.33
LP3MD	0.54	0.58
LP3BL	0.71	–0.43
LP4MD	0.46	0.75
LP4BL	0.67	–0.25
LM1MD	0.73	0.29
LM1BL	0.83	–0.16
LM2MD	0.68	0.13
LM2BL	0.89	–0.15
LM3MD	0.69	0.34
LM3BL	0.86	–0.12

Tab. 11a–c. Results of the principal component analysis on dental dimensions.

this culture belonged to the PPNB cultures of the Levant, then its odd position further strengthens the hypothesis of a large degree of heterogeneity among PPNB cultures.

The PCAs cannot differentiate between the morphology of the Natufians and their PPNB successors, with the exception of the Abu Hureyra group, which is clearly an outlier. However, the first and second discriminant analyses show the discrimination between the Natufians and other populations.

Region 5 – Greece and south-east Europe

The affinities between Early Neolithic specimens from the Levant, Anatolia and south-east Europe were previously addressed. The aim of this section is to go further, and specifically examine the following questions:

❶ Is there any evidence for continuity between local Mesolithic and Early Neolithic populations in south-east Europe?

❷ What is the relation of the Early Neolithic groups from south-east Europe to the Anatolian Early Neolithic/PPNB populations?

❸ What degree of morphological homogeneity can we detect among the Early Neolithic specimens from south-east Europe?

The location of specimens studied is provided in Figure 24.

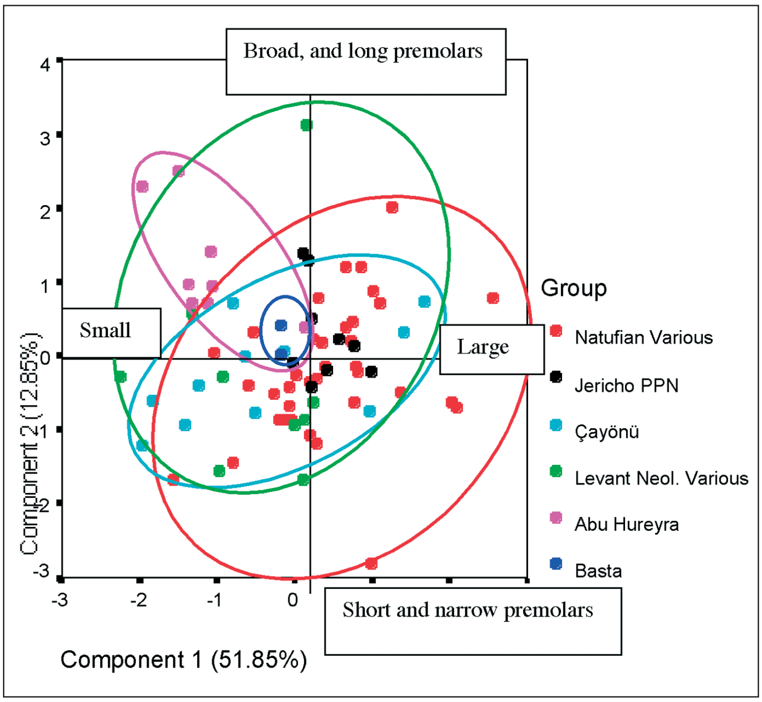


Fig. 22. A scatterplot of the first and second components.

PCA

The PCA examines the relationship between Early Neolithic specimens from Greece and Çayönü, and the Mesolithic specimens from Italy and Greece (Mediterranean Mesolithic), and the Danube Gorge (Vlasac and Lepenski Vir Mesolithic). The PCA results are described in Table 15. The selected set of variables is similar to the one utilised for Zone 1. However, the nasal length and breadth dimensions were replaced by cranial height (BBH). This set was chosen in order to minimise the number of excluded cases due to missing data and yet retain the main vault and face variables utilised throughout this work.

Group	Code
Mesolithic Levant – Natufian	1
PPNB – Abu Hureyra + Cayönü	2
Neolithic Anatolia – Çatal Höyük	3
E. Neolithic – Greece Various	4
EN Greece – Nea Nikomedeia	5
Chalcolithic Levant – Jericho	8

Tab. 12. Groups utilised in the discriminant function analysis.

Figure 25 depicts the scatterplot of the individual factor scores on the first and second components. All factor loadings, with the exception of OBH (which has a small negative loading on PC1), are positive on the first component. High loadings on the second component are of OBH (0.93) and NPH (0.56). The first component, therefore, differentiates mainly according to the size of the vault. The figure indicates a differentiation between the two Mesolithic groups on the one hand, and the majority of the Neolithic specimens on the other. This is achieved by the first component, with Mesolithic specimens having positive loadings, while most Neolithic specimens have negative loadings. The main exceptions are the two Mesolithic specimens from Ortuccio and some specimens from Çatal Höyük, which have, respectively, small and large sizes. The Mediterranean Mesolithic specimens have low faces and low orbits and thus have negative PC2 scores. The Mesolithic specimens from Franchthi Cave in Greece are not closely associated with any of the Nea Nikomedeia specimens. The group of Greek Neolithic specimens from various locations shows much variability, with some specimens such as Athens-Agora, Hageorgitika, and Greek Neolithic remains from Volos positioned next to the Greek Mesolithic cluster. The specimens from the SE Europe Early Neolithic group vary in their factor scores, and thus do not form a distinct cluster.

Discriminant analysis

A discriminant analysis was performed on the same set. The variables selected were GOL, XPB, ZYB, NPH, NLH, NLB and OBH. The groups used and sample sizes are described in Table 16, and the results of the analysis in Table 15.

The first part of the discriminant analysis examines the distribution of specimens from the seven groups in relation to each other, and the location of group centroids in the discriminant space (Fig. 26). Function 1 has a strong positive correlation with ZYB, GOL and NLH, thus describing long skulls, with broad faces and tall noses. Function 2 describes contrasting shapes defined by long (GOL: +0.418) and narrow (XPB: −0.468) skulls, with moderately tall faces, and the opposite combination.

The main observation is the disassociation of Khirokitia from all other groups analyzed. The Khirokitia centroid and associated specimens are clustered at the lower part of the graph, and are completely separated from all other groups by their high negative values on the second function (describing very short and broad skulls). The second observation is a cluster of Mediterranean Mesolithic specimens at the upper right section, and the proximity of their centroid to the centroids of the Danube Gorge Mesolithic and Danube Gorge Neolithic groups. The centroids of Çatal Höyük (code 4) and Körös (code 6) are very close to each other, while the centroid of Nea Nikomedeia is to the left. It is therefore possible to discern a cline of overall size (defined by facial breadth and height and cranial length) along Function 1, from the smaller groups (Nea Nikomedeia), to Çatal Höyük, to Körös, to the Mediterranean Mesolithic, with the Danube Gorge Mesolithic overlapping the range of variation of the latter and partially Körös. Although there is much overlap in each case, the trend in size is apparent.

a. Group Statistics

Group	Arch. Period	Code	N
Levant-Natufian	Mesolithic	1	11
Çayönü	PPN	2	4
Çatal Höyük	E. Neolithic	3	8
Greece-Neol.	Neolithic	4	none
Nea Nikomedeia	E. Neolithic	5	12
Jericho	Chalcolithic	8	6
		Total	**41**

b. Eigenvalues and Wilk's lambda

Eigenvalues Function	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation	Wilk's Lambda Test of Function(s)	Wilks' Lambda	Chi-square	df	Sig.
1	2.422	60.7	60.7	.841	1 through 4	.097	78.040	32	.000
2	1.268	31.8	92.4	.748	2 through 4	.333	36.829	21	.018

c. Structure matrix

	Function 1	2	3	4
GOL	.540	–.178	.432	–.324
OBB	.056	.770	.301	–.459
MFB	.330	.069	.641	.153
NLH	.267	.174	–.347	.017
NLB	.012	.070	–.157	.071
NPH	–.068	.069	–.119	–.068
OBH	–.160	.052	.033	.603
XPB	.040	.195	.537	.541

Tab. 13a–c. Results of the discriminant function analysis. analysis.

CLASSIFICATION

The classification included all groups plus an additional group of early Neolithic specimens for which posterior probabilities were recorded (group 8), but were not selected for the calculation of the discriminant functions. Altogether 61.4% the cases were correctly classified into one of the seven groups. Classification is 100% in the case of Khirokitia (group 1), followed by 90.9% in the case of the Mediterranean Mesolithic (group 3). In the case of the Danube Gorge Mesolithic group, the percent of correct classification is 58.3%, with 25% of the cases being misclassified into the Mediterranean Mesolithic and an additional 16.7% into Nea Nikomedia. In the case of the Danube Gorge Neolithic group, classification is poor. Only 33% of the cases were correctly classified, with single cases (i.e., 16.7% each) being assigned into groups 1, 2, 3 and 7. Among the Nea Nikomedeia specimens (group 7), 72.2% are correctly classified, and misclassification occurs in groups 1, 2, 3 and 6. In the case of Çatal Höyük, four specimens are misclassified into the Nea Nikomedeia group, while single cases are misclassified into groups 2, 3, 5 and 6. Among the Körös specimens (group 6) correct classification is 50 %, with 37.5% of the cases misclassified into the Nea Nikomedeia group and a single case into the Mediterranean Mesolithic group. In the case of group 8 (Tab. 19), all cases were assigned to one of the Early Neolithic groups.

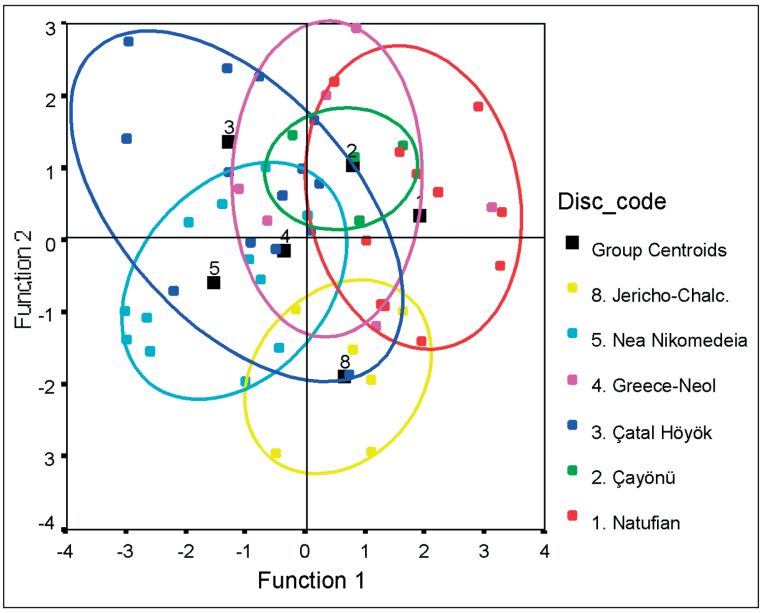


Fig. 23. A scatterplot of the first two canonical fun.

What we therefore see is a much higher degree of misclassification occurring among the Early Neolithic groups. The Danube Gorge Mesolithic and Neolithic groups have a relatively high number of cases being misclassified. These results show that discrimination between Khirokitia, the Mediterranean Mesolithic and the Early Neolithic groups is clear. However, discrimination between the Danube Gorge Mesolithic and other groups is not clearly achieved.

Summary

It is now possible to address the three questions posited in the introductory part of this section.

		Predicted Group Membership						Total
		Code	1	2	3	5	8	
Count	1	8	2	0	0	1	11	
		2	1	3	0	0	0	4
		3	0	2	6	0	0	8
		5	0	1	1	10	0	12
		8	0	0	0	0	6	6
	%	1	72.7	18.2	.0	.0	9.1	100.0
		2	25.0	75.0	.0	.0	.0	100.0
		3	.0	25.0	75.0	.0	.0	100.0
		5	.0	8.3	8.3	83.3	.0	100.0
		8	.0	.0	.0	.0	100.0	100.0

Tab. 14. Classification results.

Is there any evidence for continuity between local Mesolithic and Early Neolithic populations in south-east Europe?

There is some evidence for Mesolithic/Early Neolithic continuity only in the case of the Danube Gorge. Only about 50% of the cases of the Danube Gorge Early Neolithic groups were classified into another Early Neolithic European group or to Çatal Höyük. The other 50% were assigned to the two Mesolithic groups and to Khirokitia. In the case of Çatal Höyük, only 20% of the cases were assigned to a Mesolithic group. With Körös, only 10% (a single case) were assigned to a Mesolithic group. In the case of Nea Nikomedeia, about 30% of the cases were assigned to Khirokitia, or to one of the two Mesolithic groups.

What is the relation of the Early Neolithic groups from south-east Europe to the Anatolian Early Neolithic/PPNB populations?

The Khirokitia group stands as a population distinct from other PPNB, Mesolithic and Early Neolithic populations. In the case of Çatal Höyük, about 50% of the specimens were classified into another Early Neolithic European group. However, none of the Early Neolithic European specimens was misclassified to the Çatal Höyük group. The position of the Çatal Höyük centroid is next to the Körös centroid, and in proximity to the

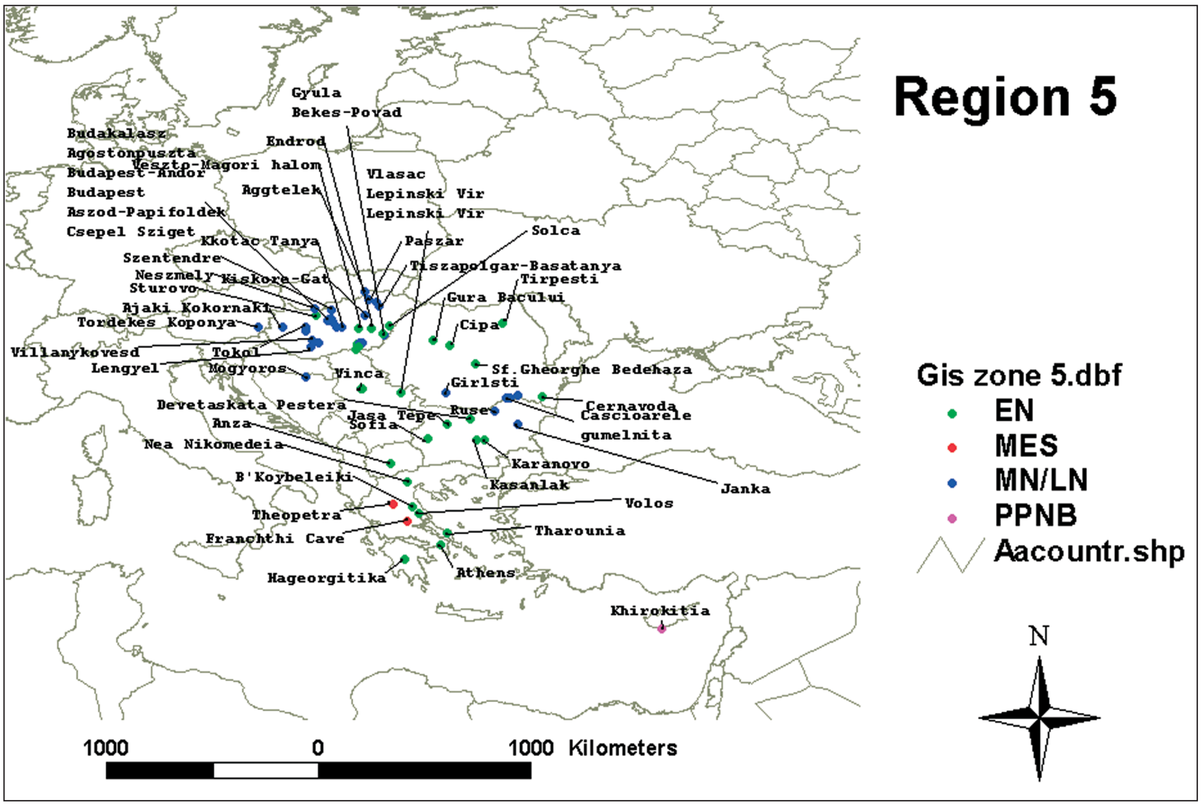


Fig. 24. Location of analysed skeletal samples from Region 5 (by site).

centroids of Nea Nikomedeia (on the left) and the Danube Gorge groups (on the right). We may therefore conclude that this group is much more similar to the Early Neolithic European populations than to any PPNB or Mesolithic groups.

What degree of morphological homogeneity can we detect among the Early Neolithic specimens from south-east Europe?

The above set of analyses was not set to particularly assess homogeneity, but rather population affinities and distances. However, the PCA gives us some idea about the range of intra-group variability. We see in Figure 22 that the Early Neolithic specimens are scattered and not clustered together as in the case of the Mediterranean Mesolithic. Nevertheless, given the existing variability of the Early Neolithic groups, most cases were still distant from the Mesolithic groups (with the exception of the Danube Gorge). This observation suggests that the apparent heterogeneity among the Early Neolithic groups is not due to their admixture with local Mesolithic populations, but rather due to other demographic, historical reasons. In addition, as this range of variability is not estimated, it is possible that it still complies with an expected range of variation in an average biological population.

Region 6 – The Mediterranean regions of France and Italy

The Mesolithic/Neolithic transition in the western Mediterranean region was a complex and diverse process (see *Plucienník 1997*). Part of this complexity is due to the fact that this region extends over a very large area of ecologically diverse zones. The review also pointed out to a 'delayed' Neolithic occupation in most of the western Mediterranean region. The majority of secure dates are from the early part of the 7th millennium BP. This implies a gap of at least 1000 years between the Early Neolithic in the Balkans and northern Greece and the western Mediterranean. In addition, the review from the various localities indicated a hiatus of more than 500 radiocarbon years between the Mesolithic and Early Neolithic occupation layers at various sites.

The questions to be addressed in this section are as follows:

❶ Regarding the Mesolithic/Neolithic transition, is there evidence for Mesolithic-Neolithic morphological affinities? We know that the 'Impressed Neolithic' pottery culture extended all across this region.

❷ Do the 'Impressed Neolithic' specimens share morphological similarities with the Anatolian speci-

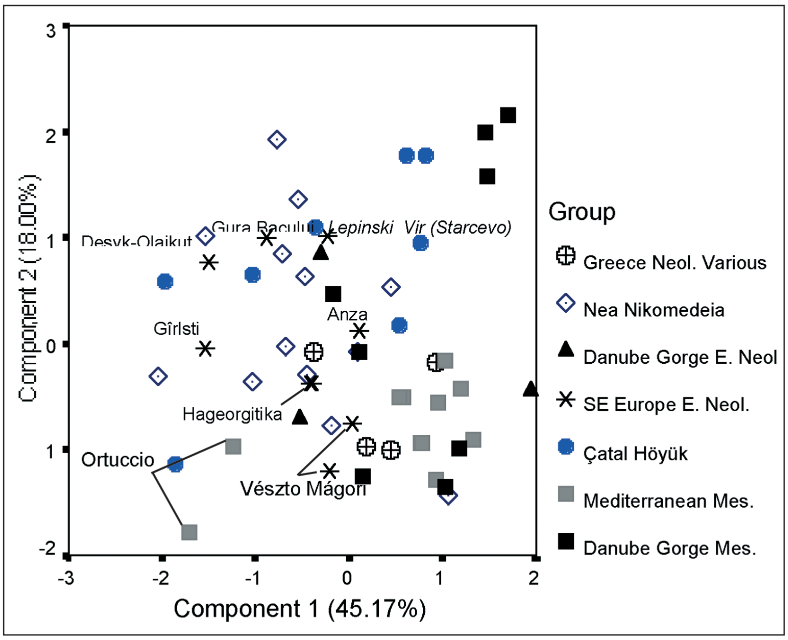


Fig. 25. A Scatterplot of the first two components.

mens from Çatal Höyük and some of the south-east European specimens?

❸ Does the morphological analysis of western Mediterranean Early Neolithic groups support the theory of a gradual logistic dispersal, or rather suggest a more rapid movement of farmers?

The location of specimens studied is depicted in Figure 27.

PCA

Analysis 1

Table 20 depicts the groups selected. The Impressed Neolithic is represented by two groups, one containing specimens from various sites (group 2) and the second containing specimens from the site of Condeixa in Sardinia (group 4). The Nea Nikomedeia is selected, as this site securely belongs to an early Neolithic occupation (group 5). The SE Europe group (group 7) contains various specimens from the following sites: Anza, Cipa, Deszk, Gura Bacalui, Devetačkata Peštera, Endröd, Hódmezövásárhely-Bodzáspart, Hódmezövásárhely-Kovács J. Tanya, Jasa Tepe, Karanovo, Kasalnak, Kotacpart, SF. Gheorge Bedehaza, Sofia, Solca, Sturovo, and Vészto-Mágori. These are all Early Neolithic sites in the Balkans and Southern Hungary. The Mediterranean Mesolithic group includes specimens from Franchthi Cave, Arene Candide, Orttocio, La Punta, San Fratello and San Teodoro, and several other Mesolithic sites.

The first analysis was performed on 72 specimens from the above set using the following variable set: GOL, XPB, MFB, BBH, NPH, NLB, NLH, and OBH. The results of the analysis are described in Table 21. Figure 28 displays the heterogeneity of the analysed groups. No separation is achieved between the Mesolithic and Neolithic groups. Positive PC2 scores are associated with high orbits, low vault, and high and narrow noses. The two Mesolithic specimens from Arene Candide (Fig. 18) belong to this type. Negative PC2 scores are associated with low orbits, wide and low noses and high vaults. The two SE Early Neolithic specimens from Devetačkata Peštera and Lengyel belong to this type.

Analysis 2

The second PCA was performed on averaged data. The groups were selected so that each one represents a single site (Tab. 22).

Results are provided in Table 23. Twenty-two groups were included in the analysis. The variables selected were GOL, XPB, MFB, ZYB, NPH, NLH, NLB, and

a. Descriptive statistics

	Mean	S.D.
GOL	185.11	7.67
BBH	136.59	6.39
XPB	138.85	6.04
NPH	67.04	4.45
OBH	32.02	2.01
ZYB	128.59	9.31
MFB	95.67	4.35

b. Eigenvalues and variance

	Eigenvalue	% of Total variance	Cumulative eigenvalue	Cumulative %
1	3.16	45.17	3.16	45.17
2	1.26	18.00	4.42	63.17
3	0.94	13.37	5.36	76.54

c. Factor loadings

	PC1	PC2
GOL	0.78	0.02
BBH	0.78	–0.05
XPB	0.63	0.11
NPH	0.66	0.56
OBH	–0.18	0.93
ZYB	0.83	–0.25
MFB	0.63	–0.07

Tab. 15a–c. Results of the principal component analysis.

OBH. Eigenvalues and cumulative variance by factor are almost identical in magnitude to those obtained in the case of the above factor analysis. The factor loadings indicate that all variables, with the exception of NLB, load highly on the first factor. The highest positive loading on the second factor is of NLB (.940). The highest negative loading is of ZYB (–.40). The highest positive loadings on the third component are of MFB (.70) and XPB (.50), and the highest negative loadings are of OBH (–.426), and GOL (–.385). We can therefore deduce that the first component accounts for general size, while the second is positively correlated with nasal breadth and minimum frontal breadth, and negatively correlated with zygomatic breadth. The third component is for the most part a reflection of variations in frontal and parietal breadth. The Mediterranean Mesolithic specimens from San Teodoro, San Fratello, Franchthi and Arene Candide are located in the forth quadrant of the graph and thus have generally large dimensions with narrow noses and wide zygomatics. The specimens from Ortuccio, Condeixa and the two Muge sites have generally small dimensions, but share with the above groups the morphological features of narrow noses and wide zygomatics. The two Cardial Neolithic groups of A. Dell'Aquila and Finale Ligura and the specimens from Tirpesti, have average cranial dimensions, but particularly wide noses and narrow zygomatics.

a. Site names and codes

Site	Code	n
Khirokitia	1	4
Vlasac Mesolithic	2	12
Franchthi Cave	3	2
Ortuccio	3	2
San Fratello	3	3
San Teodoro	3	2
Theopetra	3	1
Çatal Höyük	4	11
Lepinski Vir Neolithic	5	3
Vlasac Neolithic	5	3
Vészto-Mágori	6	6
Desyk-Olajkut	6	2
Nea Nikomedeia	7	13
Athens-Agora	7	1
B'Koybea 1	7	1
Athens-Neolithic	7	3
Tirpesti*	8	1
Cascioarele*	8	1
Gîrlsti*	8	2
Kasanlak*	8	1
Gura Bacului*	8	1

* Cases not included in the DA run, but only in the classification.

Tab. 16. Results of the principal component analysis.

Figure 29 illustrates the positions of the groups in the two dimensional space of the first two components. Great variability is evident in the distribution of Impressed Ware Neolithic specimens. We see two of the sites at the top of the scatterplot, while Grotte Sicard is at the bottom. Variability is mostly along the second axis, and thus mainly reflects variation in nasal breadth among the Impressed Ware groups.

In contrast, the Mediterranean Mesolithic groups are mostly scattered in the bottom right part of the plot, with the exception of the site of Ortuccio, which is positioned at the left part of the plot. The Early Neolithic sites of Vészto-Mágori and Nea Nikomedeia are clustered next to each other at the top centre part, very close to the sites of Çatal Höyük and Çayönü and in proximity to Tîrpesti. We see variability in the location of the Late Mesolithic sites, with Vlasac and Hoëdic at the top right (positive factor scores on both components), while the two Muge sites are towards the bottom left (negative factor scores on both components). Khirokitia is positioned in the middle of the scatterplot, and is closer to the Early Mesolithic groups and remote from the Early Neolithic Anatolian groups. The Vinča and Lepenski Vir Neolithic groups are positioned near each other at the centre-right part of the graph, near the Vlasac Mesolithic group. Thus, among the analysed Early Neolithic groups, these two groups are clearly the closest to the Danube Mesolithic and to other Mesolithic groups.

Summary

The above results point to the large heterogeneity among the Impressed Ware Neolithic groups. In the case of the cluster and PCA analyses, Arma Dell' Aquila and Finale Ligure are associated with Tîrpesti. Grotte Sicard is associated with Mediterranean Mesolithic groups, such as San Fratello and San Teodoro. The scatterplot of the PCA (Fig. 29) indicates that Condeixa is associated with the Muge groups and with Ortuccio, and is thus much closer to the Mesolithic groups than to the Early Neolithic groups. We can therefore deduce that in the case of the Mediterranean Zone, it is not possible to rule out admixture with local Late Mesolithic groups. The lack of a satisfactory sample size and geographic coverage for the Early Neolithic Mediterranean does not allow an in-depth examination of the specific areas of admixture.

The first Impressed Ware Neolithic sites appear along the Adriatic coast, and this culture only reaches the Iberian Peninsula about a millennium later. We may therefore assume a gradual spread of this culture along the Mediterranean coast, and generally along the east-west axis at the southern part of the continent. We cannot, however, based on the above results, detect whether this spread was gradual or rapid.

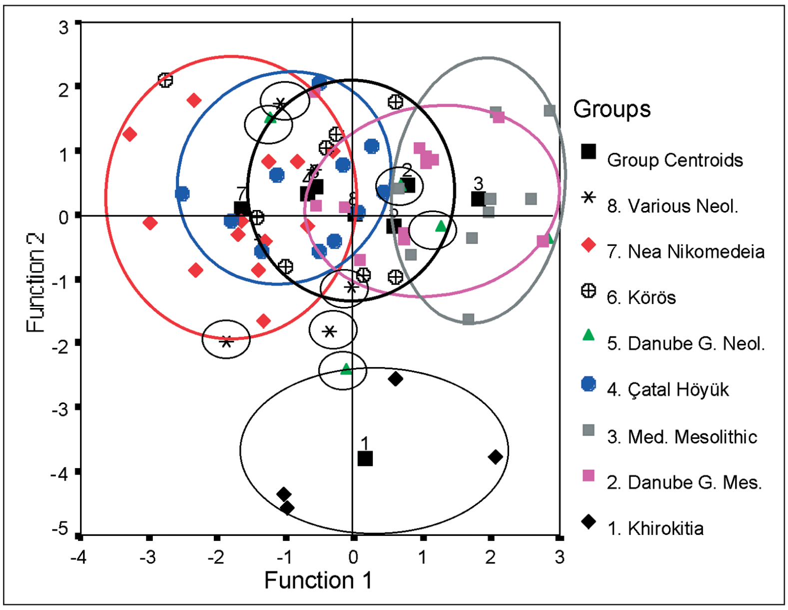


Fig. 26. A scatterplot of the first and second discriminant functions.

The Danube Gorge groups display similarities to each other and suggest local continuity. It is important to distinguish between the Balkans zone, as a whole, and the specific Danube Gorge Groups. While in the Gorge evidence for continuity may be found, the rest of the Balkan populations show clear evidence of affinities to each other, to Nea Nikomedeia, and to Çatal Höyük. These results support the hypothesis of a dispersal of farmers from central Anatolia (represented by Çatal Höyük), to the Greek Mainland and the Balkans, as well as to the southern part of Hungary.

ASSESSING THE RESULTS IN THE CONTEXT OF GENETIC STUDIES

The above discussion suggests that a general spatial analysis of genetic data may suffice to reveal general clinal patterns, but that the association of these patterns with historical events of expansion and migration is ambiguous and problematic. In general, geneticists seem to overlook the complexity of historical processes, and the fact that such processes complicate our understandings of the observed genetic patterns across space. Interpolation, coalescence, and other mathematical models and methods often applied by geneticists tend to smooth out differential densities of genetic markers in specific regions, and steep genetic boundaries in favour of clinal patterns. It has also been pointed out by Barbujani (*1995*), Barbujani and Bertorelle (*2001*), and Sokal (*1991*), that migratory events without admixture, and gradual dispersal with admixture, can result in similar geographic distributions of gene frequencies. As Barbujani and Bertorelle (*2001.22*) point out: "*A cline or gradient, for example, may reflect adaptation to variables environments, or a population*

a. Eigenvalues and Wilk's lambda

Eigenvalues					Wilk's Lambda				
Function	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation	Test of Function(s)	Wilks' Lambda	Chi-square	df	Sig.
1	.907	43.1	43.1	.690	1 through 6	.201	99.427	42	.000
2	.785	37.3	80.5	.663	2 through 6	.384	59.406	30	.001
3	.239	11.4	91.8	.439	3 through 6	.685	23.497	20	.265

b. Structure matrix

	Function 1	Function 2
ZYB	.733	–.320
GOL	.684	.418
NPH	.246	.267
NLH	.431	–.076
OBH	–.153	.188
XPB	.014	–.468
NLB	–.084	.264

Tab. 17a–b. Results of the discriminant analysis.

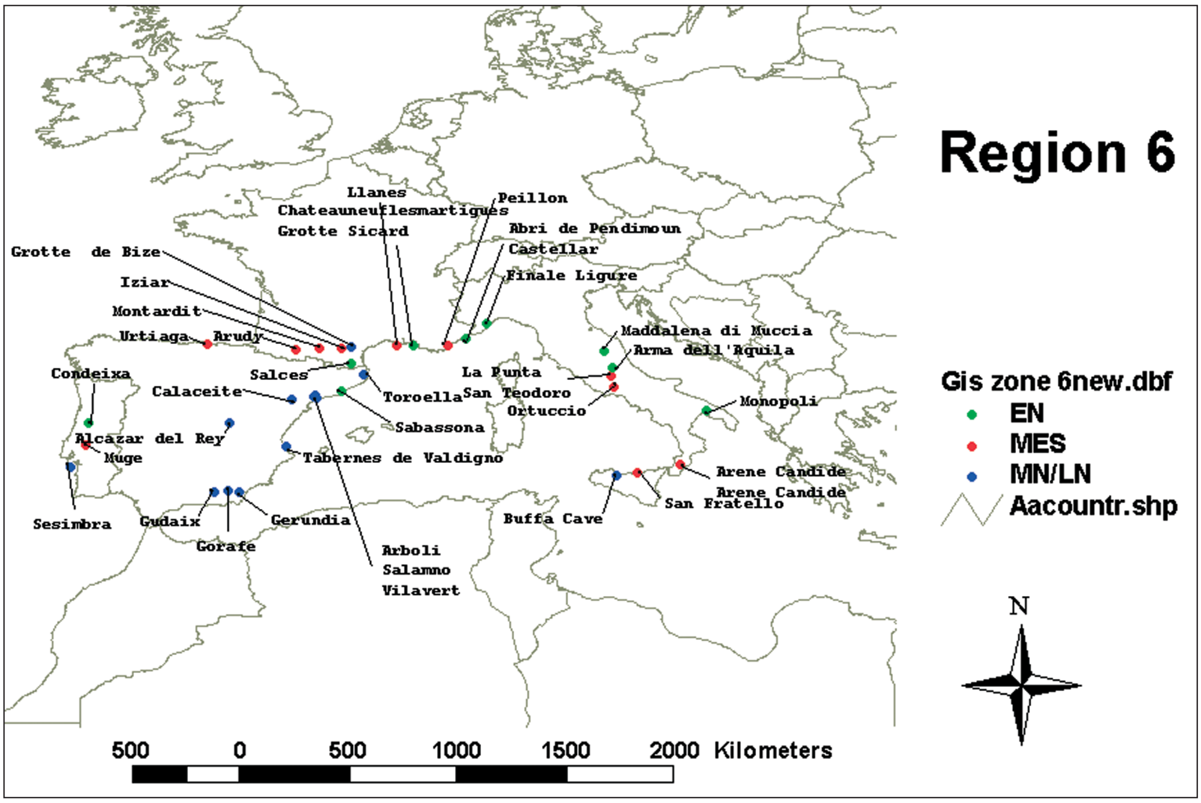


Fig. 27. Location of analysed skeletal samples from Region 6 (by site).

expansion at one moment in time, or continuous gene flow between groups that initially differed in allele frequencies". Thus, the genetic analyses cannot detect more particularistic, population-specific patterns. These specific patterns can only be revealed by the incorporation of non-genetic information. This information should include geographic data which take into account geographic barriers such as seas, lakes, mountain ranges, and possibly ecological barriers, such as deserts, forests, and so on. Most importantly, it should include archaeological and biological (i.e., skeletal) data, the only actual evidence of past peoples in time and space.

Support for 'demic diffusion' (model 2a) comes from the study by Semino and colleagues (*1996*) of frequencies of two distinct Y-chromosome markers, the p12f2-8-kb and the 49a, f-Ht 15 alleles among 3000 subjects, mainly from Europe. The study revealed that the p12f2-8-kb allele is specific to western Eurasian populations. The frequencies of this allele among Near Eastern and European populations display a cline decreasing from the Near East to north-western Europe. In contrast, a map of 49a, f-Ht 15 allele frequencies displays a cline in the reverse direction, with its highest frequencies among north-western Europeans and the Basque. On the basis of these geographic patterns, these results have been interpreted as suggesting that the 49a-f-Ht 15 allele can be considered as a proto-European haplotype, while the p12f2-8-kb allele is a Near Eastern haplotype. The south-east to

		Predicted Group Membership							Total
	Group	1	2	3	4	5	6	7	
Count	1	4	0	0	0	0	0	0	4
	2	0	7	3	0	0	0	2	12
	3	0	0	10	0	0	1	0	11
	4	0	1	1	3	1	1	4	11
	5	1	1	1	0	2	0	1	6
	6	0	0	1	0	0	4	3	8
	7	1	1	2	0	0	1	13	18
%	1	100.0	.0	.0	.0	.0	.0	.0	100.0
	2	.0	58.3	25.0	.0	.0	.0	16.7	100.0
	3	.0	.0	90.9	.0	.0	9.1	.0	100.0
	4	.0	9.1	9.1	27.3	9.1	9.1	36.4	100.0
	5	16.7	16.7	16.7	.0	33.3	.0	16.7	100.0
	6	.0	.0	12.5	.0	.0	50.0	37.5	100.0
	7	5.6	5.6	11.1	.0	.0	5.6	72.2	100.0

Tab. 18. A summary of the classification results.

Location	Assigned Group
Tirpesti	5
Cascioarele	4
Gîrlsti	6
Gîrlsti	4
Kasanlak*	6
Gura Bacului*	7

Tab. 19. Classification results for unselected cases (group 8).

north-west distribution of the latter is therefore in agreement with the 'demic diffusion' model. However, an examination of the published table (*Semino and colleagues 1996.Tab 1*) indicates that the frequency distribution of this allele is not uniform, being high among Near Eastern, Greek, Albanian, and Italian populations (f > 20), and much lower (f < 8) among Spanish, French, Hungarian and English populations. It is therefore questionable whether such results actually support the 'demic diffusion' model.

Lucotte and Loirat (*1999*) analysed the distribution of haplotype 15 at p49 (locus DYS1) of the Y-chromosome among present-day Europeans. Their sample included 2,418 individuals originating from 28 different geographic locations in Western Europe. They found the highest frequencies of the p49 TaqI haplotype 15 among French Basques (72.2%), Spanish Basques (53.8%), and individuals from the Montpellier region in France (53.5%). Frequencies were considerably lower in south-western European regions and in central Europe, while a minor peak was detected in north-west Europe (Great Britain, Brittany, Northern France, Germany, Belgium). The spatial plotting of these results, using frequency contours, reveals that there exists a gradient from north-west Europe and the Basque area into south-eastern and peripheral countries. This pattern is opposite in direction to the cline observed for the HLA genes, but is in agreement with the clinal distribution observed in the fifth synthetic map produced by Cavalli-Sforza and his team (*1994.294*). This map has very wide bands, which may represent the pre-Neolithic relict populations.

Similar results were obtained by Wilkinson-Herbots and colleagues (*1996*) (see also *Richards et al. 1996*) in their analysis of human mtDNA at site 73 of hypervariable region II. A reduced median network of mtDNA control region sequence data for European populations (*Wilkinson-Herbots 1996.Fig 1*) suggests the presence of 5 groups. The diagram indicates that the phylogenies of groups 1 and 4 are star-like, while those of groups 2, 3, and 5 are not. A possible explanation for the star-like structure of groups 1 and 4 is that they reflect the population expansion of the Late Glacial Maximum (20 000 BP), perhaps from one or two relict populations (*Wilkinson-Herbots et al. 1996*). The estimated age of these two groups is around 25 000 BP, using an evolutionary rate of 11.81% originally obtained by Stoneking and colleagues (*1992 as cited in Wilkinson-Herbots 1996*). Based on the same mutation rate, an estimate of 45 000 BP was obtained for group 5 and suggests that this population, together with parts of groups 2 and 3, represents the pre-glacial populations of Europe.

Chikhi and colleagues (*1998a; 1998b*) looked at nuclear DNA clinal variations across Europe. They found that out of 34 DNA alleles, 22 showed significant spatial structure. Approximately one third of the alleles were arranged in broad, statistically-significant gradients, while for some other alleles, long-distance differentiation was evident. These results indicate that (1) patterns observed by the study of molecular markers (*Menozzi et al. 1978; Cavalli-Sforza 1994; Sokal et al. 1989*) do not differ much from studies of non-molecular markers; and (2) there is evidence to suggest that isolation by distance has affected genetic variation at the molecular level. Chikhi and colleagues admit that more research is required in order to reveal whether these DNA markers are affected by selective forces. Nevertheless, the presence of a clinal pattern among these markers casts some doubt on the aforementioned argument of Fix (*1996*) for a selection-based clinal pattern. It thus remains to be investigated whether the European clinal pattern is the outcome of 'demic diffusion', which assumes a certain level of admixture with local Mesolithic populations, or a 'stepping-stone' model of founder effects, which annuls any admixture.

In a recent work, Chikhi and colleagues (*2002*) studied Y chromosome markers, using a genealogical

Group	Arch. Period	Code
Impressed Ware – various	Impressed Ware	1
Impressed Ware – Condeixa	Impressed Ware	2
Nea Nikomedeia	Early Neolithic	3
SE Europe – Various	Early Neolithic	4
Çatal Höyük	Early Neolithic	5
Med. Mesolithic	Mesolithic	6

Tab. 20. Groups selected and corresponding codes.

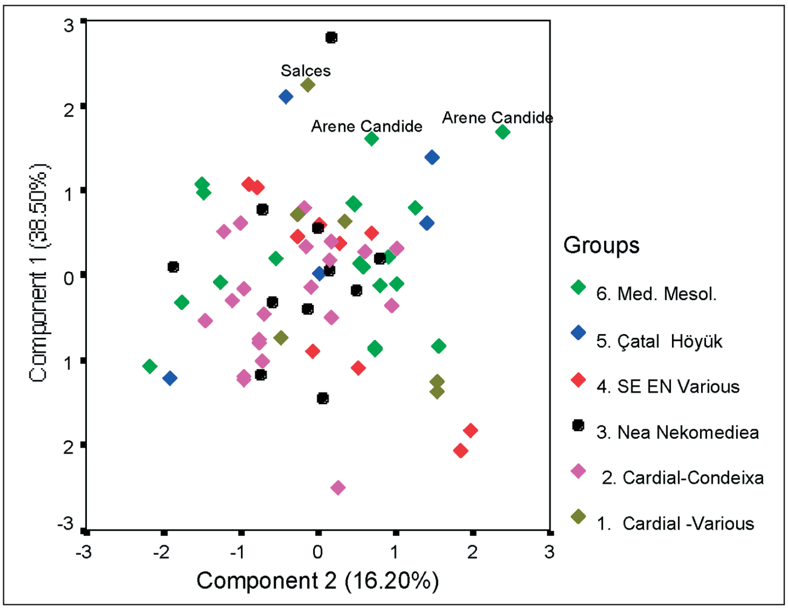


Fig. 28. A scatterplot of the 1st and 2nd components.

likelihood-based approach and to examine their findings in the light of the Demic Diffusion model of Ammerman and Cavalli-Sforza (*1984*) and the Cultural Diffusion model (i.e. indigenous transition). Their main innovation was the evaluation of genetic data from European, Anatolian and Near Eastern populations, modelling for admixture between migrating Neolithic farmers and local Mesolithic populations, as well as for the effects of drift. The data set comprised 22 binary markers from the non-recombining region of the Y chromosome (NRY) in a large number of European populations (n = 1,007 chromosomes from 25 samples). These markers are considered to be the result of unique mutational events and are called unique-event polymorphisms and are thought to be rare enough to have occurred only once in the recent history of human populations. In order to estimate admixture, the genetic structure of the original Neolithic population was derived from three samples from Syria, Turkey and Lebanon. The Mesolithic (or Paleolithic) population was represented by two samples of Basques.

The results of the analysis of Chikhi et al. indicate that there is a clear trend across Europe, with the proportion of Neolithic genes decreasing from modal values around 85–100% in Albania, Macedonia, or Greece, to around 15–30% in France, Germany, or Catalonia. The statistical significance of this trend was then assessed and quantified by combining information from the individual populations and their geographic distance from the Near East and by plotting the regressions. Estimated average p1 values across Europe were compared with the values given by Semino and colleagues (*2000*) for the same data set. Chikhi and colleagues found an average Neolithic contribution of 50% across all samples. Furthermore, Chikhi and colleagues (*2002*) point out that these figures are likely to be underestimates of the true genetic contribution of the Neolithic farmers. This is since the method utilized estimates only the proportion of genes that can be traced back to ancestors in the Near East rather than the true proportions of Neolithic vs. Paleolithic genes during the initial formation of Neolithic settlements in Europe. Thus, according to Chikhi and colleagues, the contribution of Neolithic farmers to the current gene pool of the various European populations is in fact between 65 and 100%. These results provide further support for the 'Demic Diffusion' model. Moreover, the study reveals the importance of the incorporation of demographic parameters such as admixture rates and drift in any study of the spread of farmers in Europe.

A more geographically oriented approach was applied in a study of Simoni and colleagues (*2000*). They analysed more than 2600 sequences of the first hypervariable mitochondrial control region for geographic patterns in Europe. Spatial autocorrelations were used in order to examine the relationship between genetic variability in this region and geographic distances. However, only a limited geographic pattern was observed. An area of significant clinal variation was identified around

a. Eigenvalues and variance

	Eigenvalues	% Total variance	Cumulative %
1	3.08	38.50	38.50
2	1.30	16.20	54.70
3	0.96	12.01	56.71

b. Factor loadings

	PC1	PC2
GOL	0.79	–0.15
BBH	0.76	–0.39
XPB	0.42	0.16
MFB	0.55	–0.27
NPH	0.78	0.27
NLH	0.77	0.38
NLB	0.34	–0.56
OBH	0.28	0.70

Tab. 21a–b. Results of the principal component analysis.

the Mediterranean Sea, but not in the more northern parts of Europe. According to Simoni and colleagues (*2000.275*): "*A simple demographic expansion from the Levant is easy to reconcile with the gradients observed at many nuclear loci, but it is not easy to link with the fact that mitochondrial variation is clinal only in southern Europe.*" These findings may suggest greater gene flow (female, at least) along the southern Mediterranean region than across the northern part of the continent (*Simoni et al. 2000*). These findings agree with the suggested model. As the Impressed Ware people expanded westwards, they would have absorbed differential amount of genes from local foraging groups. Signs of initial admixture were observed in section 9.8 in the case of some of the initial Impressed Ware sites.

There is an apparent discrepancy between findings from mitochondrial DNA studies (*Richards et al. 1996; Richards et al. 1998; Wilkinson-Herbots et al. 1996*), which suggest a Palaeolithic ancestry to modern western European populations, and the findings from nuclear DNA (*Chikhi et al. 1998a; 1998b*) and classical markers (*Menozzi et al. 1978; Cavalli-Sforza et al. 1994*), which suggest a Neolithic demic diffusion from the Levant as the main contributor to the European gene pool. This incompatibility can be explained if one is to accept that the gene pool of all modern European populations is to some extent admixed, with differential percentages of Palaeolithic and Neolithic ancestral contributions. This supposition is supported by evidence from mtDNA studies (*Richards et al. 1996*), which points to the mixed indigenous Palaeolithic and Neolithic (i.e., demic diffusion) ancestry of European populations. In the case of Y chromosome markers, results obtained by Semino et al. (*1996; 2000*) suggest that the contribution of incoming Neolithic farmers to the gene pool of the current European populations was as low as 22%. These results contrasts with results of the analysis of Y chromosome markers by Chikhi and colleagues (*2002*) suggesting that the genetic contribution of the incoming farmers may have been around 70%, and thus more in agreement with the demic diffusion model than with the concept of cultural diffusion without dispersal of farmers.

The analyses of variability and morphological affinities suggest that the Epipalaeolithic populations from the Levant (Natufian) differed to a fair extent from

Location	N*	Date (bp)	Lat. (N)**	Long. (E)**	Arch Period	Group Code
Arma Dell'Aquila II	3		42.37	13.37	Impressed Ware	1
Condeixa	60		40.06	8.30	Impressed Ware	1
Finale Ligure	3		44.12	8.18	Impressed Ware	1
Grotte Sicard	3		43.24	5.12	Impressed Ware	1
Arene Candide	3		38.33	16.12	Early Mesolithic	2
Franchthi Cave	3		39.00	22.30	Early Mesolithic	2
Ortuccio	3	12500	41.54	13.42	Early Mesolithic	2
San Fratello	4	12003	38.00	14.36	Early Mesolithic	2
San Teodoro	4		42.00	13.30	Early Mesolithic	2
Nea Nikomedeia	11	8180	40.65	22.30	Early Neolithic	3
Vészto-Mágori	7	6200	46.94	20.23	Körös	3
Tîrpesti	4	6240	47.17	26.33	Pre-Cucuteni	3
Vlasac	56	7755	44.31	22.01	Late Mesolithic	4
Hoëdic	18		47.21	2.52	Late Mesolithic	4
Muge-Arruda	10		39.06	8.42	Late Mesolithic	4
Muge –Moita	14		38.37	8.58	Late Mesolithic	4
Teviec	31	9025	47.00	3.00	Late Mesolithic	4
Çatal Höyük	50	7499	37.10	32.13	E. Neolithic	5
Çayönü	9	9360	38.23	39.65	PPN	5
Khirokitia	21	7368	34.54	33.00	PPN	5
Lepenski Vir – E. Neol.	23		44.33	22.03	Starcevo	6
Vinca-Neol	9		44.48	20.36	Starcevo	6

* Sample sizes are given prior to the casewise exclusion due to missing values

** Latitude and longitude are in the North East quadrant and in decimal notation

Table 22. Groups analysed in PCA mean data analysis.

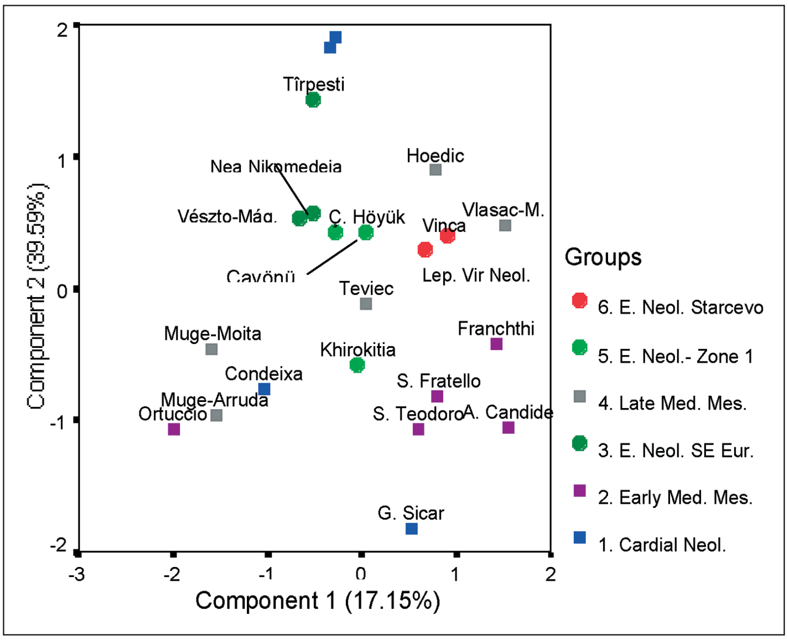


Fig. 29. A scatterplot of the 1st and 2nd components.

the Mesolithic population of the Danube Gorge, western Mediterranean and central Europe. As discussed before, no close similarities were observed between Early Neolithic and Mesolithic European groups in any of the studied regions, with the possible exception of the Danube Gorge, Mediterranean Europe, and the unstudied region of Atlantic Europe. However, there were also no clear affinities observed between the Epipalaeolithic Near Eastern groups and any other Mesolithic or Neolithic groups. These results imply a third scenario: that the original Epipalaeolithic population from which the first Anatolian farmers descended is yet to be "discovered", as there are at present no skeletons, and meagre evidence for Epipalaeolithic occupation in Anatolia (*Özdoğan 1999*). According to Özdoğan (*1999*), the late phase of the Upper Palaeolithic period is either absent or poorly represented in both central and eastern Anatolia. The absence of sites from this period seems to reflect the scant occupation of these regions, rather than any excavation bias.

The observed variability between Levantine and European Epipalaeolithic/Mesolithic groups should be studied in relation to the Upper Palaeolithic populations of Europe and the Near East. Thus, genetic studies that point to an Upper Palaeolithic ancestry of modern European populations should take into consideration population bottlenecks and segregation during the Late Glacial period, which can perhaps account for the above noted morphological variability during the Mesolithic.

The current findings question the interpretation of the first synthetic map in the study of Cavalli-Sforza and colleagues (*1994*). The claim that the observed genetic cline is in fact the outcome of a 'demic diffusion' across Europe as proposed by Ammerman and Cavalli-Sforza (*1984*) is only partially in agreement with the current results (genetic, archaeological and palaeobiological). An examination of the model outlined in figure 10.4 indicates that the SE–NW genetic cline is, in fact, a synthesis of a southern (Mediterranean) cline and the northern/western cline generated by the expansion northwards and westwards of the Early Neolithic cultures of SE and central Europe. In other words, the new model agrees with the demic diffusion model in respect to western (i.e., Atlantic and western Mediterranean regions) and northern Europe, but not in the case of south-east and central Europe. One possibility is that the genetic cline is partially the outcome of the subsequent expansion of the Early Farmers, and partially the outcome of gene flow during later historical periods.

a. Means and standard deviations

	Mean	S.D.
GOL	185.65	6.39
XPB	138.53	3.75
MFB	95.55	3.21
NPH	66.32	2.98
NLH	49.56	2.13
NLB	24.66	1.20
OBH	31.43	1.32
ZYB	130.60	7.90

b. Eigenvalues and variance

Component	Eigenvalue	% Total variance	Cumulative %
1	3.17	39.59	39.59
2	1.37	17.15	56.74
3	1.21	15.08	71.82

c. Factor loadings

	PC 1	PC 2	PC 3
GOL	0.62	0.30	–0.39
XPB	0.67	0.02	0.51
MFB	0.52	0.36	0.70
NPH	0.74	–0.17	–0.21
NLH	0.85	–0.15	–0.24
NLB	0.05	0.94	–0.07
OBH	0.48	0.24	–0.43
ZYB	0.75	–0.40	0.14

Tab. 23a–c. Results of the PCA analysis on group means (n = 22).sis of cranial dimensions.

ASSESSING THE MODELS FOR THE SPREAD OF FARMING IN EUROPE

Model 1 – Autochthonous transition across Europe

The 'indigenous' model views the transition to farming as the result of cultural diffusion, without associated migrations or dispersals of human populations. Under such a model, local European hunter-gatherer populations adopted farming either as a form of independent 'discoveries' or consequential to the arrival of knowledge and technology from the Neolithic cultures of the Near East and Anatolia. Underlying this approach is the assumption that the transition to farming occurred at different times and in different manners in the various regions of Europe. Archaeologists that support this model provide evidence which suggests continuity in material culture, and emphasise the economic, technological and cultural complexity of many of the Mesolithic cultures, which are viewed as a sort of 'pre-adaptive' stage followed by the choice of an agricultural lifestyle.

The central tenet of this model is that in each region, the Early Neolithic farmers are the descendants of local Mesolithic populations. These descendants may differ in some morphological aspects from their ancestral Mesolithic predecessors due to admixture with other Neolithic groups and changes in morphology associated with their new lifestyle. Nevertheless, their morphology must display some affinities to their Mesolithic ancestors or similarities to contemporaneous neighbouring Mesolithic groups. Moreover, one should also see regional differences in morphology, as local continuity with minimal gene flow is assumed for each of the regions addressed. If this was the case, one should expect to see morphological distances across space being greater than morphological distances by period. However, the results of the analysis of the squared Mahalanobis distances between Mesolithic and Early Neolithic groups (*Pinhasi 2003*) indicate that this is not the case. The only possible case of regional continuity observed was in the case of the Danube Gorge region, where distances between these Mesolithic groups to the Early Neolithic context from Lepenski Vir are smaller than distances between the former and other Early Neolithic European groups. It is possible that, had the data set contained specimens from Atlantic Europe and the Iberian Peninsula, one would have found similar indications for local continuity in these regions.

No firm evidence for local continuity was obtained in the case of the Levant region (*Pinhasi 2003*). The analysis of Levantine groups demonstrated a possible continuity between the Natufians and the Northern Levant and Jericho PPN in terms of their mandibular and dental dimensions. However, other PPN groups showed lack of affinities to the Natufians. One of the most intriguing results was the large degree of variability among the PPNB 'Initial Neolithic' groups from the Levant and Anatolia. The position of Khirokitia and Abu Hureyra as outlier populations was particularly noticed in numerous analyses. Moreover, the Natufians as a group display a large degree of heterogeneity, which suggests that they either represent several biological populations, a period of morphological transition with differential expression through time and space (the Natufian samples derive from several sites spanning a few thousand years), or still a period of comparatively relaxed selective pressures (in relation to earlier Upper Palaeolithic groups) that led to increased diversity.

The regional analysis indicated lack of continuity between the Early Neolithic populations of the Levant and Chalcolithic groups. The latter could be easily discriminated from most of the PPN and south-east European Neolithic groups. The observed differences reflect populations that were isolated enough from each other to allow the development of regionally-specific morphological patterns. It is then possible that, after the initial phase of adoption of agriculture in the Levant and Anatolia, the PPN populations became isolated from each other and did not share a large mating network, as in the case of various hunting populations. The existence of biologically diverse PPNB groups in this region is likely, considering the time span of 2000 years or more during which agriculture communities existed prior to the first spread of farming into Europe. In fact, we see a similar process of diversification following the first period of the Neolithic in Europe. This diversification is evident culturally in the appearance of diverse stylistic groups in east and central Europe (*Sherratt 1983; Thorpe 1996*). What is important in this scenario of a period of differentiation of PPN populations in the Levant prior to expansion of agriculturists outside the region is that the group that contributed to the gene pool of European farmers (or originated it) need not be representative of the entire PPN Levantine population, but rather of one isolated and already somewhat differentiated group.

The other possibility is that the heterogeneity among the PPNB populations reflects differences in morphology among their ancestral Epipalaeolithic populations. As there are hardly any human remains from the Epipalaeolithic period of Anatolia, we presently know very little about the late hunters from this region and cannot therefore evaluate this hypothesis.

Beyond the zone of Anatolia and the Near East we find a striking degree of morphological similarities among Early Neolithic populations. Thus, the first farmers from Nea Nikomedeia and other Greek Neolithic sites are similar to the first farmers from Çatal Höyük, as well as to specimens of the Körös and Starčevo cultures and to the first LBK groups of Central Europe. The analyses showed no similarities between Greek Neolithic specimens and the Mesolithic specimens from Franchthi Cave, and thus no evidence for local continuity in the region of mainland Greece.

Equally, there appear to be no affinities between any of the LBK groups and the German Mesolithic specimens from Ofnet, Hohlestein, Kaufertsberg, Stetten or Bottendorf (analysis of region 4 in *Pinhasi 2003*). These findings agree with Thorpe (*1996.29*), who asserts the following in regard to the appearance of the LBK culture of Central Europe "*...there have been a few archaeologists arguing that the Mesolithic population of Central Europe as far north as the fringes of the north European plain and as far west as the Paris Basin played much part in the agricultural transition of the region, apart for some evidence for continuity in stone tool production*."

The relationship between the Mesolithic and Neolithic populations of Northern Europe was examined in the analysis of region 3 (*Pinhasi 2003*). The discriminant function analysis performed included a group of four Mesolithic specimens (group 1), one of which was the Mesolithic specimen from Spiginas, Lithuania. The other three were specimens from the Danish sites of Koelbjerg, Vedbaek and Korsør. Discrimination between this group and the rest of the (Neolithic) Danish groups was achieved along the first canonical function. Because of the small sample size of the Danish Mesolithic sample, the possibility that some affinities existed between this group and Neolithic populations of the area cannot be ruled out. Nevertheless, the lack of association (in the form of easily achieved discrimination) between the two periods is a theme which has been noticed throughout.

In sum, the review indicates that local continuity may have occurred in the Danube Gorge region and southern Scandinavia, and possibly also in the Mediterranean zone and Atlantic Europe, although the evidence for these latter areas is still tentative and dependent on more in-depth analyses. Therefore, in the case of the latter zones it is necessary to examine this claim with larger skeletal samples. From the point of view of the debate on the origins of agriculture in Europe, the model of an autochthonous development does not fit the current findings regarding the regions of the Levant, Anatolia, SE Europe and central Europe.

Model 2a – Demic diffusion

The 'wave of advance' model argues for a large-scale advancement of farmers from the Near East or Anatolia into Europe in a more or less constant expansion rate of 1.1 km/year (*Cavalli-Sforza et al. 1994*). The hypothesis was largely based on a model for the 'wave of advance of advantageous genes' originally proposed by Fisher (*1937*). This mathematical model assumes that a biological population that grows at a constant rate reaches local saturation and spreads at a constant rate of migration, randomly in all directions, tending to grow and move away from its centre of origin at a radial constant rate of advance. Ammerman and Cavalli-Sforza adopted this theoretical model and applied it, with some modifications, to their study of Neolithic demic diffusion. Ammerman and Cavalli-Sforza (*1984*) used Jericho as the centre of origin from which the farmers dispersed towards Europe. The main supporting evidence underlining their model was as follows:

❶ The expansion of farmers from the Middle East to Europe was very slow, gradual, and regular, thus more compatible with the expansion of people than of a technique.

❷ Knowledge from contemporary ethnographic observations regarding demographic growth and expansion allows one to predict that the diffusion of agriculture is compatible with demic expansion.

❸ Ethnographic observations based on African Pygmies suggest that hunter-gatherers show little tendency to acculturate when in contact with farmers.

❹ A study of the modern geographic distribution of genes in Europe strongly suggests diffusion from a centre of origin in the Middle East, as well as other less important migrations (*Menozzi et al. 1978*).

The results obtained do not support the wave of advance model. Firstly, the analysis of population variability during the Early Neolithic revealed a contrasting pattern of high heterogeneity within the Early Levantine and Anatolian populations as opposed to an apparent homogeneity among the first farming populations of Europe. We also saw that the Mahalanobis D2 distances of the Early Neolithic groups from (1) Çatal Höyük and (2) Çayönü did not reveal any correlation between the geographic distances from each of these sites and Mahalanobis distances measured from remains from other Early Neolithic sites. Moreover, both Çatal Höyük and Çayönü are much closer (morphologically), to the early Neolithic European populations than to any of the PPNB Levantine groups (i.e., Basta, Abu Hureyra, Jericho, etc.).

Secondly, the 'wave of advance' model explains the observed genetic SE–NW cline as being due to the gradual absorption of the Mesolithic populations (*Ammerman and Cavalli-Sforza 1984*). If this was the case, then one should clearly see some morphological similarities between Mesolithic and Early Neolithic populations due to the impact of absorbing some of the Mesolithic gene pool. Furthermore, one should observe a clinal increase in similarity between Neolithic and Mesolithic groups, as the advancing wave would progressively be composed of a greater and greater proportion of Mesolithic genes. However, the craniometric analyses showed no evidence for such a pattern. The analysis revealed very limited and not overwhelming evidence of continuity of a Mesolithic morphology into Neolithic populations. This evidence was of possible local continuity in the case of the Danube Gorge Neolithic, and in the western Mediterranean. The analysis of northern Europe (region 3) also indicated possible continuity, but this could not be further assessed due to the lack of specimens from the Early Neolithic and Mesolithic periods in this area. The Atlantic European zone was not examined due to the lack of appropriate skeletal samples. Yet in the regions in which agriculture originated and first appeared in Europe (i.e., regions 1, 4 and 5), we found no evidence for affinities between Early Neolithic populations and the preceding Mesolithic inhabitants.

Thirdly, Barbujani (*1995*) pointed out that a demic diffusion without any absorption of Mesolithic populations can also result in the observed SE–NW cline. This has been outlined in various models of stochastic change (i.e., non-selective) due to drift and a series of founder effects (see *Wright 1921; 1933; 1951; 1969; Koningsberg 1990; Relethford 1991; 1996*). Similarly, Sokal et al. (*1991*) pointed out that persistent long term demic diffusion originating from a single source population, and repeated migrations by different ethnic groups along established corridors, will leave similar indistinguishable marks on gene frequency surfaces. The 'demic diffusion' model, therefore, does not agree with the observed findings, as no clinal pattern was observed, but rather clear morphological affinities between geographically distant Early Neolithic populations.

Model 2b

Model 2b proposes a scenario in which the admixture between Mesolithic and Neolithic farmers was delayed due to a period of consolidation, and therefore occurred in the Middle/Late Neolithic period rather than during the Early Neolithic period. The corresponding biological pattern should show some affinities between Mesolithic and Middle/Late Neolithic populations in a given region. Such a scenario must also presume similarities between Early Neolithic and Middle/Late Neolithic populations in a given region, as it would have been the former who underwent a period of population growth and consolidation which continued into the Middle/Late Neolithic.

Previous analyses of intra-population variability by period (*Pinhasi 2003*) show that the only similarities between Mesolithic and Middle/Late Neolithic groups was that in both periods sexual dimorphism and variability in general is more pronounced than in the case of the Early Neolithic period. However, when scrutinising specific indices and other morphological variables by period, it becomes apparent that many differences between the populations of these two periods exist.

The analysis of inter-population distances by period (*Pinhasi 2003*) pointed to regional differentiation during the Middle/Late Neolithic, with some Late Neolithic groups from central Europe and Hungary having large distances from each other. We know from the settlement pattern analysis (*Pinhasi et al. 2000*) that the evidence for Mesolithic occupation in south-east Europe is meagre. The apparent regional diversification during the Middle and Late Neolithic period cannot be associated with a delayed Mesolithic-Neolithic admixture in the case of this region. We must, therefore, conclude that a delayed admixture process is not supported by the data from the zones analysed in this work.

Model 3

The third model proposes a complete population replacement without admixture. To a fair extent, the obtained results are compatible with this scenario.

The small distances between Çatal Höyük and Early Neolithic European populations, and among the latter, do not support differentiation by distance. The small distances between Visenhäuser Hof, Schwetzingen, Kotacpart and Çatal Höyük suggest that, at least in southeast and central Europe, Early Neolithic populations are strikingly similar to each other. However, as mentioned before, we found some evidence for local continuity in the Danube Gorge, as well as possible continuity in Denmark and along the Western Mediterranean coast. The possibility of admixture between the local foragers and incoming farmers in these areas should be taken into account. Therefore, this model must be rejected, as it does not agree with the complete picture.

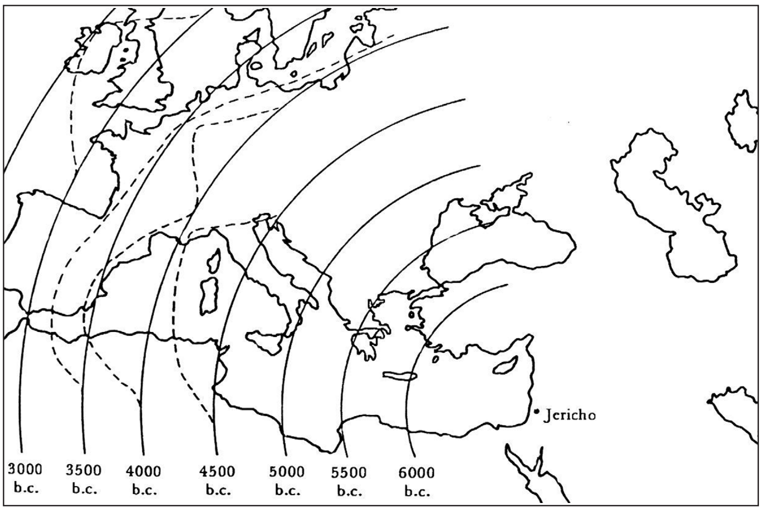


Fig. 30. The Wave of advance model. (from **Ammerman and Cavalli-Sforza 1984***).*

Model 4

The fourth model proposes that admixture was a function of the geographic region under consideration and its relevant distance from the centre of origin of the source population. Various geographic barriers exist in Europe, which more than likely affected the rate and direction of demic diffusion. These include the Mediterranean Sea, the Alps, the Pyrenees, and the Carpathians, to name but the conspicuous few. If one adds to this list an obvious preference among the dispersing farmers for fertile soils, river valleys and water sources, then the path by which the Early farmers dispersed looks much more specific and less like a radial dispersal. Moreover, the ecological preferences and geographic boundaries cannot be simply taken into account by slightly modifying existing formulas for dispersal rates, but rather requires an in-depth anthropological approach to assess past dispersal patterns.

Van Andel and Runnels (*1995*) brought forth a modified model for the dispersal of the first farmers into Europe. They based their model on the earliest occupation radiocarbon dates used by Ammerman and Cavalli-Sforza, plus additional dates from various sources.

Van Andel and Runnels point out that the wave of advance model assumes the following:

❶ An initially logistic population growth curve, which yields a continuous advance across a broad front.

❷ Local migratory activity that is, to a first approximation, continuous and random in direction (Fig. 10.2a).

This model assumes that population increase and migratory activity occurred only at the wave front, and that the rate of advance was roughly constant. Well behind the wave front, population growth slows down due to lack of room for expansion.

Van Andel and Runnels developed this model taking into account geographic barriers to dispersal. They contend that the Aegean Sea might be regarded as a geographic barrier. While sea-travel was apparently possible, it created a bottleneck that limited the number of migrants. Van Andel and Runnels (*1995*) suggest a two-phase colonisation model. At the initial stage, colonists from the Levant arrived early and almost simultaneously on Crete, at Franchthi Cave and in Thessaly, but probably only in small numbers (Fig. 10.2b). In the second step, migrating farmers, possibly from central Anatolia (T2 in Figure 10.2b) dispersed, reaching the northern part of Greece as well as Macedonia and Thrace. Van Andel and Runnels (*1995*) assert that the lengths of each step and the intervals between them were dictated by geography and by population growth in each of a slowly rising number of parent areas. However, taking a less environmentally-determined approach, one could also argue that the second wave could have been triggered by other culturally induced factors.

Van Andel and Runnels (*1995*) argue that the original dispersal westwards was by sea routes. They propose a dispersal from central Anatolia (Hacilar, Can Hassan, and Çatal Höyük) to Crete (Knossos) and the southern Peloponnese (Franchthi Cave), reaching the Larissa Basin, Thessaly and Macedonia. This model is based on the chronological discrepancies between "older" radiocarbon dates from Knossos, Franchthi, Nea Nikomedeia and Sidari, and "younger" dates from Macedonia, south Bulgaria and the Sava Valley. As has been previously mentioned, Perlès (*2001*) proposed to differentiate between "Initial Neolithic" dates in Greece, which cluster around 8800 cal BP, and the "Early Neolithic" occupation, which clusters around 8100 cal BP. The initial phase belongs to "pre-pottery" sites, which share many similarities with the 'pre-pottery" sites in Anatolia and the Levant.

The first dispersal event by sea-route would have thus been part of the dispersal of a "pre-pottery" culture which prevailed in Anatolia and the Levant and reached Crete, Cyprus, and the southern Peloponnese around 9000 cal BP. The second dispersal event would have originated from central Anatolia approximately a millennium later, and Anatolian migrants would have appeared in Thessaly and rapidly spread across south-east and central Europe. This model is illustrated in Figure 32.

Although the study of Van Andel and Runnels provides a more complex and realistic model of the initial spread of farmers into Europe, involving more than one historical event, as a model it is based on the concept of demic diffusion. The results obtained in this work do not disagree with the demic diffusion model in regards to the logistic, temporal, advance of farmers across Europe. This work did not bring forth any new evidence that indisputably supports the assertion of a rapid dispersal. The analysis of longitude and latitude of Early Neolithic sites and corresponding radiocarbon dates for first occupation showed a positive correlation between date and latitude, and a negative correlation between date and longitude, which supports a SE–NW linear advance pattern of Neolithic settlements (*Pinhasi et al. 2000*). One should then expect to detect a corresponding clinal pattern from the craniometric data, similar to the one observed for the settlement pattern analysis and Cavalli-Sforza's gene frequencies. However, the analysis of skeletal data showed no indication for such a cline. The pattern observed is of a logistic dispersal of farmers from the south-east to the north-west, without any morphological cline.

In sum, while Van Andel and Runnels' model agrees in many aspects with the obtained results, it nevertheless works with the underlying assumption of 'demic diffusion', and thus that as farmers dispersed they absorbed the local Mesolithic populations. We must, therefore, reject this model because we can not accept the assumption of a gradually increasing input of Mesolithic genes into the Neolithic gene pool as the wave of advance progressed north-westward.

Model 5

Zilhão (*1993; 2001*) proposed a model that views the spread of a Neolithic lifestyle across Europe as a punctuated process with two main pulses. The first pulse would have begun around 6800–6400 BP, characterised by the spread of farming along (1) the Danubian route, and (2) the Mediterranean route. According to Zilhão, while the spread of farming along the Danubian route was rapid and involved the absorption of local Mesolithic groups, the spread of farming along the Mediterranean coast was slower, due to the predominance of hunter-gatherer groups in these regions. Consequently, hunter-gatherer bands and a more mobile settlement system continued to exist along the western Mediterranean shores for some time.

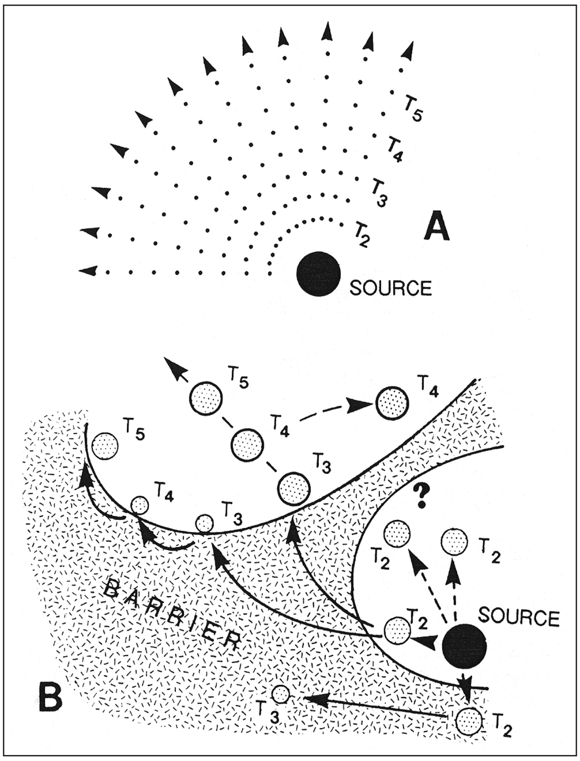


Fig. 31. The original wave-of-advance model (a), modified (b) by the addition of a barrier to gradual movement (sea, desert or mountain range), combined with strong preference for a specific but rare environment (large floodplains) from* Van Andel and Runnels 1995*).

A second pulse would have occurred after 6000– 5500 BP, in which agricultural populations would have reached northern Iberia, western France, the Low Countries, the British Isles, and Scandinavia. Zilhão contends that in contrast with the first pulse, the spread of farming in these regions is mainly the result of the adoption of these practices by local hunter-gatherer groups, rather than being due to an incoming wave of farmers.

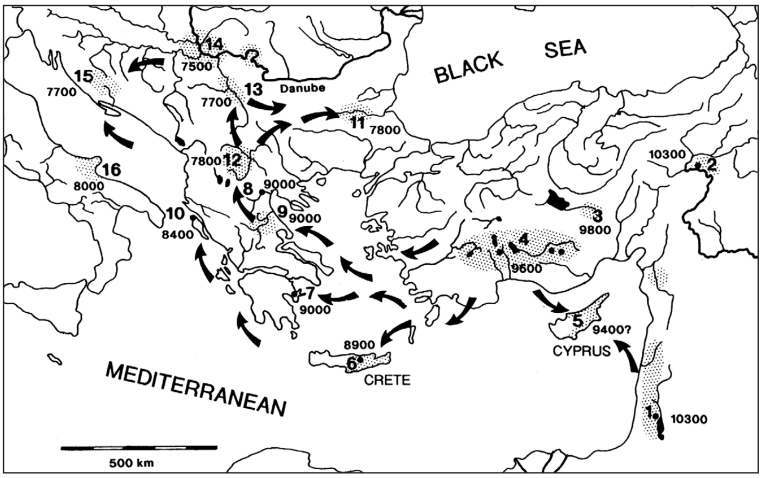


Fig. 32. Van Andel and Runnels' multi-phase colonisation model (**Van Andel & Runnels 1995*****).***

The results from the regional analysis agree to a fair extent with Zilhão's model. However, there are a few points that must be stressed. Firstly, this model examines the later stages of the spread of farming in Europe, and thus does not apply to the first stages of the process. Dates for the first pulse post-date the arrival of the first farmers in south-east Europe. Secondly, the results obtained did not indicate any absorption of Mesolithic populations along the Danubian route. The Danube Gorge sites of Lepenski Vir and Vlasac, in which local continuity probably occurred, are situated in the south-eastern part of the river and thus in a zone marginal to the westward direction of dispersal. Thus, the issue is the extent of genetic absorption of hunter-gatherer bands proposed in Zilhão's model. If the demographic process underlying the progression along the Danubian route involved but a negligible amount of gene flow from Mesolithic bands, then one should not expect to detect such a pattern in the craniometric analyses.

In sum, the results obtained do not contradict Zilhão's model. However, this model does not examine what happened during the preliminary stages of the process of spread of farming, and therefore does not offer a sufficiently extensive reconstruction to account for the spread of farming as a comprehensive historical event.

A NEW MODEL FOR THE SPREAD OF FARMING IN EUROPE

A new model is proposed. Its main tenets are as follows. The PPNA and PPNB were the periods in which we have truly 'transitional' agricultural communities. During these periods the Neolithic mode of life gradually developed, first with the development of domestic wheat, and later with the domestication of sheep, goats, cattle and, possibly, pigs. The PPNA period lasted for approximately 800 years, and was succeeded by the PPNB period, which lasted approximately 2000 years (see *Yakar 1998*). The timespan of these periods implies that the transition from a hunter-gatherer semi-sedentary lifestyle, which is best exemplified by the Natufians, to the fully sedentary agricultural Neolithic village, which is best exemplified by Çatal Höyük, was not an abrupt change, but rather a gradual development. The PPNB cultural zone consists of the Levant, Anatolia and Cyprus, and possibly extended further west to other parts of the Aegean. The boxplot analysis (Fig. 16) illustrated that PPNB populations have an extensive degree of morphological heterogeneity. The observed heterogeneity must be associated with one or more of the following aspects:

❶ Heterogeneity due to geographic/cultural isolation between some of these early agricultural populations, which occupied a very large geographical area.

❷ Heterogeneity due to morphological differences inherited from different ancestral Epipalaeolithic populations in the Levant and various Anatolian regions as the first farming practices spread throughout a "culture zone".

❸ Heterogeneity due to differential adaptations to changes accompanying the transition to agriculture.

Özdoğan (*1995*) proposes a scheme in which the Early Neolithic cultures of Anatolia may be considered as two distinct entities: (1) the Neolithic of south-east Anatolia, which is related to the Mesopotamian-Levantine tradition, and (2) the indigenous Neolithic of the Anatolian plateau. These entities are also separated temporally as the south-east Anatolian culture begins about 2000 years before the Central Anatolian culture (*Özdoğan 1999*). The former phase is characterised by the Neolithic culture of Çayönü, while the site of Çatal Höyük belongs to the latter. Following this scheme one should expect to see more similarities between specimens from Çayönü and the Natufians than between the latter and Çatal Höyük. However, the results of the analysis performed are somewhat contradictory in this respect:

❶ The results of the analysis of squared Mahalanobis distances between groups (Fig. 10) indicated that the morphological distance between Çayönü and Nahal Oren is larger than the distance between the latter and Çatal Höyük (*Pinhasi 2003*).

❷ The PCA analyses of region 1 (Figs. 20, 21, 22) point to a lack of differentiation between the Natufians, Çatal Höyük and Çayönü groups.

❸ The discriminant analysis of region 1 indicates that the centroid of Çayönü is close to the centroid of the Natufian group, and that they are both distant from the Çatal Höyük centroid (Fig. 23).

We may therefore conclude that the analyses discussed above do not unequivocally support local continuity between Çayönü and the Natufian populations.

Nevertheless, various analyses showed that the Çatal Höyük group is similar to Early Neolithic European groups of south-east and central Europe, and that this similarity contrasts with the lack of association between the latter and Abu Hureyra, Khirokitia and Basta. Based on these results it appears that the first farmers that colonised Europe did not originate from the Near East, but rather from central Anatolia. Their best represented type population is the one from Çatal Höyük, which represents the successful culmination of the 2000 years of agricultural development in Anatolia. This suggests that these farmers first arrived in south-east Europe through western Anatolia, and not by sea travel through the Greek Islands. The remarkable homogeneity among the first farmers, taken together with the differentiation between them and Mesolithic populations from these regions, implies lack of admixture between farmers and hunter-gatherers, and supports an initial 'logistic dispersal without admixture'.

Figure 33 illustrates the proposed model. The dark area represents the zone of the first farmers. The farmers would have arrived and dispersed across this zone without any significant admixture with the local foragers. The thatched circle in the Balkans represents the Danube Gorge. In this micro-region, the Mesolithic population possibly underwent an autochthonous transition to a Neolithic lifestyle, with or without some limited admixture with the incoming farmers. The spotted grey zone is the zone of the Early Impressed Ware culture.

Around 6000 BP, the dispersal of farmers would have continued in two main directions. One group of farmers advanced westward along the Mediterranean region, eventually reaching the Iberian Peninsula. This advance would have been of the Early Impressed population. The other group represents the dispersal to northern and Atlantic Europe. This dispersal would have occurred between 6000–4000 cal BP. The dispersed populations would have been the descendants of the first farmers (dark zone) who expanded westwards and northwards. This zone (northern and Atlantic Europe) was more densely occupied by foraging populations, and therefore it is postulated that the transition to agriculture in this region took different demographic paths. In some cases, the foraging populations became Neolithic through autochthonous development; in other cases the incoming farmers absorbed some local foraging tribes.

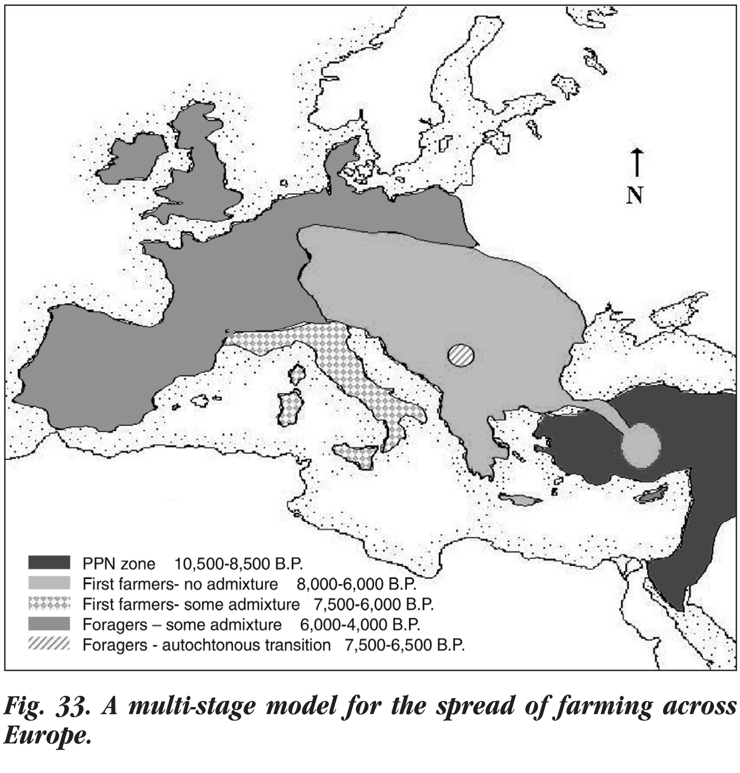


Fig. 33. A multi-stage model for the spread of farming across Europe.

SUMMARY AND CONCLUSIONS

This work elaborated upon the complex set of events that gave rise to the spread of farming across Europe. In light of the findings from the various craniometric analyses, any simplistic model that explains the prevalent pattern of population diversity across the continent as an outcome of a single evolutionary or historical process was rejected.

The review of the genetic findings suggests that the gene pool of modern European populations displays mixed contributions from 'indigenous' European Palaeolithic ancestors and from the demic diffusion of the first farmers from Anatolia. However, this statement only offers a broad generalisation at a continental level. The main point of argument, therefore, is what proportion each group contributed to each modern European population, and more importantly, the historical/demographic process that resulted in the observed genetic structure of modern European populations.

The model proposed as the outcome of this study is in broad agreement with the genetic findings, in the sense that it posits a more complex demographic process than was previously postulated by the majority of genetic studies. We saw that an original dispersal of farmers occurred during the 8th millennium BP. The source population was most probably located in central Anatolia. The dispersal of the first farmers is, therefore, in agreement with the 'Demic Diffusion' model in the temporal sense of a 'cline' in radiocarbon dates as one progress from the south-east to the north-west of the European continent. However, the demographic aspects of this dispersal cannot be explained by a logistic pattern of absorption of local foraging populations. The proposed model differentiates between a first expansion without admixture (in the case of most of south-east and central Europe), and a second subsequent expansion with some admixture (in the Mediterranean zone of Italy and south-east France). This two-phase model does not necessarily imply any temporal hiatus or change in the rate of dispersal across the continent. It does, however, speculate that the first expansion was more rapid than that of the subsequent phases.

Further research is required in order to illuminate the nature of the spread of farming in the Western European regions. Based on the regional approach, one expects to detect temporally based regional variations in the degree of admixture between local hunters and migrating farmers. With additional craniometric data from these regions, and the application of corresponding craniometric analyses based on the above methodology, it would become possible to bring forth a more detailed model in the near future.

ACKNOWLEDGEMENTS

I would like to thank Dr. Mihael Budja for inviting me to take part in the stimulating and well organised Neolithic Seminar in Ljubljana, in November 2002. I would also like to thank Dr. Robert Foley and Dr. Marta Lahr from the Department of Biological Anthropology, University of Cambridge, who supervised and guided my PhD dissertation, and for their constructive comments and corrections. Finally, I would like to thank all the people at the various research institutions mentioned above who gave me access to the skeletal material and hosted me during my field work at their institutions.

REFERENCES

ACSÁDI G. and NEMESKÉRI J. 1970. *History of Human Life Span and Mortality*. Budapest: Akadémiai.

AMMERMAN A. J. and CAVALLI-SFORZA L. L. 1971. Measuring the rate of spread of early farming in Europe. *Man N.S. 6: 674–688*.

1973. A population model for the diffusion of early farming in Europe. In C. Renfrew (ed.), *The Explanation of Culture Change: 343–357*.

1984. *The Neolithic Transition and the Genetics of Populations in Europe*. Princeton, NJ: Princeton University Press.

ANGEL J. L. 1973. Early Neolithic people of Nea Nikomedeia. In I. Schwidetzky (ed.), *Die Anfäng des Neolithikums vom Orient bis Nordeuropa, Teil VIIIa: 103–112*.

BARBUJANI G. 2000. Geographic patterns: how to identify them and why. *Hum. Biol. 72: 133–153*.

BARBUJANI G. and BARTORELLE G. 2001. Genetics and the population history of Europe. *Proc. Natl. Acad. Sci. 98: 22–25*.

BARBUJANI G. SOKAL R. R. and ODEN N. L. 1995. Indo-European origins: a computer-simulation test of five hypotheses. *Am. J. Phys. Anthrop. 96: 109– 132*.

BARBUJANI G., BERTORELLE G. and CHIKHI L. 1998. Evidence for Paleolithic and Neolithic gene flow in Europe. *Am. J. Hum. Genet. 62: 488–491*.

BEDRICK E. J., LAPIDUS J. and POWELL J. F. 2000. Estimating the Mahalanobis distance from mixed continuos and discrete data. *Biometrics 56: 394– 401*.

BIAGI P. 1991. The prehistory of the early Atlantic period along the Ligurian and Adriatic coasts of northern Italy in a Mediterranean perspective. *Rivista di Archeologia 15: 46–54*.

BONSALL C., LENNON R., MCSWEENEY K. and STEWART C. 1997. Mesolithic and Early Neolithic in the Iron Gates: a Palaodietary Perspective. *J. Eur. Archaeol. 5: 50–92*.

BORONÉANT V. 1996. The Mesolithic complexes in the Balkans and Danube Basin. *Series Coloquia 7: 59–76*.

BOYADZIEV Y. D. 1995. Chronology of prehistoric cultures in Bulgaria. In D. W. Bailey and I. Panayotov (eds.), *Prehistoric Bulgaria: 149–187*.

BRÄUER G. 1988. Osteometrie. In R. Knussmann (ed.), *Anthropologie: Handbuch der vergleichenden Biologie des Menschen, Vol. I/a: 160–231*.

BREUNIG P. 1987. *C14 Chronologie Des Vorderasiatischen, südost- und Mitteleuropäischen Neolithikums*. Wien: Böhlau Verlag.

BRÖSTE K. and JØRGENSEN J. B. 1956. *Prehistoric Man in Denmark. A Study in Physical Anthropology. Vol. 1*. Copenhagen: Einar munksgaard.

BUIKSTRA J. E. and UBELAKER D. H. 1994. *Standards for Data Collection from Human Skeletal Remains*. Arkansas Archaeological Survey Research Series No. 44. Fayetteville, Arkansas.

CAVALLI-SFORZA L. L. 1997. Genes, peoples and languages. *Proc. Natl. Acad. Sci. 94: 7719– 7724*.

1996. The spread of agriculture and nomadic pastoralism: insights from genetics, linguistics, and archaeology. In D. Harris (ed.), *The Origins and Spread of Agriculture and Pastoralism in Eurasia: 51–69*.

CAVALLI-SFORZA L. L., MENOZZI P. and PIAZZA A. 1993. Demic expansions and human evolution. *Science 259: 639–646*.

1994. *The History and Geography of Human Genes*. Princeton, N.J.: Princeton University Press.

CHERRY J. F. 1981. Pattern and process in the earliest colonization of the Mediterranean islands. *Proc. Prehist. Soc. 47: 41–68*.

1990. The first colonization of the Mediterranean islands: a review of recent research. *J. Med. Arch. 3: 145–221*.

CHIKHI L., DESTRO-BISOL G., PASCALL V., BARAVELLI V., DOBOSZ and BARBUJANI G. 1998a. Clinal variation in the nuclear DNA of Europeans. *Hum. Biol. 70: 643–657*.

1998b. Clines of nuclear DNA markers suggest a largely Neolithic ancestry of the European gene pool. *Proc. Natl. Acad. Sci. 95: 9053– 9058*.

CHIKHI L., NICHOLS R. A., BARBUJANI G. and BEAUMONT M. A. 2002. Y genetic data support the Neolithic demic diffusion model. *PNAS 99: 11008– 11013*.

COLEMAN J. E. 1992. Greece, the Aegean, and Cyprus. In H. Ehrich (ed.), *Chronologies in Old World Archaeology. Vol. I.: 247–288*.

DEMOULE J-P and PERLÈS C. 1993. The Greek Neolithic: A new review. *J. World Prehist. 4: 355– 416*.

DEMOULE J-P. 1993. Anatolie et Balkans: la logique évolutive du Néolithique Égeen. *Anatolica 19: 1– 18*.

DENNELL R. W. 1985. *European Economic Prehistory: A New Approach*. London: Academic press.

DUMITRESCU V. 1982. The Prehistory of Romania: From earliest times to 1000 BC. In J. Boardman, I. E. S. Edwards, N. G. L. Hammond and E. Sollberger (eds.), *The Cambridge Ancient History. 2nd Ed., Vol. III, Part I: 1–74*.

EFSTRATIOU N. 1995. The neolithisation of Europe: the Greek experience. *Poročilo o raziskovanju paleolitika, neolitika in eneolitika v Sloveniji 22: 63–75*.

EHRICH R. W. and BANKOFF H. A. 1992. Geographical and chronological patterns in East-Central and Southeastern Europe. In H. Ehrich (ed.), *Chronologies in Old World Archaeology. Vol. I: 375–396; Vol. II: 341–363*.

FEREMBACH D. 1969. Aprrecu sur le peuplement de l' Anatolie et du moyen-orient au néolithique. *Türk Tarih Kurumu Belleten 33: 137–143*.

1970. Les hommes du gisment néolithique de Çatal Höyük. *Bulletin de la Societé d'Anthropologie du Sud-Ouest 6: 7–14*.

1982. *Mesures et indices des squelettes humains neolithiques de Çatal Höyük Turquie*. Paris: CNRS.

FISCHER R. A. 1937. The wave of advance of advantageous genes. *Ann. Eugen. 7: 355–369*.

GARAŠANIN M. 1982. The Stone Age in the Central Balkan Area. In J. Boardman, I. E. S. Edwards, N. G. L. Hammond and E. Sollberger (eds.), *The Cambridge Ancient History. 2nd Ed., Vol. III, Part I: 75–135*.

GIMBUTAS M. 1991. *The Civilization of the Goddess*. San Francisco: Harper Collins.

1992. Chronologies of Eastern Europe: Neolithic through Early Bronze Age. In Ehrich R. W. (ed.), *Chronologies in Old World Archaeology. Vol. I: 295–408; Vol. II: 364–384*.

GRAW M., CZARNETZKI A. and HAFFNER H. T. 1999. The form of the supraorbital margin as a criterion in identification of sex from the skull: investigations based on modern human skulls. *Am. J. Phys. Anthrop. 108: 91–96*.

HARDING R. M., RÖSING F. W. and SOKAL R. R. 1989. Cranial measurements do not support Neolithisation of Europe by demic expansion. *Homo 40: 45–58*.

HENRY D. O. 1989. *From Foraging to Agriculture: the Levant at the End of the Ice Age*. Philadelphia: University of Pennsylvania Press.

HOURS F., AURENCHE O., CAUVIN J., CAUVIN M.-C., COPELAND L. and SANLAVILLE P. 1994. *Atlas des sites du proche-orient 14 000–5700 BP*. Travaux de la Maison de l'Orient Méditerranéen No. 24.

HOWELLS W. W. 1973. Cranial Variation in Man: a Study by Multivariate Analysis of Patterns of Difference Among Recent Human Populations. Papers of the Peabody Museum, Archaeology and Ethnology, Vol. 67, Cambridge Mass.: Harvard University Press.

1989. Skull Shapes and the Map. Papers of the Peabody Museum, Archaeology and Ethnology, Vol. 79, Cambridge Mass.: Harvard University Press.

1995. Who's Who in Skulls. Ethnic Identification of Crania from Measurements. Papers of the Peabody Museum, Archaeology and Ethnology. Cambridge Mass.: Harvard University Press.

KAISER T. and VOYTEK B. 1983. Sedentism and economic change in the Balkan Neolithic. *J. Anthrop. Archaeol. 2: 323–353*.

KEITA S. O. Y. 1990. Studies of ancient crania from Northern Africa. *Am. J. Phys. Anthrop. 83: 35–48*.

1992. Further studies of crania from ancient Northern Africa: an analysis of crania from First Dynasty Egyptian tombs using multiple discriminant functions. *Am. J. Phys. Anthrop. 87: 245–254*.

KLECKA W. R. 1980. *Discriminant Analysis*. Newbury Park: Sage.

KONIGSBERG L. W. 1990. Temporal aspects of biological distance: serial correlation and trend in a prehistoric skeletal lineage. *Am. J. Phys. Anthrop. 82: 45–52*.

LAHR M. M. 1996. *The Evolution of Modern Human Diversity*. A Study of Cranial Variation. Cambridge: Cambridge university Press.

LAHR M. M., FOLEY R. and PINHASI R. 2000. Expected regional patterns of Mesolithic-Neolithic human population admixture in Europe based on archaeological evidence. In C. Renfrew and K. Boyle (eds.), *Archaeogenetics: DNA and the population prehistory of Europe: 81–88*.

LUCOTTE G. and LOIRAT F. 1999. Y-chromosome DNA haplotype 15 in Europe. *Hum. Biol. 71: 431–437*.

MAKKAY J. 1984. Chronological links between Neolithic cultures of Thessaly and the Middle Danube region. *Acta Archaeologica Academiae Scientiarum Hungaricae 36: 21–28*.

1988. Cultural groups of SE Europe in the Neolithic: the PIE Homeland problem and the origins of the proto-Greeks. *AIΩN 10: 117–137*.

1992. Neolithic model of Indo-European prehistory. *Journal of Indo-European Society 20: 193–198*.

MANTEL N. 1967. The detection of disease clustering and a generelised regression approach. *Cancer Res. 27: 209–220*.

MARTIN R. 1957. *Lehrbuch der Anthropologie in systematischer Darstellung, mit besonderer Beruück-sichtigung der anthropologischen Methoden. 3*. Stuttgart: Fischer.

MELAART J. and MELLINK M. J. 1992. Anatolian chronology. In R. W. Ehrich (ed.), *Chronologies in Old World Archaeology. Vol. I.: 207–223; Vol. II: 171–184*.

MENOZZI P., PIAZZA A. and CAVALLI-SFORZA L. L. 1978. Synthetic maps of human gene frequencies in Europeans. *Science 201: 786–792*.

ÖZDOĞAN M. 1993. Vinča and Anatolia: A new look at the very old problem or redefining Vinča Culture from the perspective of the Near eastern tradition. *Anatolica 19: 173–193*.

1995. Neolithic in Turkey. The status of research. Readings in prehistory. *Studies Presented to Halet Çambel: 41–59*.

1996. Neolithisation of Europe: a view from Anatolia. Part 1: the problem and the evidence of East Anatolia. *Poročilo o raziskovanju paleolitika, neolitika in eneolitika v Sloveniji 20: 25– 61*.

1997. The Beginning of Neolithic economies in Southeastern Europe: an Anatolian perspective. *Journal of European Archaeology 5: 1–33*.

1999. Concluding remarks. In M. Özdoğan (ed.), *Neolithic in Turkey: 225–236*.

PERLÈS C. 2001. *The Early Neolithic in Greece*. Cambridge: Cambridge University Press.

PINHASI R. 2003. *The Appearance and Dispersion of the First Farmers in Europe. A Novel Approach to an Old Debate*. Unpublished doctorate dissertation, University of Cambridge.

PINHASI R., FOLEY R. and LAHR M. M. 2000. Spatial and temporal patterns in the Mesolithic-Neolithic Archaeological record of Europe. In C. Renfrew and K. Boyle (eds.), *Archaeogenetics: DNA and the population prehistory of Europe: 45–56*.

PLUCIENNIK M. 1997. Radiocarbon determinations and the mesolithic-neolithic transition in southern Italy. *Journal of Mediterranean Archaeology 10: 115–150*.

PRINZ B. 1987. Mesolithic Adaptations on the Lower Danube. Vlasac and the Iron Gates Gorge. *British Archaeological Series BAR 330*.

RADOVANOVIĆ I. 1996. *The Iron Age Mesolithic. Michigan: International Monograph in Prehistory, Series 11*.

RELETHFORD J. H. 1991. Genetic drift and anthropometric variation in Ireland. *Hum. Biol. 63: 155–165*.

1996. Genetic drift can obscure population history: problem and solution. *Hum. Biol. 68: 29–44*.

RENFREW C. 1987. *Archaeology and Language. The Puzzle of the Indo-European Origins*. London: Penguin Books.

1992. Archaeology, genetics and linguistic diversity. *Man N. S. 27: 445–478*.

RICHARDS M., CÔRTE-LEAL H., FORSTER P., MACAULAY V., WILKINSON-HERBOTS H., DEMAINE A., et al. 1996. Paleolithic and Neolithic lineages in the European mitochondrial gene pool. *Am. J. Hum. Genet. 59: 185–203*.

RICHARDS M. B., MACAULAY V. A., BANDELT H. J. and SYKES B. C. 1998. Phylogeography of mitochondrial DNA in Western Europe. *Ann. Hum. Genet. 62: 241–260*.

SCHAFER J. L. 1999. NORM: Multiple imputation of incomplete multivariate data under a normal model, version 2. Software for Windows 95/98/NT, available from http://www.stat.psu.edu/~jls/misoftwa.html.

SCHWARTZ J. H. 1995. *Skeleton Keys. The Introduction to Human Skeletal Morphology: Development, and Analysis*. New York: Oxford University Press.

SEMINO O., PASSARINO G., OEFNER P. J., LIN A. A., ARBUZOVA S., BECKMAN L. E., DE BENEDICTIS G., FRANCALACCI P., KOUVATSI A., LIMBORSKA S., et al. 2000. The Genetic Legacy of Paleolithic Homo sapiens sapiens in Extant Europeans: A Y-Chromosome Perspective. *Science 290: 1155–1159*.

SEMINO O., PASSARINO G., BREGA A., FELLOUS M. and SANTACHIARA-BENERECETTI A. S. 1996. A view of the Neolithic demic diffusion in Europe through two Y chromosome-specific markers. *Am. J. Hum. Genet. 59: 964–968*.

SHERRATT A. 1983. The development of Neolithic and Copper Age settlement in the Great Hungarian Plain. Part I: the regional setting. *Oxford Archaeol. 2: 13–41*.

SIMONI L., GUERESI P., PETTENER D. and BARBUJANI G. 1999. Patterns of gene flow inferred from genetic distances in the Mediterranean region. *Hum. Biol. 71: 399–415*.

SIMONI L., CALAFEL F., PETTENER D., BERTRANPETIT J. and BARBUJANI G. 2000. Geographic patterns of mtDNA diversity in Europe. *Am. J. Hum. Genet. 66: 262–278*.

SOKAL R. R., ODEN N. L. and WILSON C. 1991. Genetic evidence for the spread of agriculture in Europe by demic diffusion. *Nature 351: 143–144*.

STATISTICA V. 4.3. 1993. *User manual*. Statsoft.

TABACHNICK B. G. and FIDELL L. S. 1996. *Using Multivariate Statistics*. New York: Harper Collins.

THEOCHARIS D. R. 1973. *Neolithic Greece*. National Bank of Greece.

THORPE I. J. 1996. *The Origins of Agriculture in Europe*. London: Routhledge.

TODD I. A. 1980. *The Prehistory of Central Anatolia, 1: The Neolithic Period*. Studies in Mediterranean Archaeology Vol. 60 Götborg: Paul Åströms Förlag.

TREUIL R. 1989. La Néolithisation dans les Balkans: quelques réflexions prématurées. In O. Aurenche (ed.), *Néolithisations: 129–144*.

TRINGHAM R. 1971. *Hunters, Fishers and Farmers of Eastern Europe 6000–3000 BC*. London: Hutchinson.

TRUMP D. H. 1980. *The Prehistory of the Mediterranean*. New Haven: Yale University Press.

VAN ANDEL T. H. and RUNNELS C. N. 1995. The earliest farmers in Europe. *Antiquity 69: 481–500*.

VAN VARK G. N. and SCHAAFSMA W. 1992. Advances in the quantitative analysis of skeletal morphology. In S. Saunders and M. Katzenberg (eds.), *The Skeletal Biology of Past peoples: Research Methods: 225–257*.

WELLS P. S. 1992. The Neolithic chronology of Central Europe: Southern Germany, Switzerland, and Austria. In Ehrich R. W. (ed.), *Chronologies in Old World Archaeology. Vol. I: 356–374; Vol. II: 326–333*.

WHITTLE A. 1996. *Europe in the Neolithic. The Creation of New Worlds*. Cambridge: Cambridge University Press.

1998. Fish, faces and fingers: presence and symbolic identitiees in Mesolithic-Neolithic transition in the Carpathian basin. *Poročilo o raziskovanju paleolitika, neolitika in eneolitika v Sloveniji 25: 133–151*.

WILKINSON-HERBOTS H. M., RICHARDS M. B., FOSTER P. and SYKES B. C. 1996. Site 73 hypervariable region II of the human mitochondrial genome and the origin of European populations. *Ann. Hum. Genet. 60: 499–508*.

WRIGHT S. 1921 Systems of mating. *Genetics 6: 111– 178*.

1933. Inbreeding and recombination. *Proceedings of the National Academy of Science, USA 19: 420–433*.

1951. The genetical structure of populations. *Ann. Eugenics 15: 323–354*.

1969. *Evolution and the Genetics of Populations, Vol. 2, The Theory of Gene Frequencies*. Chicago: University of Chicago Press.

YAKAR J. 1991. *Prehistoric Anatolia. The Neolithic Transformation and the Early Chalcolithic Period*. Monograph Series of the Institute of Archaeology Tel Aviv University, No. 9.

1994. *Prehistoric Anatolia. The Neolithic Transformation and the Early Chalcolithic Period. Supplement No. 1*. Monograph Series of the Institute of Archaeology Tel Aviv University. Monograph No. 9a.

1998 The socio-economic structure of prehistoric communities in the southern Levant, ca. 13 000–8000 BP. *Poročilo o raziskovanju paleolitika, neolitika in eneolitika v Sloveniji 25: 53–63*.

ZILÃHO J. 1993. The spread of agro-pastoral economies across Mediterranean Europe: a view from the far west. *J. Med. Archaeol. 6: 5–63*.

2001. Radiocarbon evidence for maritime pioneer colonization at the origins of farming in west Mediterranean Europe. *Proc. Nat. Acad. Sci. USA 98: 14180–14185*.

ZVELEBIL M. 1986 Mesolithic prelude and Neolithic revolution. In M. Zvelbil (ed.), *Hunters in Transition: Mesolithic Societies of Temperate Eurasia and Their Transition to Farming: 5–16*.

1989. On the transition to farming in Europe, or what was spreading with the Neolithic: a reply to Ammerman. *Antiquity 63: 379–383*.

ZVELEBIL M. and ROWLEY-CONWY P. 1984. Transition to farming in Northern Europe: a hunter-gatherer perspective. *Norwegian Archaeological Review 17: 104–128*.

ZVELEBIL M. and ZVELEBIL K. V. M. 1988. Agricultural transition and Indo-European dispersals. *Antiquity 62: 574–583*.

ZVELEBIL M. and DOLUKHANOV P. 1991. The Transition to Farming in Eastern and Northern Europe. *J. World Prehist. 5: 233–278*.

UDK 903'12/'15(4-17)"634"
Documenta Praehistorica XXX

Stone Age transitions. Neolithization in central Scandinavia

Helena Knutsson and Kjel Knutsson
Department of Archaeology and ancient History, Uppsala University, S
Helena.Knutsson@arkeologi.uu.se, Kjel.Knutsson@arkeologi.uu.se

ABSTRACT – *A summary of a series of individual research projects focused on the processes from the Mesolithic to the Late Neolithic in central Scandinavia. The projects were embeded in the "Coast to Coast project". The historicity in this process was emphasised.*

IZVLEČEK – *V članku povzemamo serijo posameznih raziskovalnih projektov, ki se nanašajo na spremembe od mezolitika do poznega neolitika v srednji Skandinaviji. Zajeti so v projekt "Od obale do obale". Poseben poudarek je na zgodovinskih dejstvih teh sprememb.*

KEY WORDS – *Mesolithic; Neolithic; hunter-gatherers; farmers; neolithization; central Scandinavia*

INTRODUCTION

This paper is a summary of the Uppsala part of a series of individual research projects in connection with a joint research program carried out in collaboration with the departments of archaeology in Uppsala, Göteborg, Lund, and Stockholm. The project: "Coast to Coast – Stone Age Societies in Change" was launched in 1998 and is financed by the Tercentenary Foundation of The Bank of Sweden. It covers cultural development in Central Scandinavia in the early part of the Holocene, from the deglaciation (8000 cal BC) to the Late Neolithic (1800 cal BC). Our part of the project (including 3 projects from Lund and Stockholm Universities) has mainly been organized as a series of PhD works (seven in all) and deals essentially with archaeological evidence from the eastern part of central Sweden, where processes of cultural change in relation to Neolithization at the Mesolithic-Neolithic transition (F. Hallgren, C. Lidström-Holmberg, A. Sundström and C. Lindgren) and the expansion of a full Neolithic economy in the Late Neolithic (J. Apel and P. Lekberg) are studied. In the PhD project by Per Johansson from Lund University, a critical discussion of archaeological thinking in relation to the Neolithization debate is carried out, as seen from the point of view of human ecology. Apart from the 7 individual PhD projects, two research projects covering a more general discussion of cultural change and within a broader spatial perspective have been carried out by two senior researchers at Uppsala (H. Knutsson and K. Knutsson). Helena Knutsson has concentrated on the problem of the "Neolithic concept" and the processes related to its introduction in southern Scandinavia c 3900 cal BC, whereas Kjel Knutsson, basing his work on a theory of structuration, has tried to throw light on the historical roots of the "cultural substrate" that formed the socio-spatial preconditions for the Neolithization in central Scandinavia.

THE SETTING

Eastern central Sweden consists of the provinces of Uppland, Västmanland, Närke and Södermanland. The Swedish capital, Stockholm, is situated in the eastern part of the region (Fig. 1). During most of the Stone Age, eastern central Sweden consisted of a wide archipelago (compare Fig. 4) delimited by the surrounding landmasses of Kolmården and Tiveden to the south, Kilsbergen to the east, and the higher lying areas of northern Svealand to the north. To the north, the area ends in a cultural and geographically important border called "Limes Norlandicus". This border between northern and central Sweden, as will be shown in the following texts, may have been an important divide between hunters and gatherers in the north and farmers and stockbreeders in the south throughout the Stone Age, Bronze Age and Iron Age. Isostatic rebound raised an archipelago from the sea after the retreat of the ice ten thousand years ago, forming large islands and adjoining land areas. The landscape is transacted by glacial eskers surrounded by sandy areas, bedrock formations polished smooth by glacial movements, and postglacial clay in the valley bottoms. This changing landscape of small and large islands formed the basis for the colonization of the area by hunter-gatherers as early as the Preboral (7500 cal BC) (*Knutsson et al. 1999*).

Hundreds of Mesolithic sites found through surveys by the National Board of Antiquities over the last 70

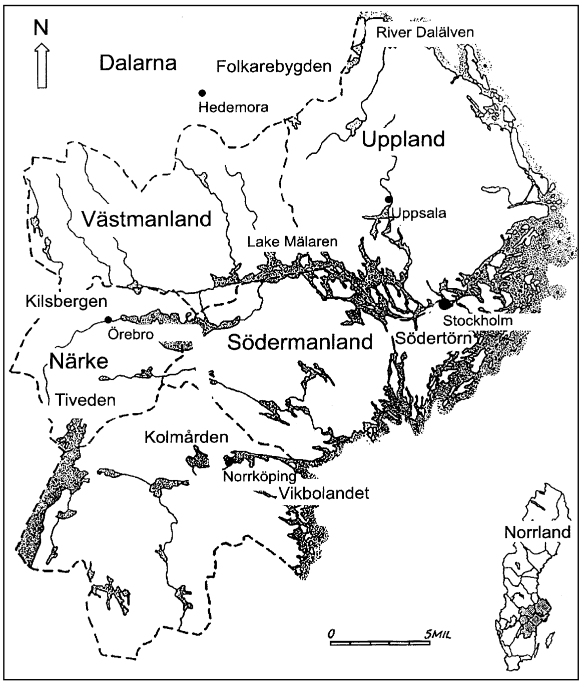


Fig. 1. Map of the discussed area, Eastern Central Sweden, and its surroundings, showing the place names and localities mentioned (after* Boas 1999. Fig. 1*).

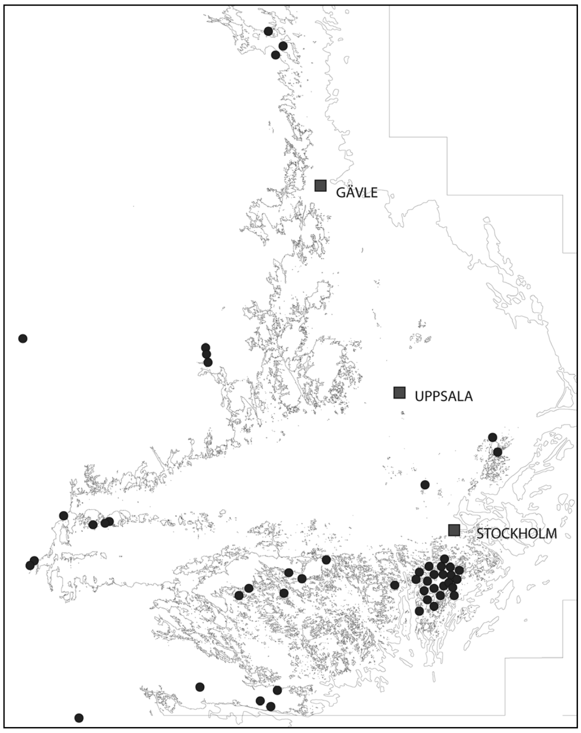


Fig. 2. All Mesolithic sites excavated in Eastern Central Sweden between the years 1935–1996. They are dated to the time span c 7500 cal BC to c 4000 cal BC and thus almost cover the entire period from the deglaciation to the neolithization. The sites are shown in relation to the shoreline c. 5000 cal BC. The concentration of sites south of Stockholm is due to recent building activities.

years are known in the area. All together, 55 sites have been excavated, primarily as rescue excavations (Fig. 2). No thorough analysis has been carried out so far, but in a recent paper (*Knutsson et al. 1999*) it has been shown that the Mesolithic was characterized by sites situated by the sea, with an economy geared mainly towards the exploitation of marine resources such as seal and fish. Some inland sites, with elk and deer bones may indicate a seasonal movement based on inland-coast commuting. Detailed analyses of some sites indicate that at least the Middle and Late Mesolithic must be characterized as a logistic settlement system (*Knutsson & Melchert in press*). So far, no Mesolithic graves have been found or excavated in this part of Scandinavia. The material culture shows low variability; quartz is the principle raw material of flaked tools, and greenstone for axes. In the Early and Middle Mesolithic, imported flints from south and west Scandinavia, mainly in the form of micro-blades, are present. In the Late Mesolithic there is a change in the lithic industry from bipolar-on-anvil to a platform technique in quartz, as well as the introduction of four-sided, polished axes and transverse arrowheads (Fig. 3). A change in the type of and variation in settlements also occurs at this time.

The Neolithic occupation is known from thousands of stray finds and hundreds of surveyed sites. Only

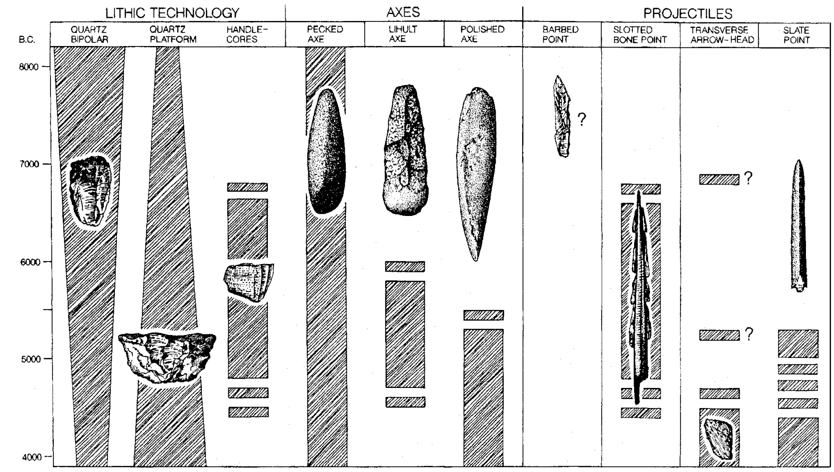


Fig. 3. Tentative chronological scheme for the Mesolithic in Eastern Central Sweden. Slate points, transverse arrowheads and polished greenstone axes are characteristic of the period 4500–4000 cal BC, indicating a clear change in material culture.

about 25 sites from the Early Neolithic TRB culture have so far been excavated (Fig. 4). The Funnel Beaker Culture (TRB) in the area is mainly characterized by two types of site: those on the coast which are dominated by the remains of fishing and seal hunting, and inland farmsteads, dominated by the remains of domestic animals such as cattle, sheep and goat, and cultivated plants: wheat, barley, peas, beans, and vinegrapes. The same types of archaeological material (funnelbeakers, polygonal battle axes, thin-butted axes, flint industry, sandstone querns, etc (Figs. 5, 20a an b), occur in both contexts. Small huts and burials are the settings of the coastal finds (Fig. 20c); houses with attached sacrificial fens relate to the inland sites. The relative dietary importance of domesticated products compared to wild resources cannot be estimated on the basis of present data.

Regarding the Pitted Ware Culture (PWC), which represents a change in the TRB society in this area towards more hunting and gathering in the Early Middle Neolithic, large amounts of pottery and a faunal assemblage dominated by seal bones characterizes the sites in the coastal area. As to the material culture, apart from the characteristic pottery, knapped quartz dominates; some imported flints and locally produced pecked axes are reminiscent of Mesolithic axes. In the later Middle Neolithic, graves and stray finds from the Battle Axe Culture are found. Only one settlement from this period was excavated, with meagre results. Whether the PWC and the BAC represent of represent cultural dualism or intercultural variation in the Late Middle Neolithic in this area is still a matter of debate.

The Late Neolithic shows a homogenisation of material culture, and the expansion and continuation of farming settlement, following the Battle Axe Tradition (Corded Ware Culture). Although conceivable changes appear in the fashions of material culture, settlements and everyday behaviour seem to continue along the same lines. The cultural process related to this general change in the economy and material culture, has been the main topic of the Coast to Coast project. At the political level we see a change toward a stratified society in the Late Neolithic, but what is more important, the process of change seems to bear on long-term historical structures, a past made active in the construction of new ideologies in periods of paradigmatic change.

THE APPROPRIATION OF THE PAST

In one of the Coast to Coast research projects formed around a theory of historical structuration, Kjel Knutsson tries to show how the historical circumstances related to the speed and direction of the melting ice at the beginning of the Holocene formed the substrate for the large scale social structures that seem to have been decisive for the spread of the Neolithic way of life in southern Scandinavia at the beginning of the fourth millennium cal BC, and a cultural distinction in the northern part of Scandinavia at the same time. The latter process is seen as formed through a process of ethnicity.

As the ice melted from south to north at a speed of roughly 500 km every 500 years, hunters and gatherers colonized new, uninhabited territories. The colonizers met a "land without history", open to colonisation by people, animals and vegetation, creating opportunities for "a construction of historical references" by ordering and name-giving, logical to a basic cosmology. Based on theories of social and ethnic processes related to the colonization of new land, it can be shown through radiocarbon dated pioneering sites and a diachronic analysis of traditional archaeological patterning, that local group formation and processes establishing local autonomy occurred at roughly every 500 km (Fig. 6). The early

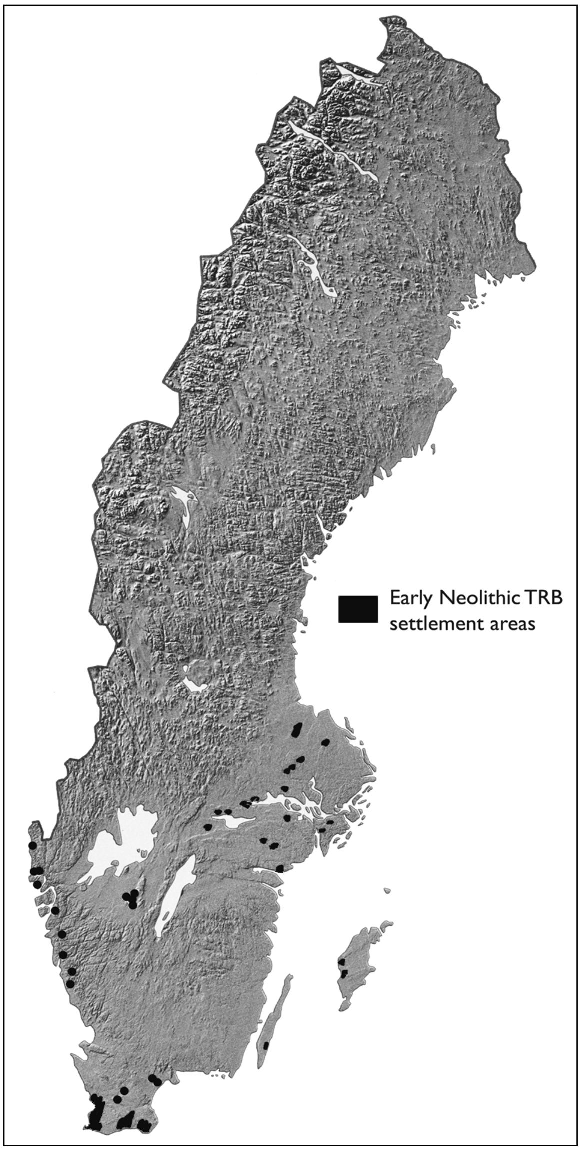


Fig. 4a. The known areas with TRB settlement in Sweden.

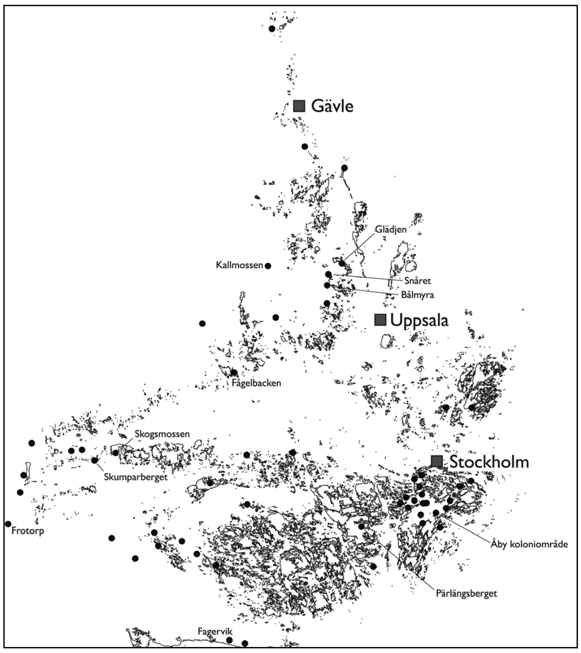


Fig. 4b. All Early Neolithic sites excavated in Eastern Central Sweden between 1935–1996. They are dated to the time span c 4000 cal BC to c 3300 cal BC. The sites are shown in relation to the shoreline c. 3900 cal BC. The concentration of sites south of Stockholm is due to recent building activities.

finds appear to the archaeologist as separated islands in the archaeological material, with large gaps between. These islands may have functioned as bases along a migratory route, something that is necessary for information about the new places to be relayed to home areas. The individuals that explore such distant new areas are dubbed scouts by David Anthony, and their activities may be identified in the archaeological material as small settlement sites with few finds. This is actually true of the early sites in the area, and at these sites we find evidence of close contact with the old homelands that is symbolically enacted in normative behaviour (in sociological terms, habitus), and in relation to lithic production and the use of raw materials. In the second phase of colonisation, we find the creation of distinctions shown by the varied use of the landscape and the use of new raw materials, in some areas overtly distinct from that of the old homelands. As new identities were formed and consolidated after about 500 years, active appropriation is so far that of new land by scouts, in areas made available by the melting of the glaciers. This process can be seen, from archaeological patterning, in Northern Norway, Finland and Sweden. The social landscape thus formed by hunter-gatherers' interaction with the changing environment, created a seemingly conservative spatial structure that is visible throughout prehistory and actually later history (Fig. 6). This can be understood by turning to landscape archaeology and the concepts of landscape as memory, because when a landscape is filled with history, it structures the later cultural and social processes. As will be shown later in the contribution by Fredrik Hallgren to the project – this historically formed spatial structure represented the social environment within which neolithization took place. As local groups with their own cultural distinction were formed by budding off during deglaciation, they were still part of the same exchange networks, as shown by the spread of lithic raw materials between areas (Fig. 7). It can be assumed that these historically formed material relations also concerned non-material aspects of culture and thus had even deeper meaning in terms of cultural reproduction.

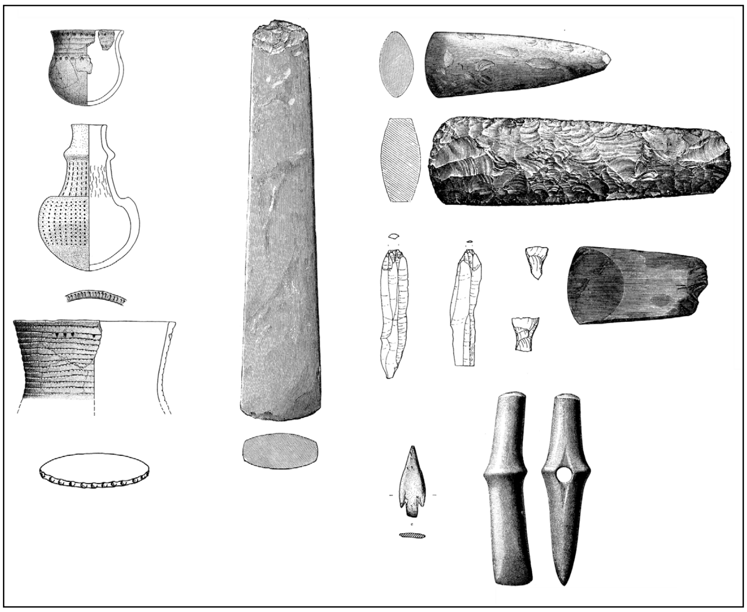


Fig. 5. Material culture of the Funnel Beaker Culture in Eastern Central Sweden. Pottery, flint- and greenstone thinbutted axes, imported flints, slate points and the typical battle axe.

The Late Mesolithic handle-core tradition is important for an understanding of the mechanisms and extension of Neolithization in Scandinavia from the perspective of interaction networks and historical ties between groups. We find it as a signature on sites ranging from northern Germany to northern Swedish Lapland. This technology was, according to several hundred radiocarbon datings from hundreds of sites, established contemporaneously, but within variable techno-complexes such as the Lihult Culture, the Ertebölle Culture, the North Swedish Macro-blade Group etc, to be found over most parts of western Scandinavia around 6700 cal BC (compare Fig. 8). It indicates a wide social network at the time, according to Kjel Knutsson's investigation, based not only on population densities in line with a materialistic explanatory framework, but on the history of early group formation in this area. Another important aspect of this technology is that it also vanishes contemporaneously in the archaeological material in a huge area north of the province of Skåne (Fig. 8). When the handle core institution as we may call it, disappears around 4500 cal BC, we see a change and split in symbolic communication among the Late Mesolithic groups, a split that cut the historically formed relations within these hunter-gatherer communities and partitioned the south from the north. The southern groups, later transformed into what we call the TRB culture, at this time incorporated and made use of a public symbolism related to some aspects of the south Scandinavian Ertebölle sphere, as illustrated by the active copying of material culture. The northern groups experienced a drastic paradigmatic change, at least as shown by a change in material culture. The latter process must have meant, according to a "social theory of critical situations or paradigmatic change", the formation of a new identity and thus by necessity a new version of the past.

Paradigmatic change is always painful to the people involved and always invokes a special sense of the past. The past in these situations forms the basis for establishing the new order. As a consequence of this theory of historically informed culture change, the hunter-gatherers north of the TRB border in this analysis can be shown to have appropriated a new past, a past that, according to the characteristics of their material culture (quartz tools, slate implements, new type of dwellings), attached them to a northern identity. This new rela-

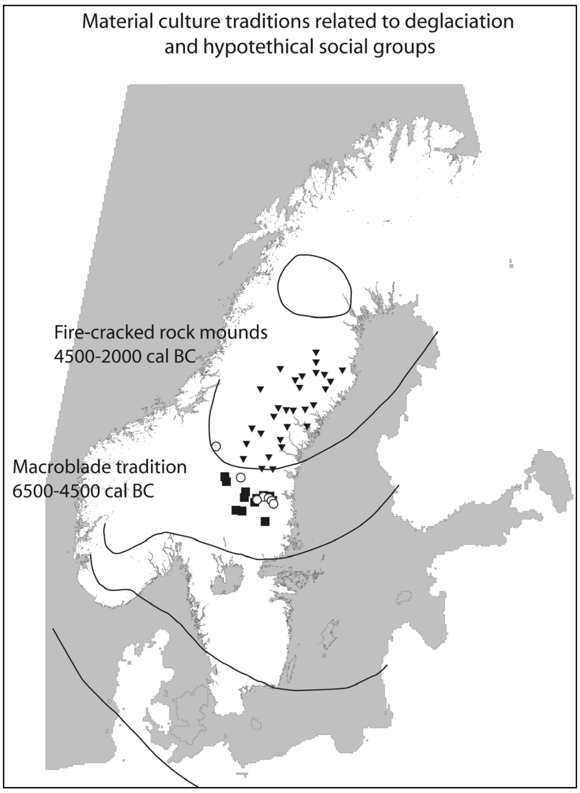


Fig. 6. The process of deglaciation, as shown by the extension of the ice sheet at intervals of 500 years. Projected onto this are archaeological "technocomplexes" indicating a tight relationship between the deglaciation process and the formation and historical reproduction of hunter-gatherer groups.

tionship expressed as a common past, is thus materialized as a set of tools and raw materials that bears on and mimics the relics from an earlier part of this area's history (Fig. 9). The study has shown how long-lasting historical structures (the past with us) is a fundamental part in the reproduction of social formations, but also, how an active relation to a distant past (the past before us) may act as important stepping-stones for the formulation of new identities and with it a new-old past as a vehicle for them. This new distinction between north and south in central Scandinavia around 4500 cal BC, formed the unintended socio-cultural substrate that set the agenda for the spatial distribution of the Neolithzation in this marginal area of northern Europe. Or as one of the PhD students of the project, Fredrik Hallgren, puts it: "the change was structured by the structure of the Late Mesolithic configurations" (*Hallgren 2002*).

SOCIAL NETWORKS AND CULTURAL TRANSFORMATION

The establishment of social groups in Scandinavia may, as proposed above by Kjel Knutsson, have been related to the speed and directionality of the deglaciation. The Late Mesolithic groups in Scandinavia that are archaeologically visible as techno-complexes (Ertebölle, Lihult, Nöstvet, The Eastern Quartz Complex etc.), thus may be said to have had historically constituted exchange connections and spatial expression, the former being shown in the down-the-line distribution of exotic materials such as flint microblades from the southernmost part of Scandinavia found on sites in eastern central Sweden and Norrland (Fig. 7). The Late Mesolithic groups in southern Scandinavia in the fifth millennium cal BC, as defined by their material culture, thus may have formed a sphere of interaction that was maintained not only as a function of population density in relation to the need for social and biological reproduction, but on the basis of common historical roots. These groups may be discussed in relation to the concept of ethnicity. Ethnic distinctions can be found at different structural levels. The "cultural groups" in the area may thus, according to Fredrik Hallgren (*2000*), be discussed and analysed using anthropological and generalizing concepts such as band, dialect, tribe, and language family (as used by *Newell et al. 1990*). The local groups that formed as new land was settled during deglaciation may thus best be understood as dialect tribes in a larger community referred to as a language family. It is within the latter, larger structure that the Neolithization took place. It must be noted that ethnicity has no essential quality. It is dynamic, and people may change identity, ethnic groups may split or merge and above all, material culture is not a simple projection of an ethnic unit defined by its common origins or territory. Therefore this discussion is problematic in terms of what people actually thought about and how they expressed their identity in this time. The basis for this discussion is, however, the fact that spatial material patterning shows continuity over time and thus may be discussed as expressions of identity.

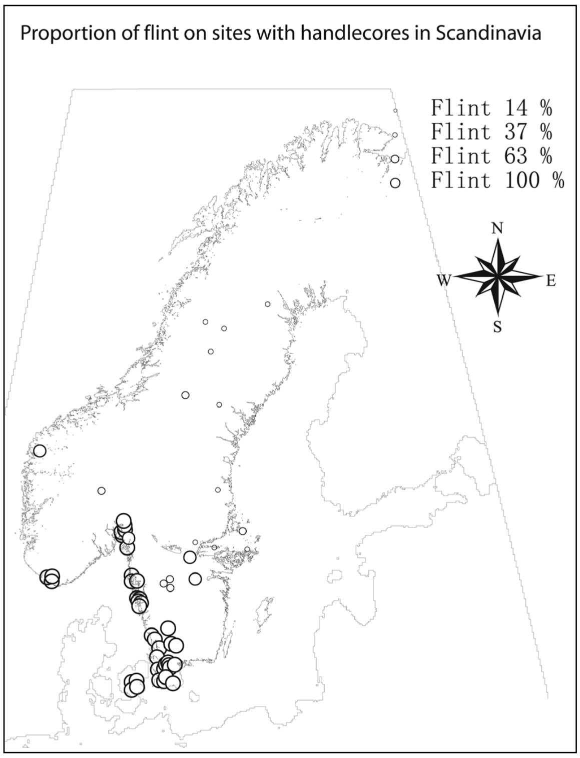


Fig. 7. The spread of exotic, south Scandinavian flint in northern Sweden during the Middle Mesolithic indicating down-the–line exchange networks. The scale of integration may be related to historical relations established as the result of the history of group formation during deglaciation.

Around 5400–5200 cal BC, the Linear Band Pottery Culture and with it the first farming economy was established over large parts of central Europe up to northern Poland and Germany. When the spread of the Neolithic way of life, manifested in the appearance of the Funnel Beaker Culture (the TRB), advances north of this border around 3900 cal BC, the change in material culture occurs according to a large body of radiometric evidence, simultaneously over the whole of southern Scandinavia up to and including central Sweden (Fig. 10). It is proposed by Hallgren that the spread should be seen as a transfor-

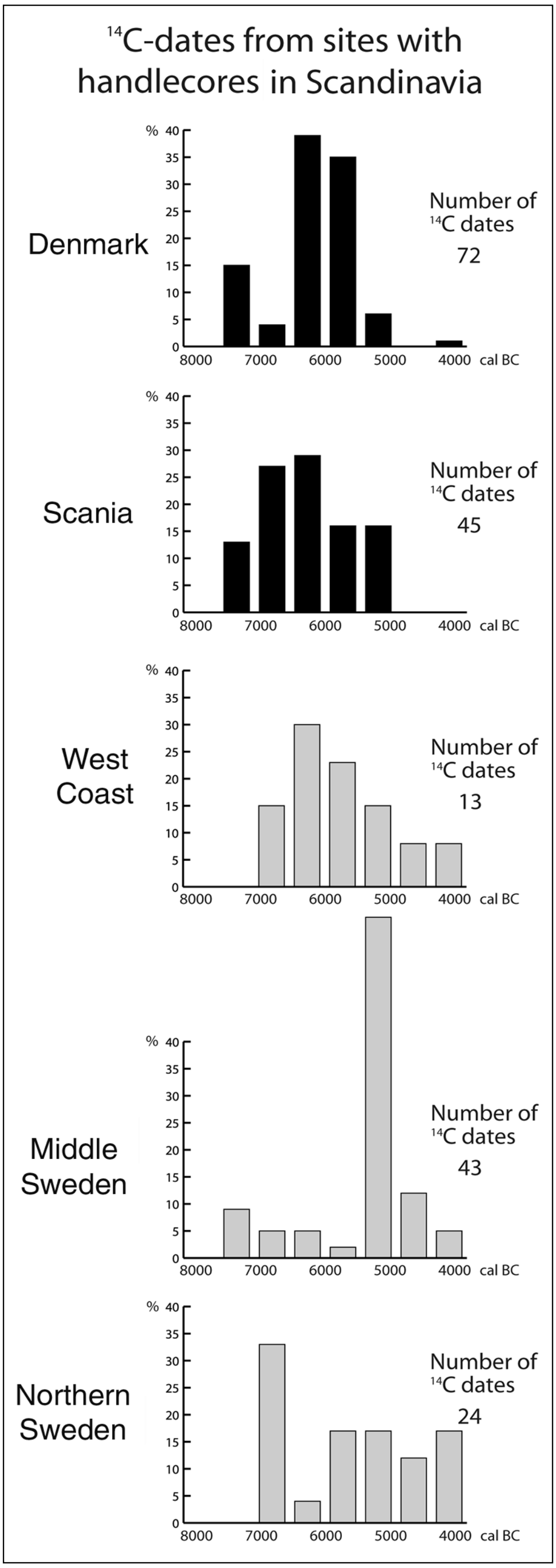


Fig. 8. ¹⁴C datings from all excavated Mesolithic sites with the handle core tradition from Scandinavia. The fact that this technological tradition is established simultaneously over the vast area from northern Germany to northern Lapland, indicates established social relations and exchange networks.

mation within Late Mesolithic society. The sharp geographical limits of the new phenomenon, the TRB culture, as well as continuities in material culture, speak in favour of this, since it follows and respects the age-old Mesolithic borders (compare Figs. 11a and b). It is suggested by Hallgren that marriages between different exogamous bands within the local groups in south Scandinavia, local groups participating in the same marriage networks, was the medium for the spread of the knowledge and new way of life, since marriage is an example of contact that is most commonly arranged between persons that originate from the same dialect tribe or language group. Ceramic technology and crop growing is introduced early in the Neolithization process and it may be the moving partner in the marriage networks that brought the new knowledge. Hallgren has also suggested that the social network of the Late Mesolithic society underwent a complete change with the creation of the Funnel Beaker Culture. He argues that a new, lineage-based society was formed, perhaps with changing gender roles as a result of the transformation of the social structure. One such change might be to the post-marital rule of residence, since the ceramic technology in the Late Mesolithic was assumed to have been introduced by in-moving spouses that, according to the rule of residence, belonged to a specific gender group, had changed by the Early Neolithic since the ceramic technology now was, as will be shown below, reproduced vertically through generations in a unilinear lineage. Hallgren's analysis of TRB houses in relation to a cross-cultural sample indicates that there might have been a change from patrilocal to matrilocal rules in post-marital residence patterns. This, as a consequence, indicates that it was the female gender moving within a Mesolithic, patrilocal rule of residence that first introduced pottery and farming to eastern central Sweden. A characteristic of matrilineal, matrilocal societies in general, a social structure proposed for the TRB in eastern central Sweden, is the occurrence of special men's houses. These houses are seen as a device to bring the men together as a group as they, as in-moving spouses, find themselves as strangers in the new environment. No such houses have, however, been found, but sites show a "clearly marked, spatial structure, with spatially separated activity areas" (*Hallgren 2000.16*) (compare Figs. 16a and b). The importance of controlling space may be explained by the desire to separate males from females. Perhaps the spatially separated activity areas served the same purpose as the men's houses. This possible distinction between female and male genders materialized on the TRB settlement sites has been discussed in more detail by another member of the Coast to Coast project, Cecilia Lidström-Holmberg, on the basis of an analysis of the find contexts of querns. We will return to this below.

The variation in archaeological sites of the Early Neolithic in eastern central Sweden also has some bearing on the interpretation of the social and economic organisation of the TRB culture, well in line with the proposition of a lineage based system. Aggregation sites with evidence of fishing and seal hunting are found on the coast, agricultural farmsteads with remains of cattle, sheep, goat, and cultivated plants on the sandy soils in the interior. Hallgren proposes that the interior farmsteads were part of a mobile swidden agriculture economic system and, based on the number of and the age of a series of radiocarbon dated pots from an offering fen at the Skogsmossen site, he suggests that the farmsteads were used at three periods covering at least 15 generations and that it had a succession of c. 200 years with a duration of each occupation of 25 years (Fig. 12). Several facts indicate that it was the same social unit that kept returning to the same spot. One of them is the fact that there is a strong continuity in the decoration of the pottery from the different phases. The stability in the design over some 15 generations shows, according to Hallgren, that these norms were transmitted and reproduced vertically through generations. Thus, they appear to have been bound to, and reproduced within a social unit rather than by single individuals, which points to a unilinear lineage that may have been either patri- or matrilinear. This interpretation suggests a degree of territoriality. The TRB sites in eastern central Sweden may therefore be interpreted as equal segments in a segmentary social system and as occupying a specific place within that system. As will be shown below, this non-hierarchical segmentary principle of social organisation attributed to the TRB culture in eastern central Sweden based on ceramic style analysis actually gets further support from the analysis of the production and distribution system of the thin-butted greenstone axe carried out by another member of the Coast to Coast project, Lars Sundström.

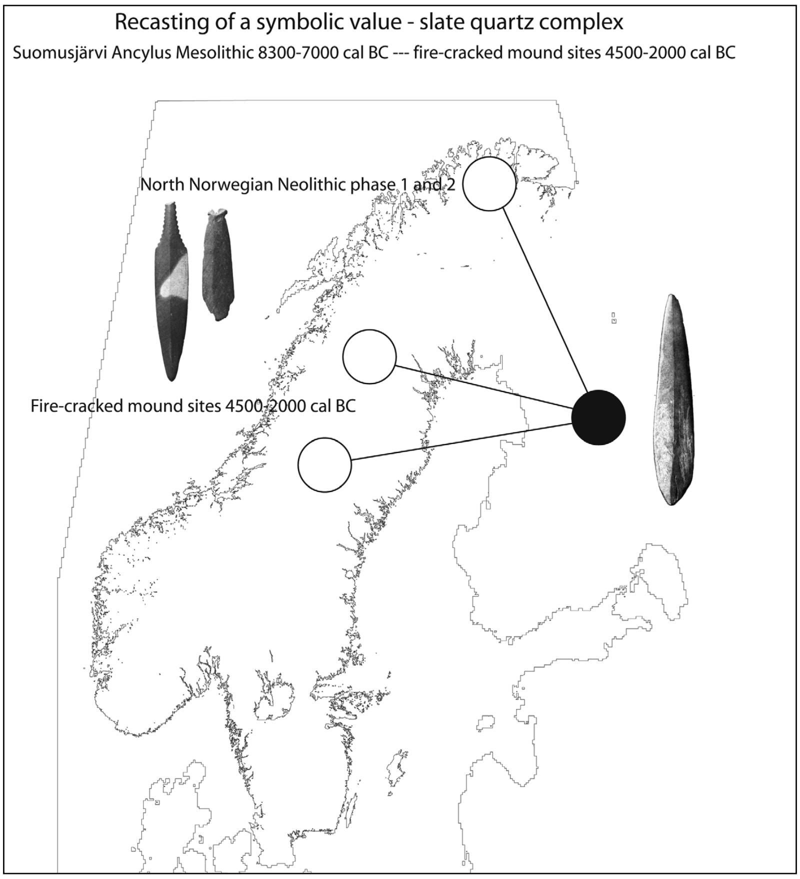


Fig. 9. The Quartz-slate complex that is established among hunter-gatherers north of Eastern Central Sweden around 4500 cal BC, may represent an ethnic process with an appropriation of and recasting of a symbolic value related to identities bearing on the past. In this case the north Swedish hunter-gatherer groups materializes a history based on the memory of the early Mesolithic Suomusjarvi tradition of Finland.

A COLLECTIVE IN PERIL

In his contribution Lars Sundström (*2003*) addresses two interrelated and equally fundamental questions that bear on the cultural transformation we call Neolithization: human nature and the mechanism responsible for social change. The first problem relates to how we approach the concept of equality. Have humans a natural propensity for equality or is it a culturally constructed ideology? He argues, based on a discussion of newly developed theories on this issue, that equality is a cultural construct, an ideology, and thus that it has to be continually reproduced. This notion has fundamental consequences for how we approach Neolithization since, according to him, social change is closely related to conflicts that develop between a social ideology as structure and human action (praxis). Based on a study of how people actually react to changes threatening social ideology and thus the social order, it is proposed that the archaeological signals that indicate change at the Neolithic transition (TRB material culture, burial customs etc.) actually could reflect act of defence by a hunter-gatherer social ideology based on an idea of equality. If this is true, not only are social ideologies (culture) manifested by communication through public symbolism (material culture), but social conservatism must have been an important factor in the process of Neolithization.

To understand this character of change then, the social institutions responsible for maintaining a social ideology have to be discussed. The pronounced ideology of equality proposed for Late Mesolithic society needed its own institutions of reproduction such as sharing, sanctions against the accumulation of property, and mobility. It was when these institutions were threatened (for example, mobility by the settled life of farming) that the ideology was made discursive and therefore possible to act upon. Based on the notion of culture as expressed in public symbolism, Lars Sundström shows that various material expressions (the treatment of human bones, decoration of pottery, polishing of axes etc.) were used to regulate and manifest the social order. The Funnel Beaker Culture must therefore not only be seen as a reflection of a new economy, but also as a material manifestation of the threatened egalitarian ideology. It was a social message, saying that in spite of the settled life and its consequences, everything would remain as it always had been.

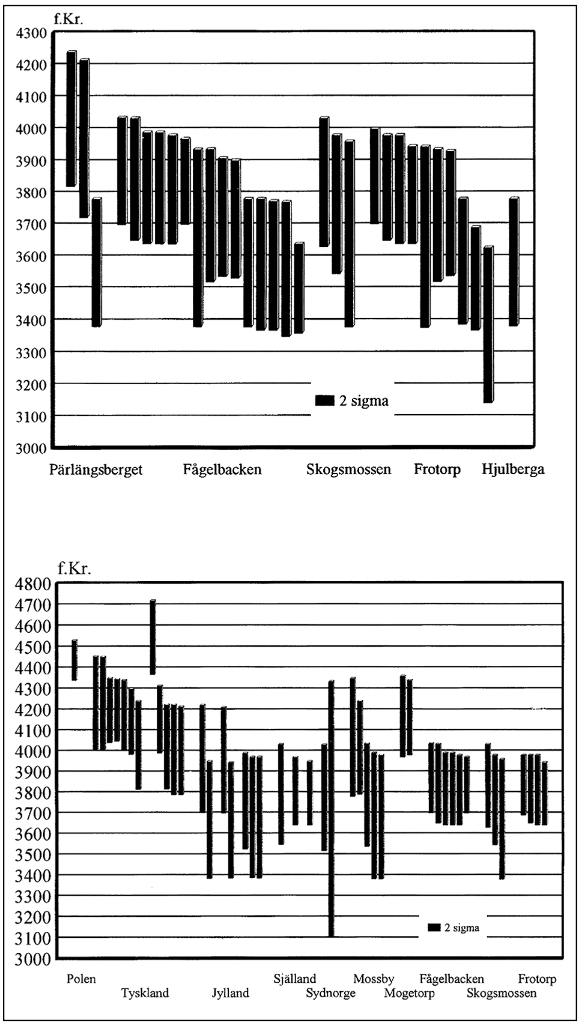


Fig. 10. Published ^{14}C dates from Funnel Beaker Culture sites in central Sweden (from* Hallgren 1996*). Note that the TRB tradition is established contemporaneous over the whole south Scandinavian area including Eastern Central Sweden.

It was stated above (F. Hallgren's contribution) that the pottery found on the TRB sites in the area indicated an "egalitarian" social organisation built on equal parts in a segmentary social system where the traditions of norms were transmitted and reproduced vertically through generations pointing to unilinear lineages in the area. Microscopic analyses of clay and temper in the pottery further strengthen this interpretation, since they show that the raw-materials for production were unique to each farmstead. On most of these inland farmsteads, production debris from thin-butted greenstone axe production was also found. Petrography analyses of the flakes from the knapping floors indicate that the raw-material sources for this production were also unique to each settlement, strengthening the proposed social interpretation. A similar analysis of stray finds of thin-butted axes indicates that these were used and later deposited at other farmsteads than the producing ones (Fig. 13b). Lars Sundström has two possible interpretations of the production-consumption pattern. One takes into account the moving systems typical of slash and burn gardening societies and proposes that the axes followed their producers and consumers to new habitations. The other suggests sharing institutions, which have been proposed as an important source of social power in egalitarian societies, and sees the consumption pattern as a result of sharing networks in a shared territory (Fig. 13c). In times of trouble, as was discussed in the first part of this paper by Kjel Knutsson, people, and thus social groups, tend to return to a conservative retrospection and preservation of the old, to seek comfort and legitimacy from an idealised history. Apart from representing ideology in material symbolism then, the past seems to have

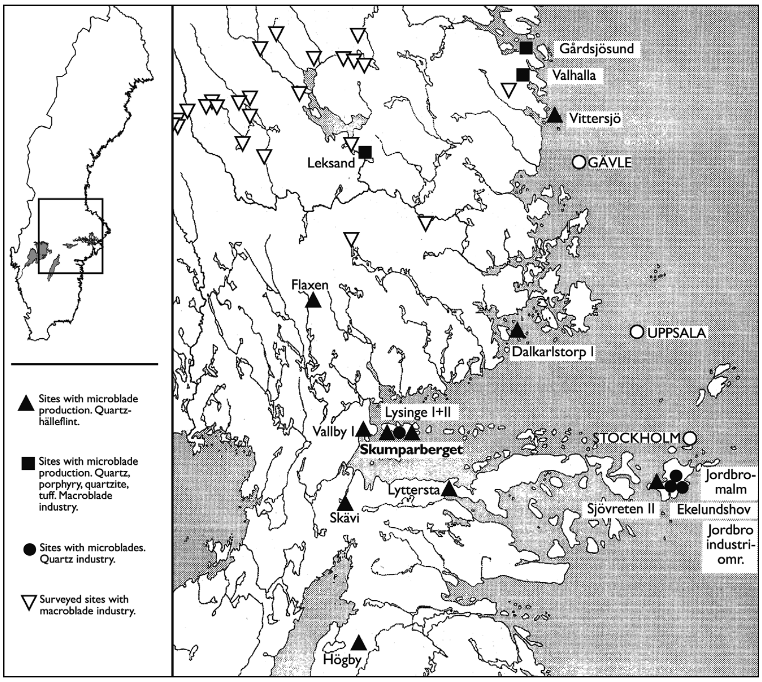


Fig. 11A. The distribution of Late and Middle Mesolithic sites (the Handle core tradition) in Eastern Central Sweden and southern Norrland. Two techno-complexes are found here. A northern group (open triangles with a distinct macro-blade industry and a southern group characterized by a knapped quartz industry.

also been activated in rituals in the Early Neolithic in eastern central Sweden. This is shown by the remains of rituals at coastal sites, where the past seems to have been made active by reference to ancestors. At these TRB coastal hunting stations in Eastern Central Sweden we find remains of rituals where the dead were buried and de-individualized by burning (Fig. 16c). This effort to reproduce the collective spirit was thus metaphorically tied to hunting. In Sundström's argument the TRB ancestors were thus still hunters and gatherers in the early Neolithic, representing and legitimizing an idealized social structure. As shown in many anthropological analyses of segmentary cultural systems, they are normally quite short-lived. The built-in conflict between the social ideology of equality and the real world of land ownership and a settled life makes the members of the society insecure and the entire society moves towards a crisis (this may take centuries!). He interprets the cultural patterns of the following Middle Neolithic period as two different reactions (Fig. 16) to this crisis, an in the end unbearable situation forcing the groups to change their culture and social structure.

In the southern part of the TRB area there seems to have been a strengthening of social control. The construction of collective central sites of the Sarup type in the Megalithic TRB phase is thus seen as a manifestation of ritual practices aiming to reinforce and preserve the collective, the idea of egalitarian relations. In the northern part of the area, the tension within the segmentary TRB society takes another form. Here, the past acts as a stepping stone for change. The idealized hunter-gatherer lifestyle presented in the reproductive myths and played out during ancestral cults at the coastal sites is actually returned to. The transformation of the farming TRB culture to the hunter-gatherer Pitted Ware Culture is thus explained by Sundström as a way of solving the crisis by reintroducing a lifestyle that made the institutions that reproduced the egalitarian mode of life possible to uphold.

As we move into the end of the Middle Neolithic the societal conflict in the southern TRB is finally solved by the construction of a new past. As will be shown by the work of Helena Knutsson below, the cultural heroes of the bearing myths change: no longer are they hunter-gatherers, but landowning farmers. The idealized farmer of the new ideology is materialized by the ritual paraphernalia attached to those interred in BAC graves, which are installations for reproducing individuals within a new social order.

QUARTZ, QUERNS AND SOCIAL IDENTITY

We have so far argued that the cultural change around 4000 cal BC had long-lasting historical roots and thus that the change was structured by Late Mesolithic configurations. The change is further seen as a manifestation and defence of the old hunter-gatherer egalitarian ideology. TRB material symbolism expressed equality. Since this was a materialization and thus visualization of the previously embedded ideology of hunter-gatherers, it became vulnerable to critique and thus to change. We have also discussed the importance of the constructed past in reproducing society and that the TRB past still was a past of hunter-gatherers metaphorically manifested during ancestral cults at hunting stations. The reproduction of society is, however, not only expressed in ritual contexts. The routines of everyday behaviour

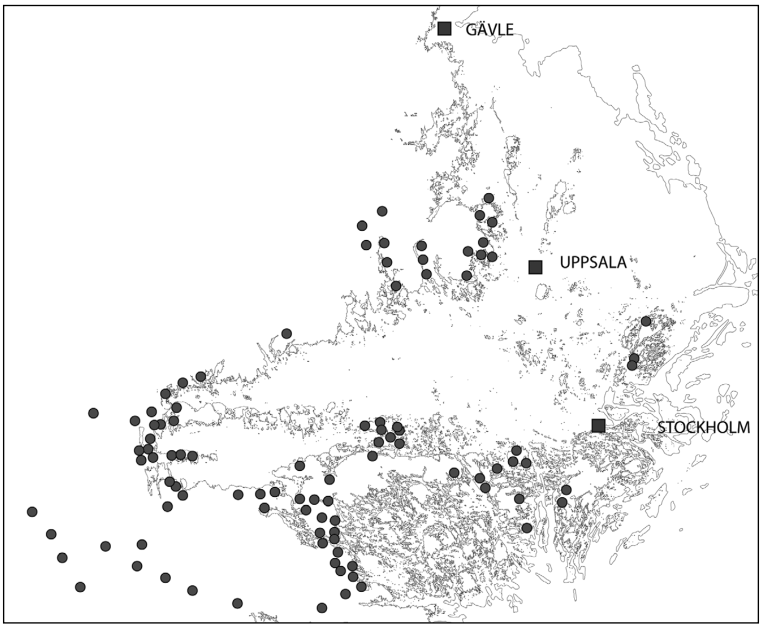


Fig. 11B. The distribution of multifaceted shaft hole axes in Eastern central Sweden represents the settled areas of the Funnel beaker Culture between 3900–3300 cal BC. Note the continuity in the North-South distinction between time periods where the TRB is formed only in the southern hunter gatherer group (compare with Fig. 11A).

comprise another arena where central categories are played out. In times of cultural change these cultural codes are re-evaluated and changed. Different domestic technologies are part of everyday behaviour and thus cultural codes are enacted as they are implemented, for example, on settlement sites. The way we understand and use the concept of technology is thus critical to how we deal with questions of prehistoric cultural transformations such as, for example, the process of Neolithization. Taking an engendered view of technology as a starting point, Christina Lindgren and Cecilia Lidström-Holmberg, have analysed changes in quartz tool technology and the production and use of querns/grinders during the Mesolithic-Neolithic transition process.

According to an analysis of compiled, radiocarbon dated sites, there seems to be a change in quartz technology in eastern central Sweden around 4500 cal BC (*Lindgren et al. 1997*). This change occurs simultaneously to the shift in symbolic communication and possibly ethnic distinction between north and south that was discussed by Kjel Knutsson earlier in the paper. Using a newly developed theory of quartz fracture patterns, the social dimensions of technology and Giddens theory of structuration, Christina Lindgren describes a reproduction of cultural codes and social organization, where the relationship between technology and praxis communicates identity within settlements. Referring to the general ideas of a "pre-Neolithic" change discussed by Knutsson, Lindgren uses the two identified technologies (platform and bipolar-on-anvil methods, compare Fig. 3) to describe a process of social change. Shifts in size and variability of Mesolithic sites in the area seem to harmonize in time with this change in technology. Before 4500 cal BC the sites are characterized by great differentiation of habitation area sizes, the tasks performed in them, inner site features and artefact production technology. In the three former aspects, the younger sites seem more homogenous. All over the transition period, the sites are situated on the beaches of the outer archipelago islands (Figs. 2 and 15). A preliminary activity area analysis using the quartz fracture pattern theory, of excavated Mesolithic sites dating both before and after 4500 cal BC, does not, however, seem to indicate any change in symbolic communication on site level. This may indicate that the change in quartz technology related to other aspects of the TRB society than social roles or that it was not part of the social distinction. As we will see, other aspects of material culture seem to relate to a need for social distinction in the TRB.

The TRB inland sites in eastern central Sweden interpreted as farmsteads with evidence of domesticates such as cereals and cattle showed, as discussed earlier by Hallgren, "clearly marked, spatial structures, with separated activity areas". A tentative explanation presented by Hallgren stated that this need to control space may have been the result of a desire to separate males from females. This possible distinction between genders materialized on the TRB settlement sites may, accordingly, relate to social changes in the local Mesolithic community resulting from the new situation impinged on society by a new way of life. This change started probably with a shift in symbolic communication and social roles related to large-scale changes in social relations and ethnic distinctions at this time, as proposed earlier in the paper. Studying the social structure of the TRB society by means of a contextual analysis of grinding tools from the area, Cecilia Lidström-Holmberg (*1998 in press*), in accordance with her view on technology, wants to challenge the traditional paradigmatic discourse on querns, where it was assumed that they had no social intentional meaning beyond the functional. The low archaeological value, she says, may have been due to negative associations, "a monotonous and unqualified female task", related to a set of historical values that are brought into play in interpretations. Instead, Lidström-Holmberg wants to explore prehistoric value systems by means of critical gender theory. The grinding tools, she states, can be interpreted as an active part of Neolithic social and ritual life in eastern central Sweden (*Lidström-Holmberg 1998.124–129*). Grinding tools are, together with hearths, cooking pots and other food processing implements, the only stone tools directly associated with female activities, from tool manufacturing to their maintenance. If an economic and social organisation of gender relations structured the Neolithic way of life, it may also be observable in the daily material culture associated with grinding tools and food processing techniques. As was mentioned above, the Early Neolithic inland farmsteads were strictly structured and the principles for this may be interpreted as having been based on gender categories, as the activity area analysis shows separate areas for axe production, and areas with grinding equipment like querns and other food processing remains (Figs. 16a and b) (*Lidström-Holmberg 1998.128*).

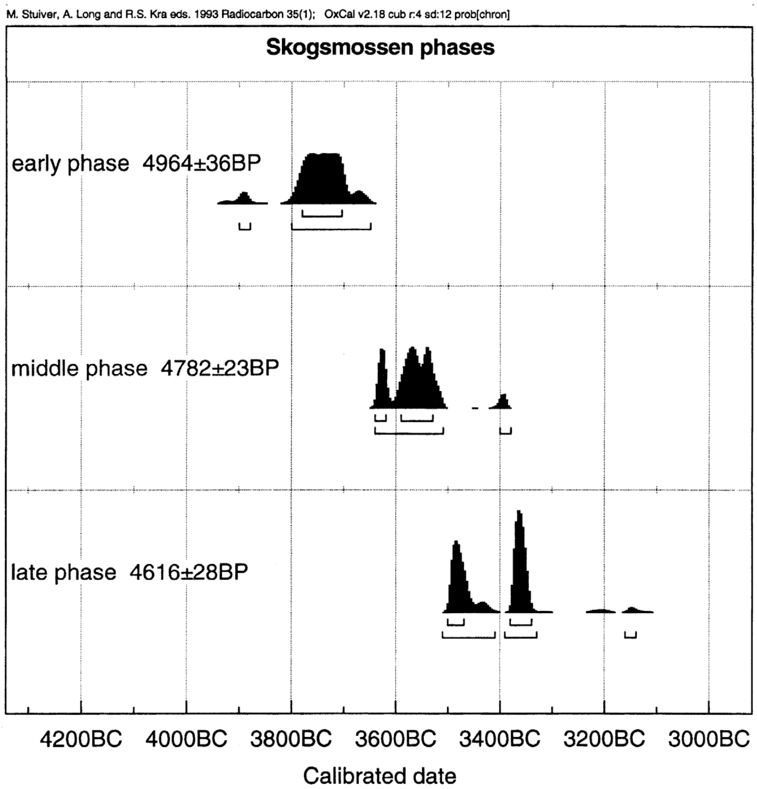


Fig. 12. Probability distributions (black coloured areas) at 1 sigma and 2 sigma significance interval respectively (brackets below the distribution curves) for the three chronological phases based on ¹⁴C dating of pottery from the Skogsmossen offering fen (see Fig. 16b) (from **Hallgren & Possnert 1997.127*)*.**

The Mesolithic querns are usually smaller and less standardised in form than the Neolithic ones in eastern central Sweden. It is not until the Mesolithic-Neolithic transition that large, actively designed grinding tools appear in the archaeological record in the area. A saddle-shaped grinding slab is accompanied by a two-handed, loaf shaped handstone, both parts carefully designed by knapping, pecking and grinding (Fig.17a). The production probably required considerable technological knowledge and thus, because artefacts are produced and used in a context of interaction, the technology must be seen as part of social production. The morphological changes in grinding tool design that appear in the Mesolithic-Neolithic transition are linked by Lidström-Holmberg (*1998.132*) to dynamic changes within these societies. Shared ideas of grinding tools as social and ritual metaphors are proposed to be included within the conceptual domestication of the Neolithic communities. It is thus of importance to see that "symbolism is active in all parts of society, including daily life", a statement that brings us from the querns to the context in which they functioned, the settlement. Here the evaluation of the archaeological context is crucial as a source for the definition of the context of communal experience, since the querns in this study are seen as representations of internal experiences of culturally defined values and concepts, including gender distinctions.

Drawing on, albeit meagre, the ethnographic experience of women's everyday activities, it seems as if grinding tools cross-culturally were used, produced and owned by women. Although womanhood is a cultural interpretation of sex, grinding tools can thus in ethnographic cases at least be shown to express human relationships, i.e. ideas of marriage and social and economic interdependence and thus played a part as important social signifiers in initiation rites. During the rite, the initiates were instructed in the use of the objects, as well as in social and moral life and the role of adult womanhood. The friction between the grinding slab and the hand-stone meta-

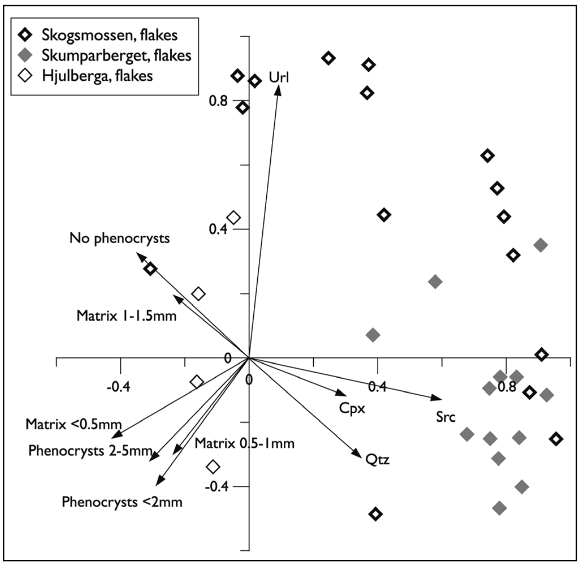


Fig. 13A. Correspondence analysis of the lithology of flakes from porphyry axe production found at three TRB farmsteads in Eastern central Sweden. Note that the lithology differs between sites but is similar within sites indicating local raw material quarries. This indicates self sufficient local groups in a segmentary social structure.

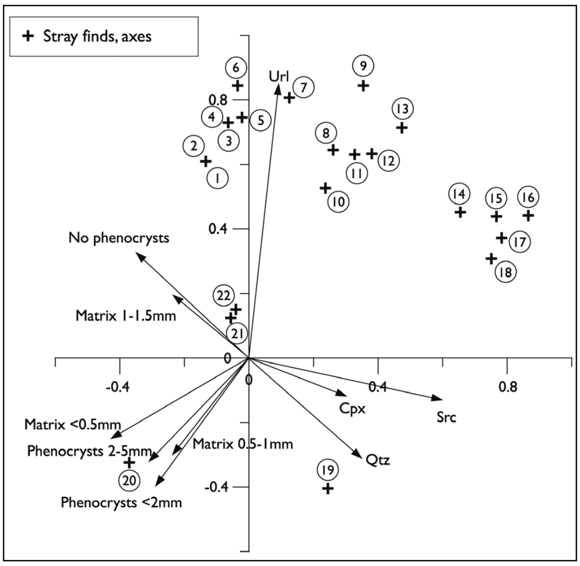


Fig. 13B. Correspondence analysis of the lithology of stray-found porphyry thin-butted axes from assumed farmsteads in Eastern central Sweden. The axes forms groups of similar lithology indicating that they have been produced at a few farmsteads (from Sundström 2003*).*

phorically came to represent the ideal relationship between man and woman. But the relationship between the handstone and the grinding slab could, as shown by other ethnographic examples, also express the relationship between age sets, for example, mother and child. A case in point in eastern central Sweden concerning the latter suggestion is two child burials at the Östra Vrå TRB site, where the charred bones from the buried children were covered by an astonishingly large number (80) of saddle shaped querns. The deposited querns where mainly grinding slabs, representing the "mother" in the mother/child quern metaphor (Fig. 17b).

Similarities in artefact remains from communities belonging to LBK and the TRB in Scandinavia have been noted for a long time. It is thus interesting to note the similarities in tool design of LBK grinding tools and the saddle-shaped grinding tools found in eastern central Sweden. The quern and its design may, as indicated by the ethnographic examples and the graves discussed, have been important in the ritual reproduction of the TRB social structure. The find contexts of querns at different sites in eastern central Sweden studied by Cecilia Lidström-Holmberg actually point in this direction. They have been found, as already mentioned, as sacrificial offerings in graves, and as structured organization of space on farmsteads and finally, as votive offerings in wetlands.

The Early Neolithic is in general known for its many finds of pots, axes etc. in wetlands, indicating a votive offering practice. The whole of Early Neolithic chronology in Denmark is based on typology and ra-

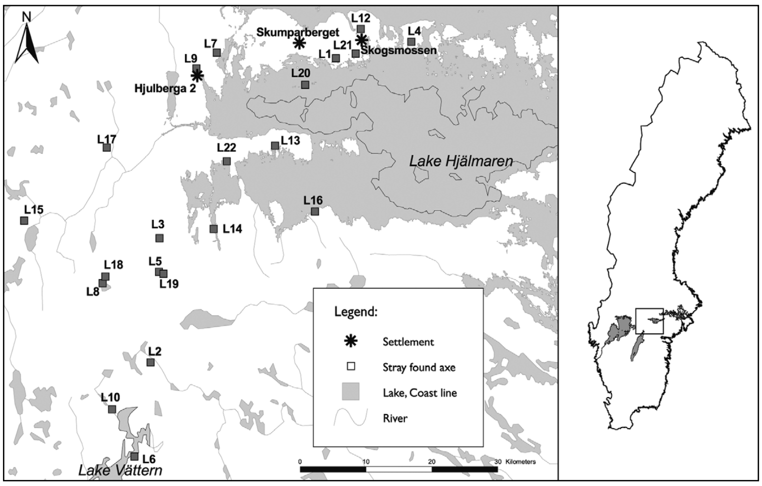


Fig. 13C. Dissemination of the stray-found axes analysed in Figure 13B. Axes from different lithological groups are found throughout the TRB landscape in Eastern central Sweden indicating a network of exchange relations or illustrates the movement of segments in the social structure within the landscape (from Sundström 2003*).*

diocarbon datings of funnel-beakers found in moors. These pots are interpreted as belonging to offerings close to TRB farmsteads. On the farmstead at Skogsmossen in eastern central Sweden, a small fen, interpreted as a votive offering fen, has actually been excavated. Here, finds of pots and axes were made, together with remarkable elongated quern handstones of micaeous schist. The latter were deposited in a straight line in an east-west orientation across the southern part of the fen (Fig. 16b). The saddle shaped grinding slabs, on the contrary, are deposited in a north-south line along the fen. According to Lidström-Holmberg, then (comparing the settlement layout and the organisation of votive offerings in the fen): "The pattern of deposition in the fen may be interpreted as a reflection of the gendered living space in general." The way people structured their living space through gender ideologies seems to have set part of the agenda for both daily life (the settlement) and ritual action (the fen). The definition of symbolism as active in all parts of society, including daily life, seems to be particularly "true" at the gendered Skogsmossen site (*Lidström-Holmberg in press*).

Changes within the structure of households during Neolithization, as it seems, can be discussed in terms of negotiations of gender roles and gender norms within the Early Neolithic communities. Querns, food and food processing are thus seen as important gendered strategies for social action and negotiations, both within households as well as in the wider community. Cecilia Lidström-Holmberg suggests, after her preliminary investigation of the TRB quern material in eastern central Sweden, based on her critical reading of gender theory, that progress, transformation and technological advance, is indeed a gendered enterprise. Querns are socio-technological objects involved in domestic action, both manifesting and negotiating gender principles as shown by the distinctions in both the settlement sphere and the fen (*Lidström-Holmberg in press*). As a consequence of this "interpretation", the assumed perception of households as unchanging and known socio-economic domestic entities obviously needs to be further deconstructed before we can go beyond simple dichotomies.

The structure of the TRB social organisation, here formulated as binary oppositions, thus makes too easy a blueprint of present-day gender relations. Whatever the case may be, no doubt the querns and their contexts of deposition in eastern central Sweden during Early Neolithic, indicates a cultural need

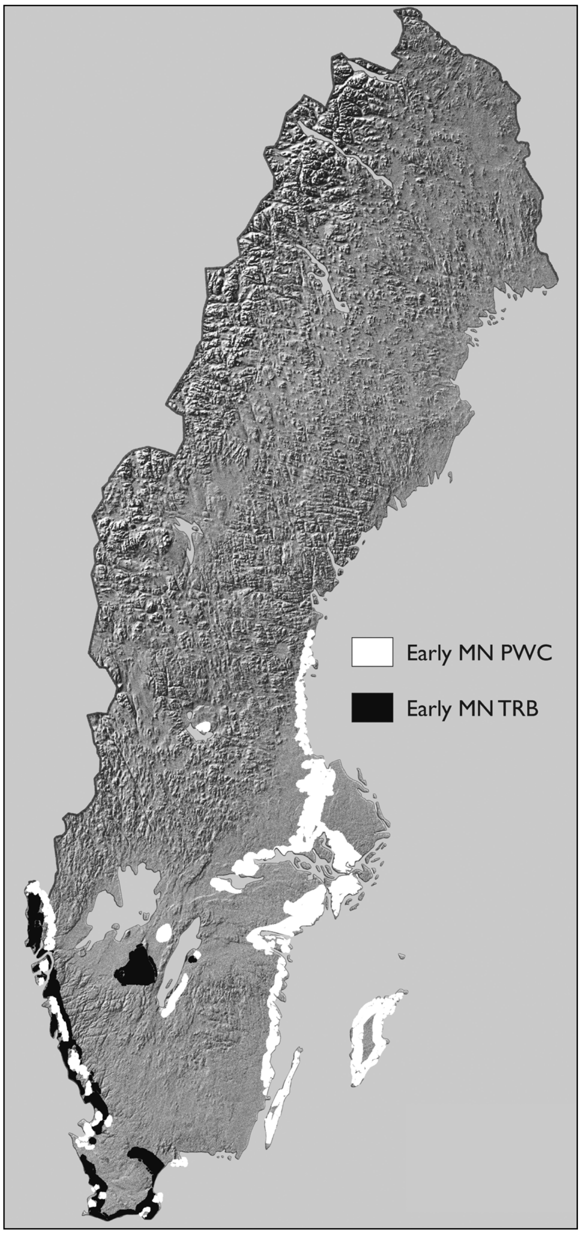


Fig. 14. The distribution of the Middle Neolithic "cultural groups in southern Sweden. Both The Pitted Ware Cultureand the Megalithic TRB are formed on the same Early Neolithic cultural substrate. The PWC returned to and lived the egalitarian life of the ancestral stories, the megalithic TRB indicates a strengthened ritual control over the egalitarian social ideology (from **Burenhult 1999 and Sjögren 2003*).***

of distinction in the TRB, a distinction that so far, according to Lindgren's study discussed briefly above, have not been found in earlier contexts in the area. The importance of a female/male separation in matrilineal, matrilocal societies has been proposed for the TRB in eastern central Sweden by Fredrik Hallgren. The references to male-female relations and fertility as metaphorically materialized in querns may thus be part of a fertility cult reproducing a domestic unit typical at the inland farmsteads. The east-west/north-south distinction of grinding slabs and hand-stones in the Skogsmossen fen calls for an interpretation of the querns as representations reproducing male/female relations, and in a wider meaning, a cosmology formulated around an idea of the "canopy of heaven". This interpretation concerns only inland settlement life. At the same time, in the coastal settlements, as proposed by Lars Sundström earlier in the paper, the same groups struggle to keep their old rituals, concentrating on the re-creation of an ancestral past, returning to the idea of a hunting, gathering and mobile life style (Fig. 16. c). This dualistic settlement structure and its social connotations no doubt by and by created a crisis in the minds of the Neolithic "eastern central Swedes". As Sundström puts it, this problem found two different solutions in the TRB region as a whole. Some groups, after some generations, changed the idea of their ancestors to make it commensurate with daily life as farmers, while others went back to the mobile hunting style of life, commensurate with the world view presented in the common rituals at the coastal settlements. The idea of "the farmer" and some of its associated material metaphors are important here and they have been dealt with by Helena Knutsson in her part of the project.

BLADES FOR THE ANCESTORS

In the foregoing we have shown that material culture must have been important in social communication in Mesolithic and Neolithic societies. In periods of change it also functioned metaphorically as a vehicle for the construction and manifestation of a new world view and thus, by necessity, a new past. If much of the TRB material culture was related to the communication of an idealized idea of equality with reference to a pantheon of hunter-gatherer ancestors, the flint blade or the harvesting sickle may be seen as a metaphorical materialization of "the farmer". Found in late Middle Neolithic graves, it may represent one important aspect of the paraphernalia, the neccesary gear, of an ancestor commensurate with the real life of TRB farmers. As such, they were actors in the reproduction of Late Neolithic society. Blades, unlike polished axes and pots, are common artefacts in Scandinavian archaeological contexts throughout the Stone Age and long into the Bronze Age. They are found in settlements, graves, and depots. In some cases their production sites have been found, usually in settlement remains. In several periods of the Stone and Bronze Age their

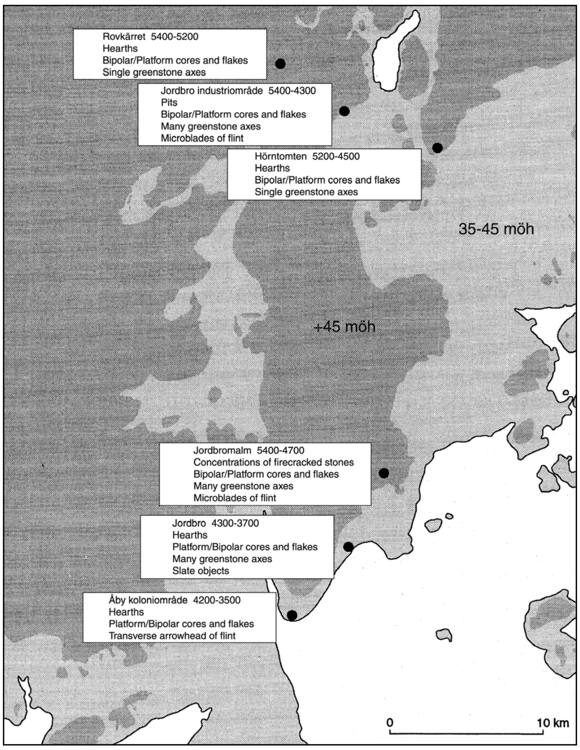


Fig. 15. Map of one micro-region in Eastern Central Sweden during the Late Mesolithic showing the variation in settlement types.

production seems to have been standardised and plentiful. So, how can we possibly understand their role in the transition to agriculture?

Helena Knutsson has chosen to look at three aspects of artefacts: the technology of production, traces of use, and contexts of deposition. Taken together, they inform us about cultural processes in the transition to farming and, as we shall see, in a way that seems logical to the idea of cultural reproduction in the Neolithic as proposed by Lars Sundström above – that is, the need to create new pasts and ancestors to accommodate the new life of "the farmer". The production of blades in Scandinavia had already begun in the Late Palaeolithic. During the Mesolithic, production was more and more sophisticated, the size of blades diminished, the regularity of their shapes increased. Then, in the Late Mesolithic, the blades again grew in size, and regularity appears to have been more important then ever. During the so-called Kongemose culture, partly contemporary with the first farming groups producing linear band pottery in northern Europe, there are production sites in southern Scandinavia with thousands of blades. We also find depots with neatly packed blades (produced from one or two cores, still packed tightly together, as if they had been kept in a bag) (Fig. 18). At the end of the Mesolithic, the production of blades

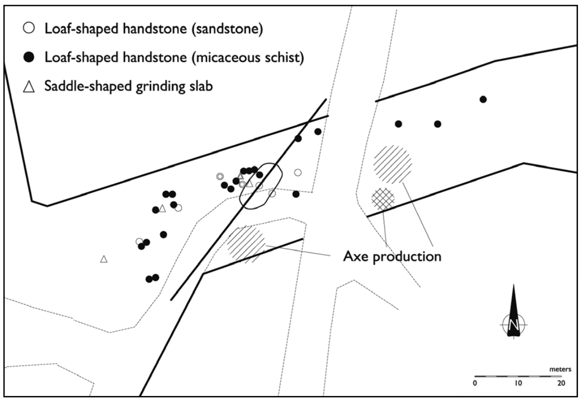


Fig. 16A. Map of the Skumparberget Early Neolithic TRB inland farmstead. Note the spatial distinction around the house of activities related to axe production and food preparation.

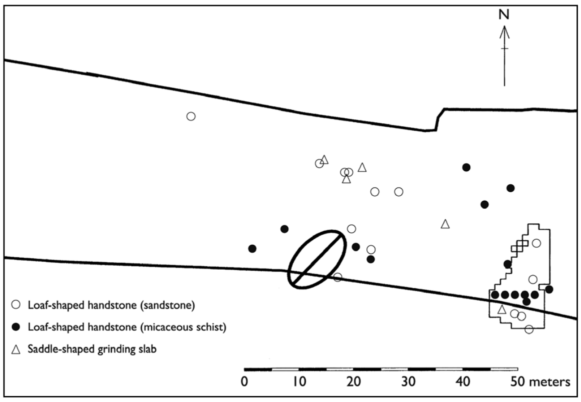


Fig. 16B. The Skogsmossen TRB inland farmstead. Note the grinding slabs and handstones in the offering fen.

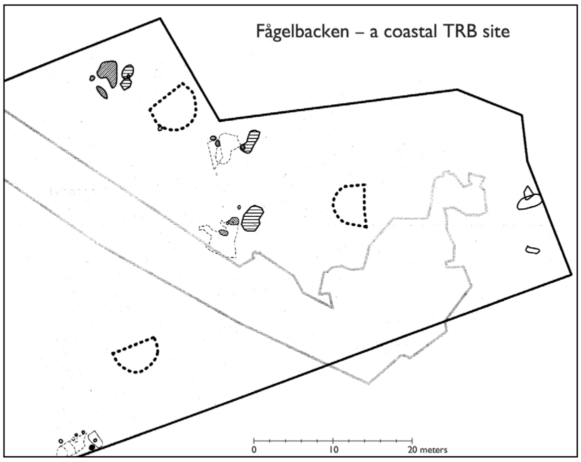


Fig. 16C. The Fågelbacken coastal TRB hunting station with pits with human burials, huts and hearths (from **Lidström Holmberg 1998** *and* **Hallgren 1997***).*

seems to follow other needs than hitherto. Much rougher forms were produced, regularity seems no longer important, but they are still produced in great numbers. Also, at Neolithic TRB sites in Scandinavia we find blades, but they are more regular than the Mesolithic examples, and above all, fewer. Moreover, their deposition sites changed. At the end of the Mesolithic they were placed in graves, and left in great numbers in settlements together with production debris. In the oldest TRB they are still found in the same settings, but when we look at the remains of the Middle Neolithic, deposition habits have changed considerably. The blades, often only slightly modified, increase in numbers in burials, and their context of production disappear. The same tendency can be discerned both in Middle Neolithic TRB megalithic graves and in the central and north European Corded Ware Culture mound graves. This specialised production, seemingly for ritual purposes, can be understood, as is shown by Helena Knutsson, in relation to the construction of a "Neolithic way of life".

The important thing about the change in blade production is not only the change in the deposition context of the TRB blades, but the fact that we now see two different blade technologies and two social contexts of production and use emerging from the archaeological record (see Figs. 20a and b), one related to the southern TRB farming communities, another related to the former northern TRB area with PWC hunters and gatherers. The former are, as already mentioned, found only as gifts for the dead in TRB and later on in late Middle Neolithic BAC grave contexts. They are either unused, or used as sickles for the harvesting of grain. The latter blade technology is found as both tools and waste from production on Pitted Ware Culture settlement sites. Here, the use profile is varied, indicating domestic use in non-ritual settings.

A quick look at the continental traditions of blade production tells us a slightly different story. Blades were produced during Upper Paleolithic times, and they remained in the settlements, deposited as waste from production or after use. The Mesolithic is a troublesome concept in continental Europe, but still the materials defined as Mesolithic do not contain blades at all, or the blades found in them are made with no specialised needs in sight. With the arrival of domesticated species to Europe, the blades systematically produced and used as sickles or rather harvesting tools pop up in the settlements. This is especially documented at the Early Neolithic sites of south-eastern Europe (*Perlès 1992; Demoule and Perlès 1993; Pérles and Vitelli 1999*). The origin of their technology of production has been traced to the Middle East or Near East, where sources of at

Fig. 17A. A grinding slab and handstone found in situ on at Neolithic site in Eastern central Sweden.

first obsidian and later flint were systematically exploited from the beginning of the Early Neolithic. (*Özdoğan 1999; Kozłowski 1999*). All this exploitation and blade production began long before pottery seems to have been accepted as an important part of Near and Middle Eastern Neolithic culture. In this sense we can state that blades constituted a much more original and important part of agricultural techniques than pots and polished stone tools.

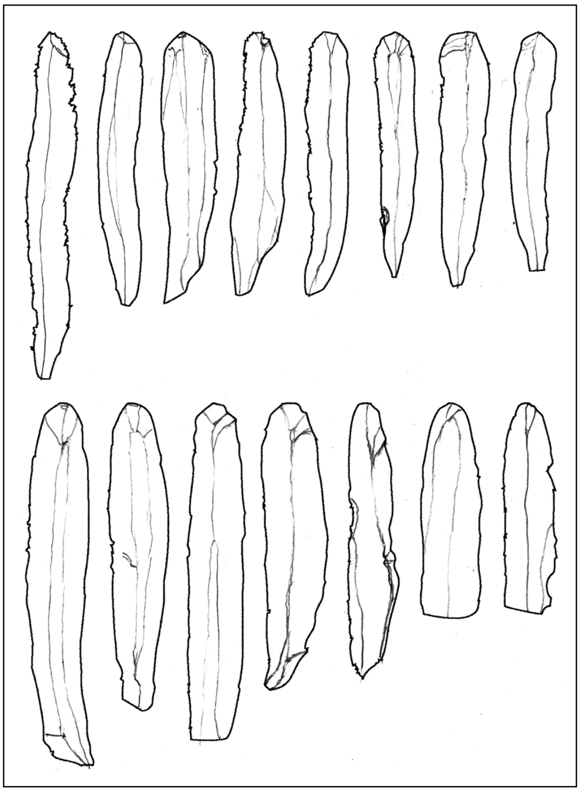


Fig. 18. A deposited package of Late Mesolithic blades from the so-called Kongemose technocomplex. This might indicate a "specialized" production of large prismatic blades already in the Mesolithic in the south Scandinavian region (after* Salomonsson 1955.Fig1*).

Fig. 17B. Childrens graves? from Östra Vrå in Eastern Central Sweden. The grave pit with charred bones from children where filled with grinding slabs and burnt cereals (after* Welinder 1999.Fig. 162, Fig. 213*).

As presented in an earlier article (*Knutsson 1999*), it seems reasonable to understand the suddenly increasing exploitation of several of the stone quarries in southern and central, and later even northern Europe, as a consequence of an increased need for raw materials among other things, especially for blade production. This, according to Knutsson's earlier study, probably promoted the establishment of new types of large-scale networks through Europe in Early Neolithic, which also involved hunting and gathering groups and compelled a change of life style throughout the continent (*Knutsson 2002*). The need for raw materials was, as even today, a crucial aspect of the lifestyle of growing agricultural societies with growing hierarchical structures. The practical reasons were, perhaps, an increasing number of people, a lack of salt to keep livestock alive, and new technologies of everyday life. Other reasons were probably the needs of elites to form groups marked by special material symbols, and maintain their superiority over other groups with the help of these symbols. The development in production and use of pottery is a good example of such a divergence in thinking (Fig. 19). Practical reasons perhaps dominate when pottery is discovered and made as a "domestic" tool, but this doesn't happen within the agricultural societies. Later, when the idea of pottery is accepted by such groups, a development starts towards a refinement of techniques for the display of the finished objects, which turns them into beautiful and not especially practical things. This idea is supported by the latest dating results of early pottery in eastern Asia (Russia and China), where the radiocarbon datings clearly show that the development of pottery has to be ascribed to the mobile hunting and gathering groups in this area (*Kuzmin 2002; Chi 2002*). The early systematic use of pottery is a part of the Asiatic hunting and gathering life style, and its spread to agricultural communities only happens long after these communities changed their own life styles. After the adoption of new life styles we can trace a divergence in production styles of pottery along hunting-gathering lines (big pots, with pointed bases and a relatively "quick" type of decoration, useful for cooking and easily stored) and farming lines. The farmers make pots with round bases, richly decorated, with or without colour, and less practical. The pots are made by skilful artists and they represent, perhaps, the first really symbolic and useless objects distributed for non-practical purposes (i.e. agriculture, domestic tasks). In large part this is opposite to the role of harvesting blades. But even these seem to have been deposited with their symbolic values in mind. In the burial contexts where they are mostly found, they might express the importance of agriculture (i.e. harvesting) and admission to useful resources (i.e. flint), more than their being the personal property of the deceased.

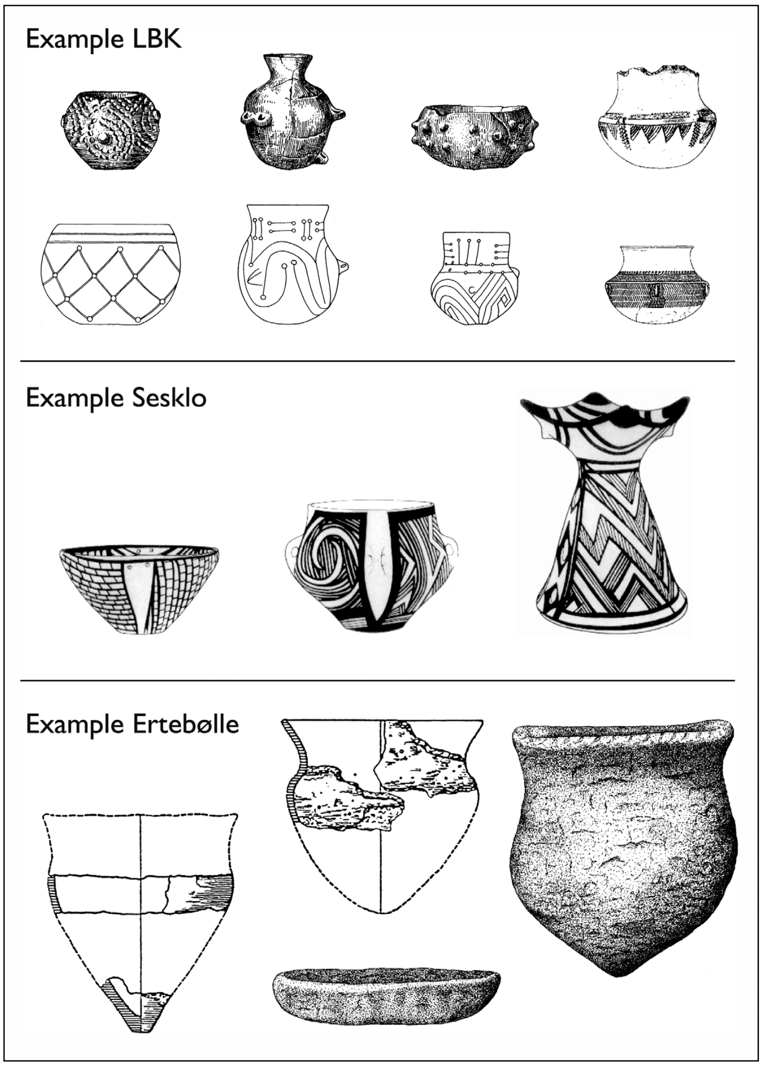


Fig. 19. Hunter-gatherers' pots and LBK/Sesklo/Dimini/Starčevo-Körös pots. The forms and ornamentation types suggest different social uses of the vessels. (Compilation from **Persson 1999.134, Vlachos 2002.123, Podborsky et al. 1993.79–80, Burenhult 1999.223.*)***

From being deposited in graves as the remains of the personal possessions of the deceased which they used in everyday tasks during the Palaeolithic and Mesolithic, the blades change designation in the Neolithic world (Fig. 20). In the Neolithic context they become representations of the "most important tasks", or the most valued: tasks brought by the ancestors, farming activities. If not in graves, they seem to have been stored carefully, with production waste separated from finished products. Viewing the treatment of blades in Neolithic contexts (from the Middle East to northern Europe), one can tell that in everyday life they were used as specialized, systematically constructed tools, and in connection with death they were important symbols, embodying the needs, wishes and desires of the surviving near and dear of the deceased.

The burial rituals which followed the spread of farming in Europe have some structural similarities, such as the crouching positions of the deceased, gender differences in their skeletal positions, the occurrence of pots and "harvesting blades". These similarities crossed the boundaries of probable ethnic entities in Europe and this makes Knutsson to believe that they were not only tools in the farming tool kit, but important metaphors of the farming idea. In Scandinavian TRB and BAC contexs (*Knutsson 1999 and 2000*) they seem to serve as properties in a play where the deceased in burial rituals are seen as actors in the ancestral stories. It is reasonable to see the funeral gatherings as occasions where and when the important stories of farming were repeated, as ancestral histories; as enactments of the coupling of the technical and social body-parts of the society. The graves became installations where the deceased were made to model farmers in the pantheon. In this process the blades, "the reapers", seem to have been important material manifestations (Fig. 21). The context of blade making and use by the Pitted Ware groups (the "heirs" of the TRB in central Scandinavia), is totally different, is totally different, related as it is to domestic production and use at settlements. As two different economic and social systems, the reproduction of the TRB and PWC social formation through public symbolism, of necessity followed two different paths. Helena Knutsson and Lars Sundström thus both see history and the past as important when cultural codes are changed and thus when a new world has to be legitimized. As the TRB farmers in southern Scandinavia formulated a new past with the settled farmer as a role model, then they probably could no longer defend their segmentary settlement ideal, the egalitarian ideology. The institutions needed to do so were now lost, also as an idealized past. In the wake of the lost egalitarian ideology the seeds of change followed, a change that may have triggered a process towards inequality. The BAC graves probably represented elite graves by means of which the elites related themselves to the ancestors by actually becoming them at death. As the Middle Neolithic changes into the Late Neolithic this process of social stratification seems to be well underway in the former TRB area of southern Scandinavia.

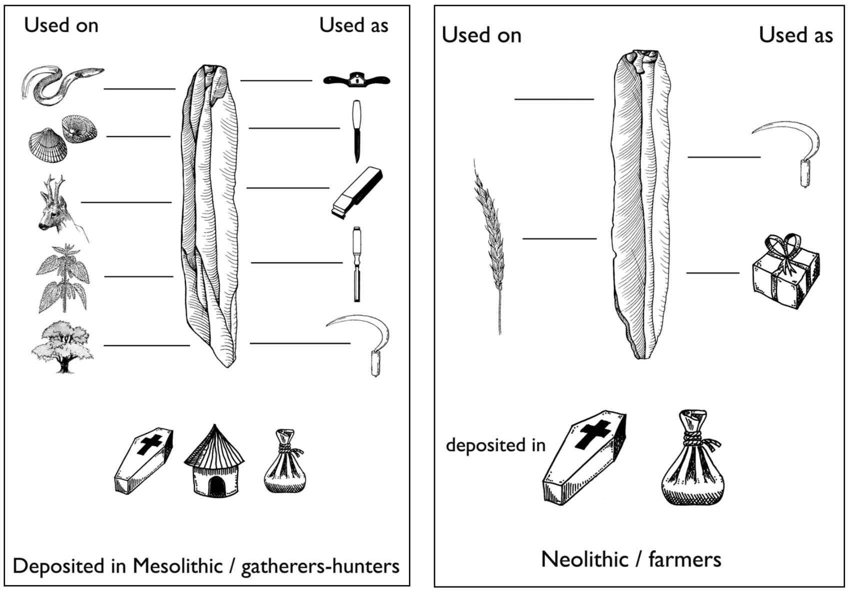


Fig. 20A and B. The variable use of prismatic blades in the Mesolithic (hunter-gatherers) and Neolithic (agricultural) societies. The find-contexts and use-wear patterns suggest a transition from domestic use to ritual use.

LIVES OF AXES; LANDSCAPE OF MEN

The social organisation of the TRB society, as interpreted by Lars Sundström above, seems to indicate, contrary to the standard view, that the Early and Middle Neolithic TRB culture actually was a material manifestation of an egalitarian ideology, rather than the first expression of social hierarchy in Scandinavia. Throughout the Neolithic this unstable, ideologically driven segmetary social organisation, as Sundström pointed out, had to invest more and more in and publicly manifest its ideology to be able to reproduce it, as exemplified by a change from the EN long barrow sites to the large MN ritual centres of the "Sarups type". The collapse of the strained TRB society at the end of the MN, probably saw the beginning of a new social order based on the notion of "the farmer" as ancestor. The Battle Axe Culture graves seem, in Helena Knutsson's study of blade and blade contexts, to be part of the reproduction of this social ideology – an ideology that might have been related to stable settlement and land ownership, thus forming the seed of change.

In an investigation of the Late Neolithic landscape and society in eastern central Sweden based on a contextual analysis of hammer axes (Fig. 22 above), Per Lekberg (*2002*) has shown how the political economy of a stratified society emerged as the Battle Axe Culture ideology changed around 2300 cal BC. Based on the analysis of axe morphology from three different find-contexts, graves, votive offerings and settlements, Lekberg shows how the stray finds represent hammer axes at different stages of their life-history (Figs. 22 below, 23, 24 and 25). The life histories are thus related to variable contexts in Late Neolithic society. The dissemination of a large body of stray finds of Late Neolithic hammer axes in eastern central Sweden, representing variable contexts of action, shows that a structured cultural landscape emerges with settlements, graves and places for votive offerings (Figs. 24, 25a and b). A discussion of axe production and value further shows how simple locally produced and consumed hammer axes can be compared to more complex forms. The latter are produced at certain quarries and thus probably controlled by certain groups. These axes from quarries can be shown to have been used in ritual contexts. The interpretation is that they must have been part of an exchange of goods in the area, probably as part of a prestige goods economy. Lekberg can show, through a GIS application, that the different axe forms are capable of revealing not only a cultural landscape of contexts and action-spheres, but also, when mapped, a dispersal of value. This forms the basis for a discussion of the political economy and social organisation of Late Neolithic society.

The studies carried out show that there is an unequal distribution of wealth (daggers, special hammer axes, etc) in the LN cultural landscape (Fig. 25c and d), indicating the political organisation of a stratified society. The accumulation of wealth related to certain settlements and regions is interpreted with help of Marxist social theory (*cf. Hayden 1995; 1998*), in accordance with the concept of chiefdoms, and thus the reproduction of power through descent. The latter proposition is grounded on spatial continuities of wealth distribution in the landscape from MN B, over LN to the Early Bronze Age, manifesting the importance of descent and location. The Late Neolithic collective stone cist burials and settlements are other indications of this. The observations of collective burials in megaliths, a tension between collective and single graves, buried children in the collective graves, and the differentiation in size of houses at excavated settlements, all signal hereditary social ranking. Since house size differentiation communicates a socio-economic difference, social rank seems to have been related to an economic dimension, a social index referring to the degree of economic control.

The clustering of settlement areas, 20 by 20 km, as shown by the distribution of stray finds (Fig. 25a and b), is interpreted as clan territories, each controlled by a hereditary elite. The accumulation of exotica and valuables in the core areas indicates further that these elites were internationally connected. Elites use different tools in creating and upholding their status and otherness. One of these is the establishing and upholding of contacts with realms unattainable to ordinary people. The exotic goods found in the Late Neolithic core areas may have been used, through display, to legitimize their right to dominate and accumulate. They probably thereby controlled the way the world was understood, by a genealogical reference to gods and other important members of the pantheon in their myth of origin. In Per Lekberg's thesis the elites' control of important aspects of the reproduction of cultural codes was carried by reference to distant tracts, materialised through exchanged valuables from a wide social setting in Europe. A wider European outlook thus seems to provide the axe hammers, as well as Scandinavian Late Neolithic society as a whole, with Bronze Age contexts of Pan-European contacts, possibly based upon earlier Corded Ware Culture networks of interaction. This latter proposition is well in line with the discussion of large-scale networks already in the Middle Neolithic shown by Helena Knutsson (*2001*).

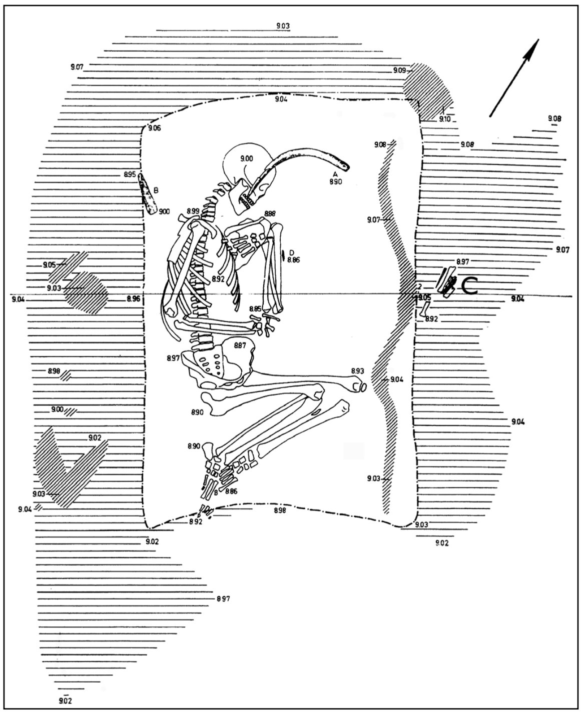


Fig. 21. A Battle Axe Culture grave. The uniformity of grave goods and grave structure from this period indicates that the ritual was formed by and stered by a common narrative. This may be due to the use of the burial occasion to manifest a social position defined as an actor in the myths "explaining the world" in this culture. In the grave ritual the person reproduced its position by reference to the ancestral past (after **Malmer 1975.Fig 36*****).***

DAGGERS, KNOWLEDGE AND POWER

Per Lekberg's study of the contexts of hammer axes showed a Late Neolithic stratified society with a power structure based on descent, and thus by definition a type of "chiefdom". Elites in such stratified societies reproduce their power through, among other things, the display of wealth. To archaeologists this is seen as a precondition for craft specialization (*Olausson 1998*) and thus formed the ground for the development of groups of people that produce these display goods. One such display item of the Late Neolithic society, the flint dagger, has been discussed by Jan Apel within the coast to coast project. He uses the production and consumption pattern of the dagger to elucidate questions of craft specialization and thus social structure in the LN society. The provenience of the Scandinavian daggers has been well known for along time, and their secondary spread indicates exchange networks spanning the southern part of Scandinavia and in general terms respecting the age old border between the hunter-gatherers to the north of Limes Norrlandicus and farmers to the south (Fig. 26). The late Neolithic networks thus bear heavily on the historical structures from which it was once born.

The flint daggers were produced in several of the Danish flint mining areas (Fig. 30). Since they were seen by archaeologists as inciting/ instigating objects, all possible analyses of them have been made, chronologies, geographies of production schemes, and so on. But an overall picture of the growth of knowledge and development of technology has been missing. To achieve this, Apel cooperated with a skilful flint-knapper, Errett Callahan, of Lynchburg in Virginia (*Apel 2001*). Callahan and Apel mapped the procedures of all the processes involved in the production of the Danish types of daggers. They divided the process of production into steps, with different degrees of skill needed (Fig. 27). Based on this division, Apel could see that an apprenticeship system was needed to transmit the knowledge (theoretical part) and the know-how (practical, internalised physical part) of the production of these prestige objects. The social theory explaining and exploring the role of knowledge in power struggles is applied and compared with the patterns of production. Apel, as did Lekberg earlier, thus interprets Late Neolithic society as the first Scandinavian society in which power is inherited and knowledge is transmitted within family groups and guarded as a family possession.

From the analysis of knapping debitage in the flint-rich areas and close to flint mines in Denmark it was possible to deduce that learning processes were accomplished partly in secluded places. The production of daggers was performed in different places, depending on the availability of flint (Fig. 30), as well as the degree of know-how needed in the production stage. Those parts of production processes which needed a low degree of know-how were conducted in seclusion, often close to the sources of raw material. The difficult parts of production, which demanded high skills, were carried out publicly, in the settlement sites. Apel interpret the latter as performances, or public manifestations of knowledge, tradition and history and probably status of the flint knappers whereas the hidden production of the simpler and easily replicated stages is seen as a way of controlling knowledge. In those parts of Scandinavia that were distant from flint sources (Fig. 26), for example the area of eastern central Sweden, no production of daggers at all is documented although thousands of readymade daggers exist there. The debitage found at the settlements however shows that the daggers, or, other large bifacial tools (like sickles and spear heads) were resharpened in an amateurish way. Moreover, one special type of dagger production debitage was imported from southern Scandi-

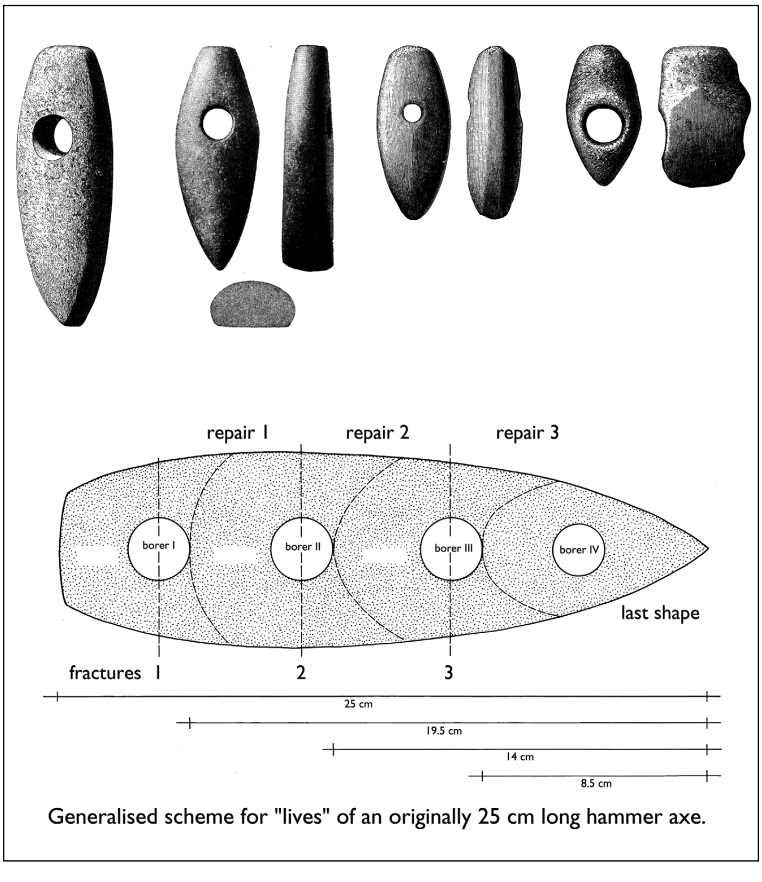


Fig. 22. Shaft hole axes, or hammer axes from Swedish Late Neolithic period and their assumed "life history". At different stages of its life the axe was ritually deposited in different settings. The long unused axe was deposited in caches, the short, used axes in graves and the broken axes in settlements. The stray found axes thus gives a picture of the Late Neolithic cultural landscape.

navia, bifacial thinning-flakes. They were locally transformed into arrowheads through a simple pressure technique (Fig. 28). The interpretation is that the imported flakes and tools where knapped by non-professional knappers, that they had a high symbolic value, which was manifested among other things in their role as burial objects and that the Late Neolithic society outside the flint areas, actually needed these flint items to be able to reproduce central categories of its ideology among other things in burial rituals

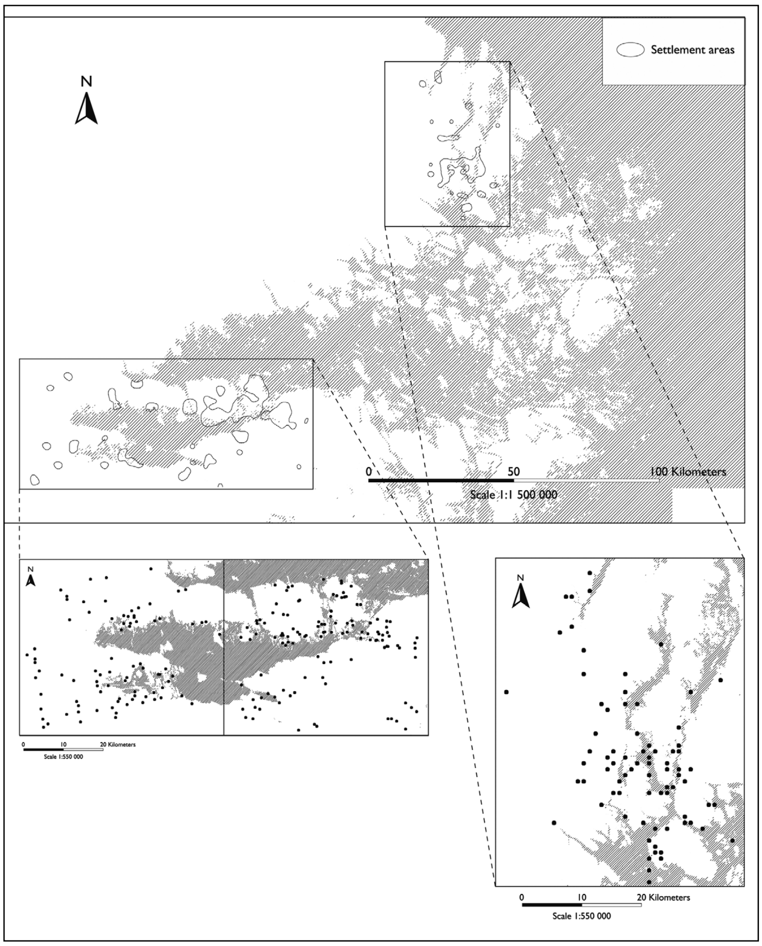


Fig. 23. Lekbergs study area around the lake Hjälmaren and north-eastern Uppland, with an image of a Late Neolithic landscape, created through the distribution of shaft hole axes

In Helena Knutsson's work above it was said that the burial ritual of the battleaxe culture may have been a dramatization of parts of the culture bearing myths. The dead personified some of the actors in it and the tools, for example the flint blade sickle, was important symbols in the construction of the ancestral individual, relating him or her to farming. In the Battle axe culture the ancestors had thus according to this interpretation become farmers. Apart from flint blades (see Fig. 21) the bow and arrow and above all the battleaxe was an important metaphor in the battle Axe Culture indicating a relationship to warfare. In the Middle Neolithic/Late Neolithic transition in southern Scandinavia flint daggers seem to have replaced the battleaxe as the principal male prestige weapon. Modifications in social functions and symbolic meaning, probably accompanied the material shift, which was linked to the creation of an attractive masculine identity. In the Battle Axe Culture every man, at least in elite groups, was a warrior. Maleness was simply synonymous with a social being as warrior (*Vandkilde 2000.39*). In the Beaker affiliated Late Neolithic period, discussed by Jan Apel, the warrior role has apparently become slightly more privileged as we see a variation in grave types and wealth put in them. To be a warrior possibly implicated membership of a brotherhood of warriors who occupied the peak of the social hierarchy of prestige. In eastern central Sweden we see the development of social stratification as expressed in the landscape as shown by Per Lekberg in his work. Although the "clan territory" do not coincide to well with the deposition of daggers (Fig. 25b), it might be that the reproduction of the social structure in the area was carried out at ancestral places where the flint dagger, the flint flake, the bifacial flint point – all imported goods – where used as insignia of "the warrior", a warrior that was part of the myths relating the present social structure to ancestral beings. Jan Apel interprets this behaviour in terms of a concept brought into anthropology by Maurice Bloch – the past in the present. It is to be understood as a description of the use of tradition and history in daily life and tasks and in social power struggles. The idea of the warrior, a European theme at this time (Fig. 29), seems have been one important institution in this process, as shown by the need to have all the necessary gear: dagger, bow, etc. The craft specialization attached to dagger production as suggested by Apel, is commensurate with such a social formation.

A detailed analysis of the chronological scheme of the daggers by Ebbe Lomborg, presented earlier and supported by critical investigations made by other

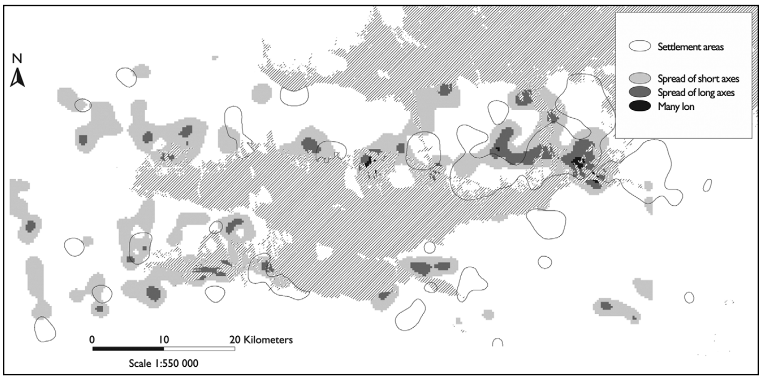


Fig. 24. Lekbergs study area around lake Hjälmaren and north-eastern Uppland. The Late Neolithic cultural landscape as shown by the spread of axes of different life histories and thus size. The dark areas mark ritual centres where long axe has been deposited. The grey areas probably represent areas with graves.

researchers, is an important section of the book. Detailed comparisons, combined with radiometric datings made in 1989 (*Vandkilde 1989*) show that if we accept the groups presented by Lomborg, we have to understand them more in terms of regional differences than in chronological sequences. Elaborating on this theme, Jan Apel suggest that we can trace two separate dagger production areas within the Danish flint bearing districts. They develop in the beginning of the Late Neolithic, one in the Limfjord area on Jutland, the other in the east, on Danish islands and in south western Scania. In a rough scheme the so-called type I daggers were produced in the western mines, and type II–III daggers were produced in the east (Fig. 30). He also took on the task of mapping the distribution of Danish daggers, in an a attempt to reconstruct distribution routes, consumption habits and patterns. A detailed mapping of the daggers found outside the flint areas, i.e. the production sites, shows that the spread of finished products was directed along two main routes to northern Scandinavia. The Jutland products were distributed along the western route, mainly to western Norway and northern Sweden. The Jutland producers seem to have exported their daggers also along the south eastern Baltic coast and to eastern central Europe. The island daggers were mainly distributed to southern Sweden and south eastern Norway along some eastern routes, but they were also traded to western central and western Europe (Fig. 30).

Daggers were produced in the marginal areas of Denmark, i.e. the least productive agricultural zones. As a matter of fact, these areas seem to have been abandoned in the preceding periods. The production of daggers, i.e. the availability of suitable raw materials, made the area attractive to settlers during the early Late Neolithic. Production flourished over 400 years. Around 1950 BC, the influx of bronze objects into the areas of dagger consumers made the flint knapping groups more or less obsolete. At least the western producers in Jutland seem to have lost their position. The eastern producers designed forms in flint which imitated the imported bronze goods. They contiued production into times which are normally attributed to the Early Bronze Age.

In summary, Apel views the society of the Late Neolithic in Scandinavia as well-organized in patrilineal structures. Chieftain lineages controlled the most productive agricultural land, and in marginal areas groups exercised power over the available resources such as flint. Here, the groups specialized in the extraction of wealth from these resources and traded them for agricultural products as well as access to power. The knowledge of the profession seems to have been guarded and passed down along lineage lines. When flint as a raw material for prestige objects went out of fashion, the status of the dagger producer lineages vanished.

THE LURE OF ORIGINS – A COMMENTED CRITIQUE

A classic storyline in the form of an evolutionary process from egalitarian hunter-gatherers in the Mesolithic to chiefdoms in the late Neolithic has been presented in the paper, albeit in a scientific vocabulary. The forces of change have been related to a continuous process of increasing conflict between structure and praxis, between past and present. Since this may be called a process of structuration, we have set the focus on history as a force in the construction and reproduction of social ideologies, a past communicated through material symbolism continously reinterpreted to suit the present. As archaeologists we also reuse the past to make the present logic to our world view. The writing of a history of origins for our present-day society always in some respect has to make this process seem continuous and logical. This problem of the backward gaze has both social and psychological implications. Pierre Bourdieu has seen this in peoples' process of constructing personal narratives; Norbert Elias sees the process as formed by evolutionary thinking in general.

In one of the PhD projects attached to the project, Per Johansson in a critical evaluation of archaeological writing on Neolithization, among other things addresses just this problem: the psychology of writing the past into the present. One could perhaps say that he sees the work of the archaeologist partly as we have seen the Mesolithic and Neolithic populations of Scandinavia, Johansson studied the interpretation of the material remains of central Sweden and discussed the discrepancy between the focus on Neolithization (i.e. the import of the agricultural idea, people, or techniques) and the actual lack of material remains which would support the view of a massive change during this time (*Johansson 2003*). The early appearance of agriculture has been supported by very little material evidence, Johansson argues. The burden of proof lies mostly in secondarily associated materials and material changes. It is of course a pedagogical problem for archaeology that the presentation of these secondary connections has not been made clear enough. The first analysed relation is that between the distribution of axes and farming. Here, the problem is that the axes seem to have been used as a reinforcement of other, natural farming indicators. It is noted that the form of farming archaeologists are expect in the area is swidden cultivation, "primitive" enough to be accepted as a primeval agricultural method in the region. The arguments for connecting axes with agriculture are weak, and support for the interpretation of early agriculture as swidden cultivation is so far almost non-existent.

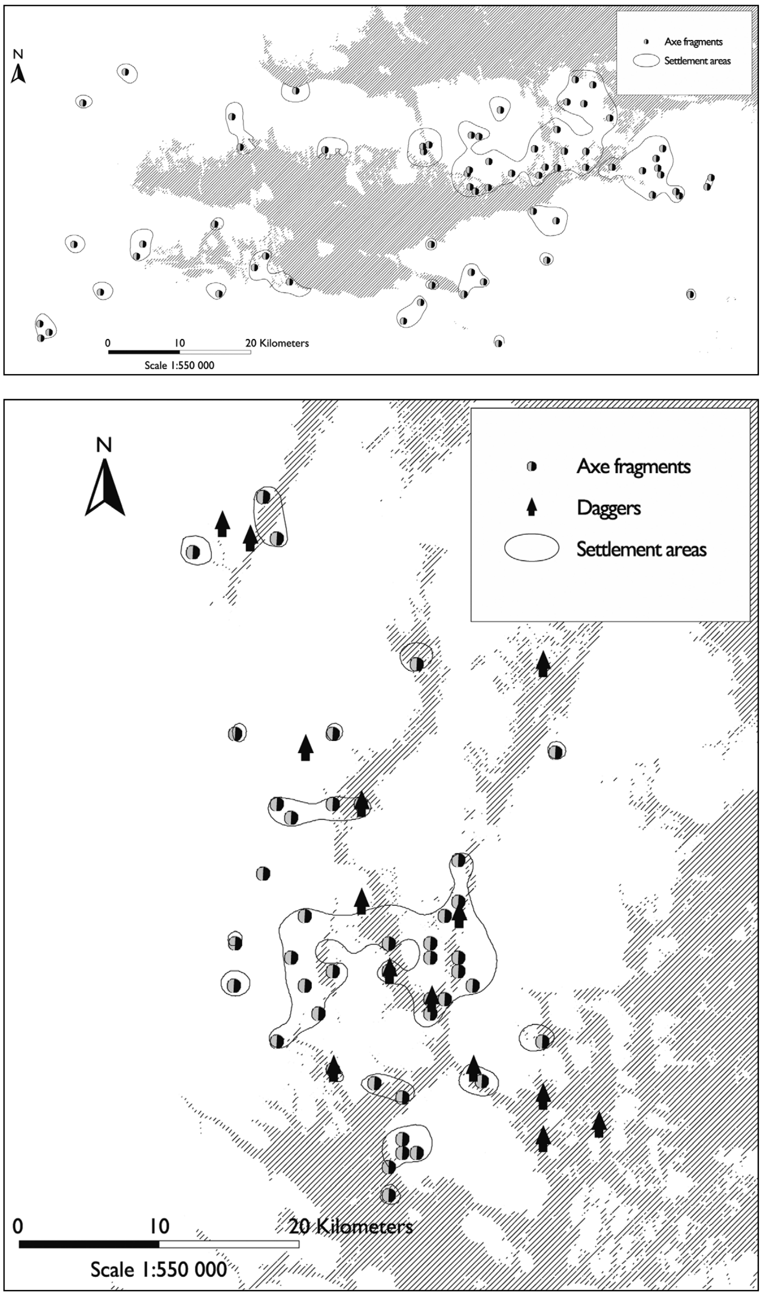


Fig. 25. Lekbergs study area around lake Hjälmaren and north-eastern Uppland. A and B. An image of settlement areas created through an interpolation of the distribution of shaft-hole axe fragments.

From the vegetation analyses it is obvious that forests have been cleared since at least Late Mesolithic, and that the clearings were intensified during the EN. The development (or introduction) of either domesticated (imported) species or endemic (wild) plants is discussed in connection with this. The fact is observed that archaeologists are still missing instruments for the classification of domestication, especially when it comes to endemic, originally wild species (this applies also to animal species, like wild boar and deer). The concept of "caring for" is brought into the discussion here. It is, however, difficult to bring together the making of clearings and the occurrence of agriculture. From this point of view, Johansson means, the dating of domestication to around 4000 BC seems arbitrary. It is beyond doubt that in the first part of the Neolithic period there were changes in habitation structure both within the sites and in the settlement of the landscape. As we understand from Johansson's critique, we have not been able to explain the changes very clearly. The problem which he calls the coast/inland problem is a good example of this. The pattern which appeared around 4000 BC, when excavated, is distinctively different from the former Mesolithic period, and this difference appears clearly first in the combination of the details making the pattern. However, we are still bound to analyse the individual parts of this pattern. We think that in the discussion we lose the pedagogical line and strength of explanation (we could say that what is obvious to archaeologists is not mentioned in the discussion, since there is agreement on that; this then disappears from the eyes of the outside reader). In this case, the pattern of sites and the differences within them are obvious to all archaeologists. The coastal sites preserve, as is obvious from radiocarbon dates, Mesolithic patterns into the Neolithic, concerning the shape of dwellings, faunal remains and the site chosen for occupation. They display similarities in the pattern of artefacts, such as the occurrence of pots, polished thin-butted axes and some appearances of domesticated species. But they also have individual characteristics, for example in pottery decoration styles and burial customs, and this pattern also occurs within the group of coastal sites dated to the Neolithic. The so-called inland sites have their own patterns, comparable in the same way. They display a special intra-site organisation, with solitary long-houses, sometimes a few generations of them on the same spot. They show a dominance of domesticated species among the ecofacts; they have pots with characters which link them together, but separate them from the nearest coastal sites, and so far they lack traces of funerals. Since all these observations are relatively recent, they are of course submitted to critical discussion within the archaeological community, and this make the interpretation of them a little "un-transparent".

Per Johansson also touches upon the essence of archaeological concepts of the Funnel Beaker Culture and the Pitted Ware Culture. He correctly points out

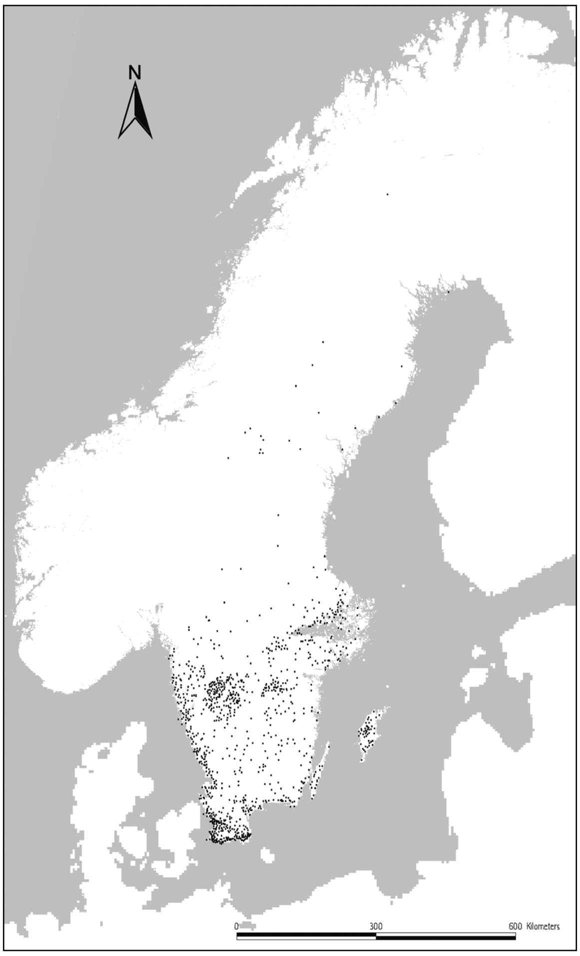


Fig. 26. The distribution of flint daggers in Sweden. Note the structural relationship between the Late Neolithic and the earlier TRB culture.

the incongruities and the debate about their meaning, but his words reveal another of the weaknesses of archaeology as used in public contexts. Because of its very complexity, archaeology often presents its interpretations in the form of narratives. These narratives have many extrapolations between a few known points. In recent decades these narratives captured some parts of the "inner field" of archaeology, where, rightly, Johansson expects methodologically and theoretically grounded scientific debate. Many of the postulates that he picks up from different archaeological works are no more than loosely proposed ideas often grounded on impressions, and not thorough analyses of all the available material. These proposals are, of course, subjected to critical scrutiny, often in the form of oral debates which in many cases are not published. In the end, the visible results found by the outside visitor to archaeology are loose ends in the form

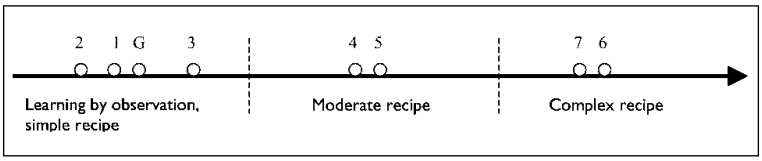


Fig. 27. The seven production stages defined by Callahan (and a grinding stage G), graded according to the degree of theoretical knowledge. Apel assumes depending on find context for these different stages that the easier stages where the performed in secluded places, the stages needing more know-how within the settlement sites. This is seen as a social strategy.

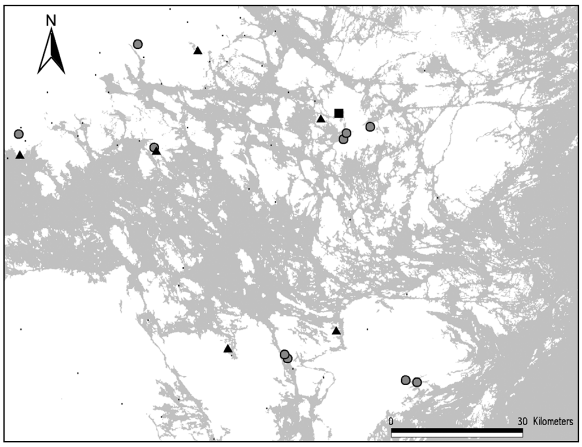


Fig. 28A. Excavated Late Neolithic sites in eastern central Sweden. Settlements are marked by circles, gallery graves by triangles and the ritual depositions by a square.

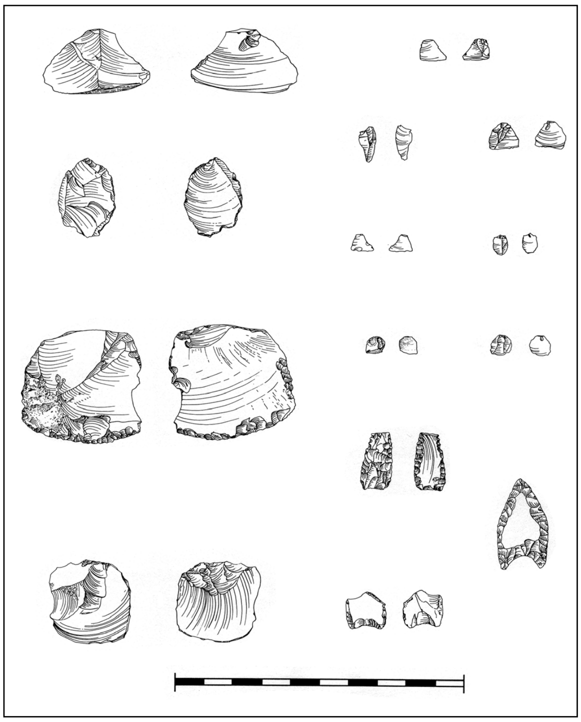


Fig. 28B. Different types of production debitage and formally defined artefacts of imported flint found at Late Neolithic site in eastern central Sweden.

of "scientific statements". This is the case with propositions of the non-existence of Pitted Ware Culture, or differences in the Neolithisation process in western central Sweden. These are impressions which turn into probabilities, and they have a tendency to turn into truths the further from archaeological discussion they appear. In addition, in these cases archaeology has itself to blame, for not being explicit in its demands on arguments for the proposals presented. Johansson points out two other important discussions. One concerns the time schedule of the appearance and development of complexity in the Stone Age. This discussion in archaeology, according to our view, has suffered from the implicit social evolutionism inherent in archaeological thought, which Johansson discerns elsewhere. Complexity is simply expected to increase in the course of the Stone Age, and interpretations of "cultures" have been adjusted to these expectations, even in the modern debate on Neolithisation.

The other discussion concerns the real evidence of the artefacts about prehistoric peoples' lives. This discussion, as Johansson points out, is vivid in archaeology. One part concerns interpretations of the present, and the missing artefacts; the other concerns the symbolism of the remains. Here, the discussion was especially hot after the presentations of English archaeologists maintaining the polarity of the wild and the tame (or domus and agrios, as named by Hodder (*1990*)). Per Johansson detects the archaeologists' decision to argue along these (partly structuralist) lines, and he also detects the missing burden of proof for it. Here, the narrative aspect of archaeology again invades scientific thinking. The problem of the initially scarce traces of agricultural techniques and living habits (i.e. what we today define as belonging to agriculture, heavily dependant on anthropological analogies, not to say parallels) is solved by pointing out as more important the changes in ideology that supported the continuation into the age of agriculture, which Johansson calls circular arguments. He points out the paradox of archaeology, in which arguments still surround the opinion that more artefacts are equal to more complexity, which means a more developed culture. This is nonsense, but is also the state of much of archaeology today, as it is presented to the public. The solution to these problems would be to detach archaeological interpretation from its inherent idea of explaining the origins of today's society, Johansson suggests. We have to see the importance of comparisons of different ways of life, not to judge them, at least, lives already past. And not presenting them only as "historically rooted historical roots" of the paths our cultures are following. Johansson says all developments or changes also have a present aspect which we cannot find in looking backwards. The same is applicable to the views of past cultures. He shows that the search for origins lures us to see what needs to be seen in prehistory; and we have to admit that he is right. But in a very special way, this desire, at least as we feel it, is the way in which archaeology fulfils the expectations of our modern society, and archaeologists must, in our opinion, participate in the social and political debate in society, showing exactly this problem and changing the path of this desire.

SO... WHO WHERE THE ANCESTORS?

Emile Durkheim, the French sociologist, once argued that religion was for pre-modern society what science is for the modern world. Both institutions "explain the world" and thus have ontological status. At the core of identity in every society there are myths of origins, narratives of a place from where the people originated, narratives of ancestors, founding fathers or mothers, and, pantheons of gods. The world and its inhabitants are thus explained with reference to origins, whether it is the Garden of Eden, the story of The Big Serpent, or Lucy and Big Bang. As cultural codes are questioned and societies live through paradigmatic change, as must have been the case in Scandinavia in the Late Stone Age, then these stories reproducing society must have changed to accommodate to the new "paradigm" or world-view. The important question to ask then is: "Who where the ancestors". In the Coast to Coast project, this may be seen as one of the recurring themes in the explanation of the material representations of social reproduction in Scandinavia during the Stone Age and thus active in the process of Neolithization. This explanation of cultural change is well in line with our attempt to downplay materiali-

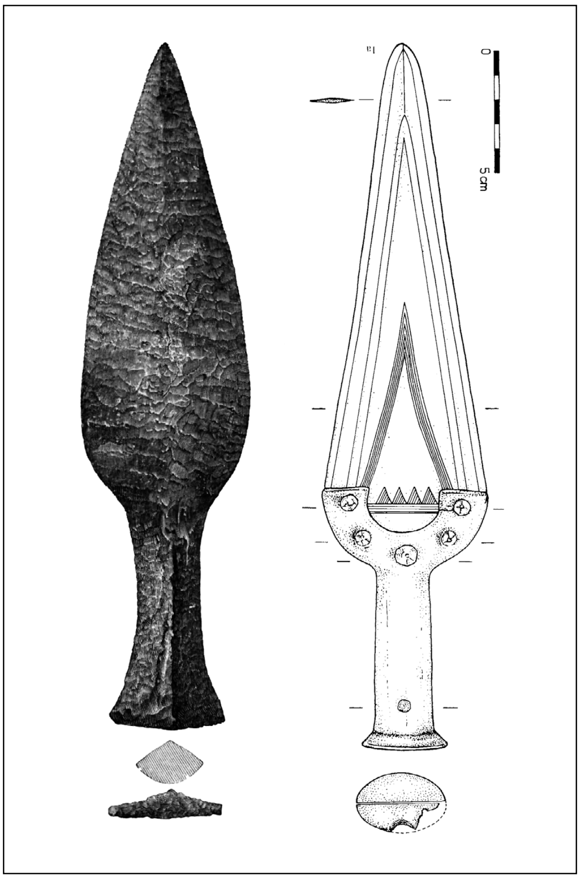


Fig. 29. A prestige weapon used in rituals in the Late Neolithic. The Scandinavian daggers presumably copied Unetice bronze dagger and may very well have been part of a similar "warrior ideology" at this time. In this paper we assume that they also where actors in ritual plays where the important narratives of ancestral deeds where told.

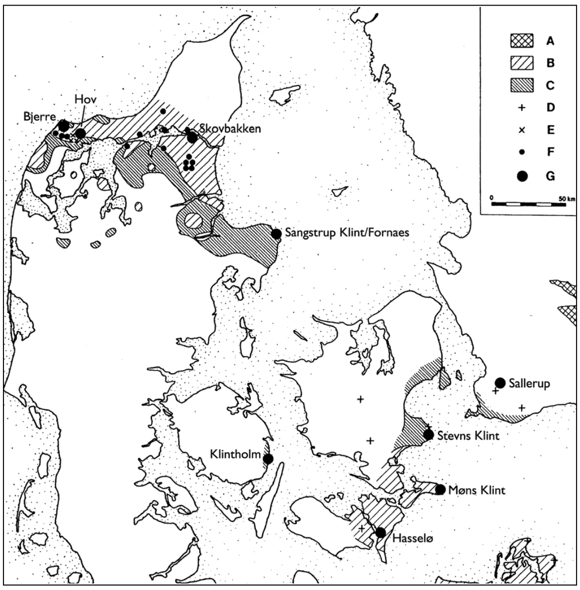


Fig. 30A. The natural occurrence of flint in southern Scandinavia. In this area the daggers where produced that later, through exchange networks where distributed to eastern central Sweden (compare Fig. 26).

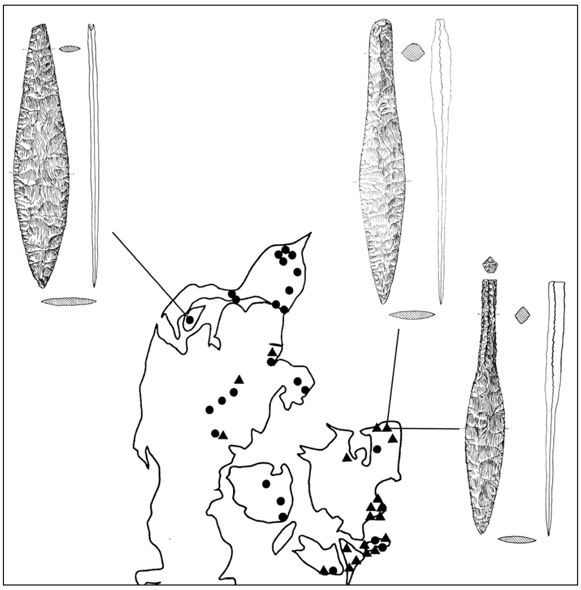


Fig. 30B. The distribution of dagger hoards in Denmark. The hoarding mainly took place in the flint bearing areas.

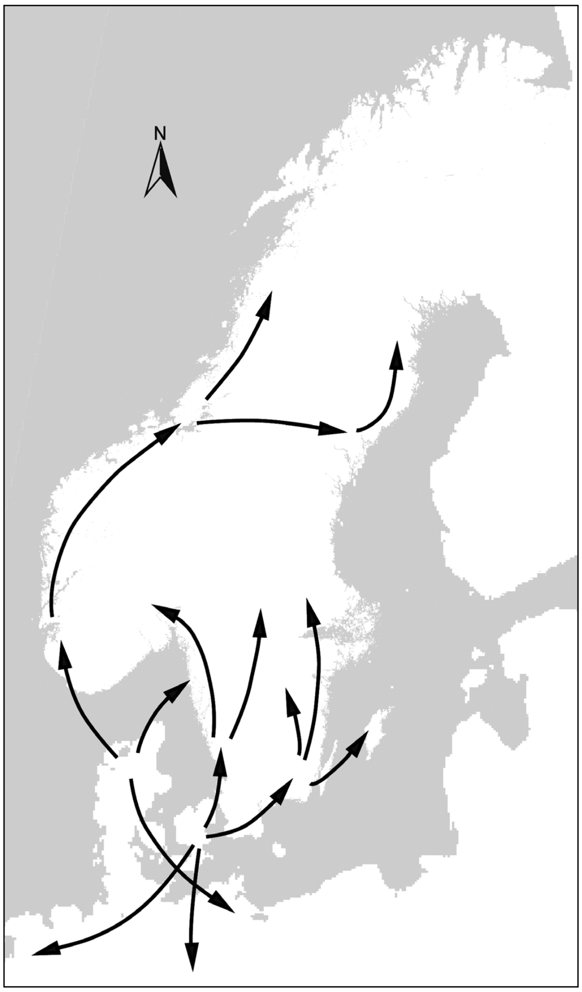


Fig. 31. Exchange routes from the two main production areas to different parts of Scandinavia during the late Neolithic.

stic explanations of cultural change within the Coast to Coast project in general.

We have shown how the tension created within the age-old old hunter-gatherer networks in Scandinavia as Neolithic life ways where introduced, could be resolved by redefining identity and thereby defining a new "origin" as illustrated by public symbolism in the form of the adoption of new technologies and raw-material use in the north. As the Neolithic as we know it (TRB) was introduced in southern and central Scandinavia, the past was further made active during rituals at the coastal hunting stations as a way of creating a defence of the old egalitarian ways of life by way of an idealized past. As tensions between daily praxis and the ideology within the segmentary and thus vulnerable TRB society became too great in the Middle Neolithic, the past was brought in as a saver again. Now the past was once again rewritten to suit the present; the ancestors and thus the "model life" became "the farmer". Graves became installations, materializations of the important narratives of the past. Other aspects important in the understanding of cultural change discussed in the project have been tension in gender roles and how they may have been activated and thus important in the process of change. We have seen them played out and materialized in daily routines on settlement sites by the work of Hallgren, Lindgren and Lidström-Holmberg. A discussion of the occurrence of marked, spatial structures, with spatially separated activity areas mimicking special men's houses are discussed in relation to post-marital rules of residence and descent and thus social organisation in the TRB. We have also discussed how a fertility cult in sacrificial fens related to the early TRB inland farmsteads seems to have paralleled the social structures on the settlements. Here, the grinding tools two parts were metaphorical actors in a ritual that must have had its narrative counterparts.

The idea of "the farmer" that was founded in the late Middle Neolithic as evidenced in grave rituals must at the same time have brought with it the final blow to egalitarian institutions, paving the way for struggle for power in the Scandinavian area at the time. In the project a discussion by Apel and Lekberg of the political economy of the late Neolithic in southern and central Scandinavia indicates the development of a hereditary political organization as shown by crafts specialization, unequal access to and spatial continuities in the accumulation of wealth. Also, the grave rituals were manifestations of the power structure by reference to cultural heroes (specially designed sets of gear, such as daggers, hammer axes etc) that must have been part of the narratives that "explained the world" at that time.

The evolutionary sequence as presented above produced by the group of researchers in the Coast to Coast project no doubt follows closely the common interpretations of change from the Mesolithic to the Late Neolithic. It explains in a process from the simple to the complex the history of the present, created by a series of important events, like for example Neolithization. We have put emphasis on the importance of historicity in this process, thereby somehow naturalising our own activity as archaeologists. The past has always been returned to and made active in socio-political processes, the modern world we live in is no exception.

REFERENCES

APEL J. 2001. *Daggers, Power and Knowledge*. Coast to Coast Books No 3. Uppsala.

APEL J. BÄCKSTRÖM Y., HALLGREM F., KNUTSSON K., LEKBERG P., OLSSON E., STEINECKE M. and SUNDSTRÖM L. 1995. Fågelbacken och trattbägarsamhället. *Tor 27. Uppsala: 47–132*.

BURENHULT G. 1999. (ed.) *Arkeologi i Norden 1*. Stockholm.

CHI Z. 2002. The discovery of early pottery in China. In M. Budja (ed.), *Documenta Praehistorica XXIX. 9th Neolithic Studies: 29–36*.

DEMOULE J.-P., PERLÈS C. 1993. The Greek Neolithic: A New Review. *Journal of World Prehistory Vol. 7, No. 4. 355– 416*.

HALLGREN F. 1996. Sociala territorier och exogamirelationer I senmesolitisk tid. *Tor 28 Uppsala: 5–28*.

HALLGREN F., DJERW U., AF GEIJERSTAM M. and STEINECKE M. 1997. Skogsmossen, An Early Neolithic settlement site and sacrificial fen in the northern borderland of the Funnel-beaker Culture. *Tor 29. Uppsala: 49–112*.

HALLGREN F. and POSSNERT G. 1997. Pottery design and time. *Tor 29. Uppsala: 113–136*.

HALLGREN F. 1998. Etnicitet under stenåldern i Mellansverige och Södra Norrland. In B. Johnsen and S. Welinder (eds.), *Etnicitet eller kultur. Östersund: 61–77*.

2001. Lineage Identity and Pottery Design. In Olausson D. and Vankilde H. (eds.), *Form-Function-Context. Lund: 173–191*.

2002. My place or yours? In Larsson L., Kindgren H., Knutsson K., Loeffler D. and Åkerlund A. (eds.), *Mesolithic on the Move: 592–599*.

HAYDEN B. 1995. Pathways to power: Principes for creating socioeconomic inequalities. In Price T. D. and Feinman G. (eds.), *Foundations of Social Inequality: 15–85*.

1998. Practical and Prestige Technologies: The Evolution of Material Systems. *Journal of Archaeological Method and Theory. Vol 5. No 1: 1–53*.

HODDER I. 1990. *The Domestication of Europe*. Oxford.

JOHANSSON P. 2003. *The Lure of Origins. Coast to Coast Books No 8*. Uppsala.

KNUTSSON K., LINDGREN C., HALLGREN F. and BJÖRCK N. 1999. The Mesolithic in Eastern Central Sweden. In Boas J. (ed.), *The Mesolithic in central Scandinavia. Ny rekke. Nr. 22: 87–123*.

KNUTSSON K. and MELCHERT P. (manuscript). Skumparberget I. A Mesolithic hunting stand. In Apel J., Y. Bäckström, C. Hadevik, K. Knutsson, A. Kritz, E. Kars, H. Kars, P. Lekberg, P. Melchert, M-L. Nilsson and L. Sundström (eds.), *Skumparberget I och II. En meslitisk aktivitetsyta och tidigneolitiska trattbägarlokaler vid Skumparberget i Glanshammars sn, Örebro län, Närke. Rapporter från Arkeologikonsult AB. Upplands-Väsby*.

KNUTSSON K., FALKENSTRÖM P. and LINDBERG K-F. 2003. Appropriation of the Past. In Larsson L., Kindgren H., Knutsson K., Loeffler D. and Åkerlund A. (eds.), *Mesolithic on the Move*.

KNUTSSON H., 1999. Two Technologies, Two Mentalities. In Linda R. Owen and Martin Porr (eds.), *Ethno-Analogy and the Reconstruction of Prehistoric Artefact Use and Production. Urgeschichtliche Materialhefte 14. Mo Vince Verlag. Tübingen: 53–74*.

2001. Technology, mythology and the travels of the agricultural package in Europe. In M. Budja (ed.), *Documenta Praehistorica XXVIII. 8th Neolithic Studies: 117–132*.

KOZŁOWSKI S. K. 1999. The Eastern Wing of the Fertile Crescent: Late Prehistory of Greater Mesopotamian Lithic Industries. *BAR International series 760*.

KUZMIN Y. V. 2002. The earliest centres of pottery origin in the Russian Far East and Siberia: review of chronology for the oldest Neolithic cultures. In M. Budja (ed.), *Documenta Praehistorica XXIX. 9th Neolithic Studies: 37–46*.

LEKBERG P. 2002. *Yxors liv, människors landskap. Coast to Coast Books No 5*. Uppsala.

LIDSTRÖM-HOLMBERG C. 1998. Prehistoric Grinding Tools as Metaphorical Traces of the Past. *Current Swedish Archaeology, Vol. 6. Stockholm: 123–142*.

(in press). Feminist critique on the worth of words. Inquiries into Early Neolithic gendered Quern-technology. In Damm C. and Engelstad E. (eds.), *Womens worlds. Revisiting the Past. Tromsö*.

LINDGREN C. 1999. Material culture and site variability. *L'Europe des derniers chasseurs, 5e Colloque international UISPP, 18–23 septembre 1995: 367–375*.

LINDGREN et al 1997. My way or your way. On the social dimension of technology as seen in the lithic strategies in eastern middle Sweden during the Mesolithic. 2003. In Larsson L., Kindgren H., Knutsson K., Loeffler D. and Åkerlund A. (eds.), *Mesolithic on the Move. Oxbow books. Oxford: 177–183*.

OLAUSSON D. 1998. Battleaxes: Home-made, made to Order or Factory Products? In Holm L. & Knutsson K. (eds.), *Third Flint Alternatives Conference at Uppsala. OPIA 16: 125–140*.

ÖZDOĞAN M. and BASGELEN N. 1999. *Neolithic in Turkey. The craddle of civilization. New discoveries*. Ancient Anatolian Civilizations Series: 3. Istanbul.

PERLÈS C. and VITELLI K. D. 1999. Craft Specialization in the Neolithic of Greece. In Halstead P. (ed.), *Neolithic Society in Greece. Sheffield studies in Aegean archaeology: 96–107*.

PERSSON P. 1999. *Neolitikums början. Coast to coast Books No 1*. Göteborg.

PODBORSKÝ V. and collective 1993. *Pravěké dějiny Moravy. Vlastivěda Moravská. Země a lid. Nová řada. Svazek 3*. Brno.

SALOMONSSON B. 1955. A Closed Find of Fifteen Flint Blades. *Meddelanden från Lunds Universitets Historiska Museum: 205–212*.

SJÖGREN K. G. 2003. *"Mångfalldige uhrminnes grafvar..." Megalitgravar och samhälle i Västsverige*. Göteborg

SUNDSTRÖM L. 2003. *Det hotade kollektivet. Coast to Coast Books No 6*. Uppsala.

VANDKILDE H. 1989. Det aeldste metalmiljö i Danmark. In Poulsen J. (ed.), *Regionale förhold in nordisk Bronzealder. 5. Nordiske Symposium for Bronzealdersforskning på Sandbjerg Slot 1987. Jysk Archaeologisk Selskab Skrifter XXIV: 29–46*.

– Material Culture and Scandinavian Archaeology: A Rewiew of the Concepts of Form, Function and Context. In D. Olausson and H. Vandkilde (eds.), *Form, Function and Context. Material culture studies in Scandinavian archaeology: 3–50*.

WELINDER S. 1998. Del 1. Neoliticum – Bronsålder 3900 – 500 f. Kr. In Welider S., Pedersen E. A. and Wigren M. (eds.), *Jordbrukets första femtusen år 4000 f. Kr. – 1000 e. Kr. Stockholm: 11 – 236*.

VLACHOS D. 2002. Changes in the production and use of pottery from the Early Neolithic to the 'secondary products revolution': some evidence from LN Makriyalos, Northern Greece. *Documenta Praehistorica XXIX. 9th Neolithic studies: 119-126*.

UDK 903(4-191.2)“633/634”
Documenta Praehistorica XXX

Migration, acculturation and culture change in western temperate Eurasia, 6500–5000 cal BC

Detlef Gronenborn
Römisch-Germanisches Zentralmuseum Mainz, Johann-Wolfgang-Goethe-Universität, Frankfurt am Main, D
gronenborn@em.uni-frankfurt.de

ABSTRACT – *After the introduction of the pottery tradition of La Hoguette and contemporaneous research on Earliest LBK about 10 to 15 years ago, research on the spread of farming in Central Europe had somewhat stagnated; there were hardly any major advances in factual knowledge, nor could theoretical models be refined. In the last few years, however, an abundance of new data has appeared, partly deriving from botanical and anthropological analyses. Furthermore, newly available results from excavations in European Russia widen our understanding of the manifold and complex changes occurring during the latter 7th and 6th millennium cal BC.*

IZVLEČEK – *Po uvedbi keramične tradicije La Hoguette in sočasnih raziskavah zgodnje LTK pred okoli 10 do 15 leti, so raziskave širjenja kmetovanja v srednji Evropi nekoliko zastale; skoraj nobenega napredka ni bilo v faktografskem znanju, niti nismo izboljševali teoretičnih modelov. V zadnjih letih pa se je pojavilo veliko novih podatkov, ki izvirajo deloma iz botaničnih in antropoloških analiz. Poleg tega so sedaj dostopni tudi rezultati izkopavanj v evropskem delu Rusije, kar razširja naše razumevanje raznovrstnosti in kompleksnosti sprememb, ki so se dogajale v času poznega 7. in v 6. tisočletju cal BC.*

KEY WORDS – *Central Europe; Eastern Europe; Neolthic; forager-horticulturists; acculturation*

MODELS OF NEOLITHIZATION

If one looks at the traditional cartographic representations of the spread of farming in Europe there is always a preponderance of Central Europe, the Balkans and the Near East (Fig. 1 a–c). Supposed migrations or lines of diffusion are often indicated by arrows which are generally oriented in a south-easterly to north-westerly direction.

Only very recently do maps show a spread from southern France towards the Northeast, into Central Europe. This spread is related to the geographical distribution of La Hoguette (LH) pottery, a ware which is found in association with a Late Mesolithic lithic tradition and a subsistence system in which people practised hunting and gathering combined with small-scale horticulture (*Jeunesse 2000; 2001*).

Completely barren of any cultural changes, apparently, are the east European territories, the taiga, the deciduous forests, and the steppes of what is now Russia, Belarus, and the Ukraine. As will be shown below, this bleakness does not correspond to prehistoric reality, but much more to the effects of the “iron curtain”, although this fell in 1989.

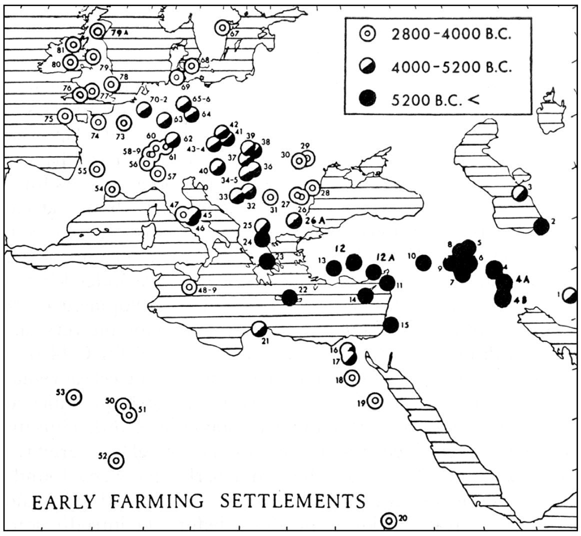
In this paper, I will present new advances in knowledge on the “classic” themes of Neolithization in Central Europe: the LBK expansion and the reaction of indigenous populations, but I will also incorporate new data from Eastern Europe and attempt to expand the conception of the process generally termed the “Neolithization of Europe”.

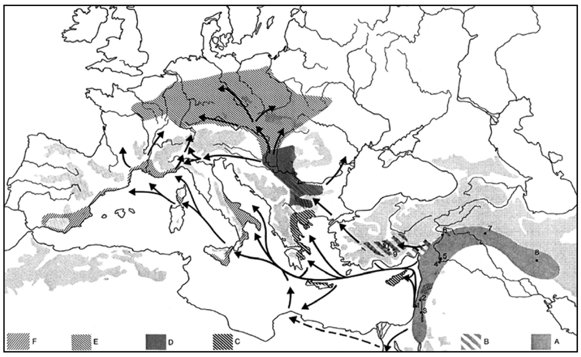
LBK Expansion

I will begin with the spread of the Linear Pottery Culture or German "Linienbandkeramik" (LBK). An abundance of new data has not only altered our concepts of its distribution, but also added new insights into the process of interaction with indigenous societies.

The state of research up until the late 1990ies has been summarized in Gronenborn (*1999;* see also *Bogucki 2000*). Since then, new data has evolved from typological studies, as well as palaeobotanical and dendrochronological work. As to the question of the origins of the earliest LBK (eLBK; Meier-Arendt's [1972] phase I), new material has been published by Bánffy (*2000a; 2000b; 2000 c*). She discovered a pottery tradition with Starčevo and eLBK elements at the site of Pityerdomb in Hungary, SW of Lake Balatón. However, the associated ^{14}C-dates appear relatively late in the eLBK sequence, so it is not impossible that Pityerdomb represents an acculturation phase which evolved when eLBK expanded southward into the lands between Lake Balaton and the Drava River. The typological origin of LBK ware has recently been delineated by Petrasch (*2001.16*). Like Pavúk (*1994*), he considers the territory encompassing the Bakönyi and NE Transdanubia as the most likely area of origin. It remains, however, to be clearly noted that the whole of Transdanubia is an area where only a few small excavations have yet been undertaken, and certainly the question of the exact locaton of the interaction between the Starčevo culture and the eLBK needs to be further investigated. Nevertheless, from this still somewhat hypothetical core area in Transdanubia eLBK expanded in a north-westerly direction. Two dates are available for its advent in western areas, one stemming from the eLBK well at Mohelnice (*Tichý 1998*), which has now produced a dendrochronological date of around/after 5540 ± 5 den BC and not later than 5460 ± 5 den BC (*Schmidt, Gruhle 2003; pers. communication B. Schmidt*). The other date comes from the eLBK burial at the site of Schwanfeld near Würzburg, which was analyzed by conventional ^{14}C-dating, and revealed a date of 5560–5480 cal BC (*Stäuble 1995* [HD–14219 6580 ± 20 BP]).

Both dates are considered to be the earliest absolute points in time for the westward expansion of eLBK. The eastward expansion around the Carpathian Mountains into Poland and further towards Ukraine can be dated with ^{14}C-measurements from the sites of Stolno (5440–5310 cal BC) and Boguszewo 41 (5480–5250 cal BC/5440–5270 cal BC, both at 68,2 % Std Dev), both located in the Chelmo region along the lower Vistula River (*Bednarz 2001*). Absolute dates for the beginning of eLBK in Transdanubia remain problematic. Recently obtained ^{14}C-dates and a combined correspondence analysis of eLBK pottery from the sites of Neckenmarkt and Strögen in Lower Austria produced rather young dates for the proposed first settlement phase at these locations, namely 5490–5080 cal BC ([at 68, 2% Std Dev] *Lenneis, Stadler 2002*). It needs, however, to be mentioned that the Neckenmarkt assemblage does





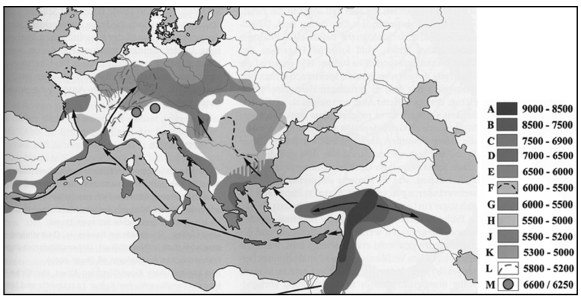


Fig. 1. Cartographic representations of the spread of pottery and farming (after* Piggott 1963 *(upper); after* Uerpmann 1983 *(upper right); after* Zimmermann 2002 *(right down).

not represent the earliest typologically discernable eLBK ware in the region (*Lenneis 2001*). The earliest secure dates for the westernmost extension of eLBK settlements in the Rhine-Main confluence region have recently come from dated pollen profiles from the Wetterau region north of Frankfurt am Main. The changes to vegetation typically wrought by eLBK settlements date to 5470–5310 cal BC and 5620–5480 cal BC (*Schweizer 2000.95–97*). This is slightly earlier than anticipated from archaeological material from the region, which seemed to begin after 5400 cal BC (*Gronenborn 1997.136; Stäuble 1995*). In any case, judging from the present evidence, eLBK seems to have expanded into the larger part of its distribution area by the 55th century cal BC (Fig. 2).

The new data calls for a reconsideration of the hypothetical three-step expansion model proposed earlier (*Gronenborn 1994; 1997*). Apparently, the LBK expansion cannot be subdivided archaeologically by ^{14}C-dates. The process seems to have taken place within a time frame of 100 years, during which more than 800 km were crossed. A rapid spread of groups originating in Transdanubia over wide territories is also indicated by the distribution system of Szentgál radiolarites towards the West (Fig. 2). Recently Petrasch (*2002.144*) has suggested a similar model on the basis of stylistic similarities of so-called Idols from Frankfurt-Niedereschbach and Vel'ký Grob in SE Slovakia. He proposed that these figurines would represent ancestors who were worshipped by individual lineages. Members of these lineages would have lived in different settlements between the Rhine and Middle Danube valleys. Ancestor figurines or not, it is not improbable that lineages expanded and that contacts visible in material culture such as pottery ship lines (*Gronenborn 1997; 1999*).

To further understand how eLBK societies were organized and how the expansion proceeded, it may be worthwhile looking at what ethnography has to offer. Sahlins (*1961*) developed the concept of the segmentary linage as a well-adapted form of sociopolitical organisation. Under stress these societies would organize themselves under the leadership of capable and charismatic war leaders and would decentralize again after the conflict was over. This short-term military superiority would then be advantageous in conflicts with "tribal" societies into whose territory the society would expand. Modern ethnography has developed more subtle modes of explanation, one example being that of the segmentary Dagara in today's Burkina Faso and Ghana (*Kuba 2001*). Over a period of about 200 years the Dagara, starting from a core territory, expanded into a region of several hundred square kilometres. They invaded the lands of surrounding groups which were organized on the same socio-political and economic level, segmentary farming societies. The advantage of the Dagara, however, was their tradition of establishing ritual ties to the terrain, and thus gaining control of the rights of utilization of this land. The land is ritually administered by an earth priest, who maintains a shrine, often an accumulation of rocks at a prominent tree. This earth priest is responsible for the administration of arable land and the territory in general; the land is divided up into 'power spheres' of such shrines. There are older, more powerful shrines, and more recently founded ones with a less intense ritual domination. While most of the groups in the area do have the institution of earth priest, the Dagara seem to maintain a more mobile and more flexible way of handling the concept of earth shrines and were thus capable of ritually dominating larger portions of land (*Kuba 2001.424*).

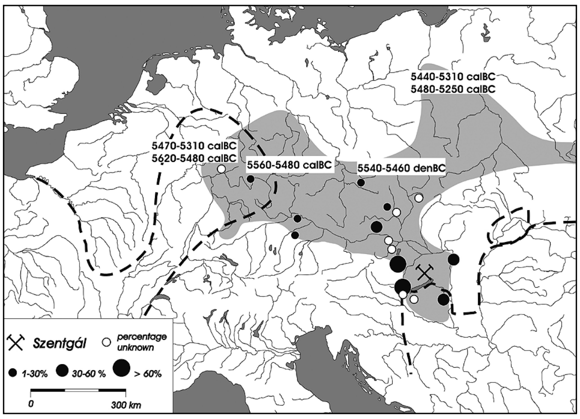


Fig. 2. Distribution of Earliest LBK. Extension of eLBK is shaded, dashed lines represent the pottery traditions of La Hoguette in the West and Starčevo-Körös and Szatmár in the East respectively (modified after* Gronenborn 1999*).

Dagara expansion proceeded in three steps. First, small groups migrated into new territories and settled peacefully among the local population. Perhaps the first motive for expansion was the search for better farming conditions (*Kuba 2001.422*). In any case, in the second step the Dagara-communities expanded and conflicts with the local population evolved. In the third phase, previously uninhabited portions of the land were settled, and the expansion was fuelled by the fissioning of communities (*Goody 1958*), and often pioneer settlements are founded by hunters. These hunters are then followed by their kin or friends. Certainly, there are quite a number of differences between the eLBK and the West African analogy, but generally this example might help to illustrate expansionist societies and their interaction with neighbouring local groups.

Indigenous Components in Central Europe

New evidence is also available for the local Terminal Mesolithic populations along the western fringes of the eLBK territory: the above mentioned pollen profiles in the Wetterau show indications of an economy based on foraging, with additional horticulture and small-scale animal husbandry of for instance sheep and/or goat already before the advent of the classical LBK pollen profile markers (*Schweizer 2001*). A slight, but discernible increase in heliophylic plants during the Middle Atlantic is evident; the dense forests were artificially opened. Also, small charcoal particles and burned pollen increase, so some kind of fire management may be supposed. Plantago and poppy indicate the presence of humans, and since the variety of poppy (*Papaver setigerum*) is indigenous to southern France it is clear that these economic innovations would have had their origins in regions in this direction. This makes it likely that the manufacturers of the La Hoguette pottery, which has stylistic ties to southern France, were responsible for the environmental changes. These indications of small scale horticulture and animal husbandry date between 5700 and 5500 cal BC.

Pre-LBK farming had already been proposed by Erny-Rodmann et al. (*1987*) and is now supported by new data from the Loire valley in France (*Visset et al. 2002*). It becomes increasingly evident that Late Mesolithic populations were practising some kind of horticulture and perhaps husbandry already during the latter half of the 7th millennium cal BC. This may somehow contradict the recent proposition of a relatively late onset of farming along the West Mediterranean coast. According to Zilhão's (*2001*) interpretation of ^{14}C-dates on short-lived material at early Neolithic sites in Italy, southern France, Spain, and Portugal, a rapid onset of the Neolithic package around 5500 cal BC or shortly thereafter seems more likely than earlier scenarios of a gradual shift from hunting/gathering to the fully evolved Neolithic. The question is how to resolve this contradiction: there are indications of small-scale horticulture in temperate Europe, possibly already during the latter part of the 7th millennium, and husbandry and small-scale horticulture after 5700 cal BC, whereas the Mediterranean coastline seems to have been colonized by farmers only after 5500 cal BC. This apparent contradiction should be tackled in future research. It remains to be noted that also in Central Europe a discussion around the validity of "traditional" ^{14}C-dates and AMS measurements on short-lived materials has been going on for about a decade and a consensus has not yet been reached (*Gronenborn 1997; Lenneis, Stadler, Windl 1996; Lenneis, Stadler 2002; Stäuble 1995; Stöckli 2002*).

In Central Europe, botanical, sedimentological, and zoological analysis of the materials recovered at the LH site of Stuttgart-Bad Cannstatt has brought an abundance of new insights into the economy of the Terminal Mesolithic forager-horticulturists. The site was discovered and tested already during the 60ies by W. Taute and his team (*Brunnacker et al. 1967*), but at the time LH was still unknown, so the material was left uninterpreted. After pottery fragments of the first excavation were identified as LH by A. Tillmann another small excavation was started. Both test pits had only a very small extension, since the archaeological material is deposited beneath travertine layers and located in the zoological-botanical garden of Stuttgart, hence it was impossible to conduct large-scale excavations. Four cultural layers were identified, of which the lowest one (WIL 1) is dated through organic remains from a LH pottery fragment. The date is 5460–5290 cal BC (68,2%: UtC–5450 6353 ± 45 BP) and thus contemporaneous with eLBK in the region, which should date after 5500 cal BC (*Meurers-Balke, Kalis 2001.634*). The excavations produced a small number of artefacts: apart from the above-mentioned pottery fragments, bone harpoons and lithic material were found (Fig. 3). Of interest is a fragment of a so-called pointe de Bavans, a triangular arrowhead which is also known from the LH layers of the site of Bavans (*Jacottey 1997.323, Fig. 4c*). Botanical analysis showed that the location was continuously visited during the spring and fall. The seasonal human occupation was not long-lasting, but was intensive enough to have brought about slight alterations in the natural plant cover, which is supposed to have been dense, although large trees would not have grown immediately on the location. Thus, heliophytic plants increased, as well as snails which are adapted to open vegetation (*Kalis et al. 2001.666*). Some wheat pollen (*Triticum aestivum type*) shows that domesticated plants were processed at the site, but the amount of cereal pollen is too low to have resulted from permanent gardens or fields. Probably the cereals were brought in from other locations. Additionally to cereal pollen some pollen from *Papaver setigerum* was found, as mentioned above, a plant of southern French origin. Bones of sheep/goat show that domesticated animals were killed and consumed at the site; other bone material comes from the typical wild fauna of the area, mostly red and roe deer. The archaeological as well as botanical, zoological and sedimentological analyses all present a picture of an economy which was largely based on hunting and gathering, but which was supplemented by certain "Neolithic elements": animal husbandry and small scale horticulture. ELBK sites do exist in close proximity to Bad Cannstatt, but there are no clear indications of any artefacts of LBK origin at the site. Only wheat might have been exchanged from a settlement with a farming economy (*Strien, Tillmann 2001*).

The situation at Bad Cannstatt does not reveal any clear indications for farmer-forager interactions, but such evidence is available from a number of other sites along the Rhine River, mainly Bruchenbrücken (*Gronenborn 1990; 1999*). More information on such possible interaction has come from other sites: recent strontium isotope analyses on skeletal material from a number of LBK burials also show some amount of migration within the population of LBK communities (*Price et al. 2000; Bentley et al. 2002*). Three burial grounds were investigated: the LBK Phase II burial ground of Flomborn, the Late LBK burial ground of Schwetzingen, and the Middle-Late LBK burial ground of Dillingen. In Flomborn both male and female immigrants exceed 60 %, while the rate of male immigrants in the later cemeteries is notably lower than that of females. This shows that in early LBK communities a considerable number of individuals did not grow up in those settlements where they died. Where they had come from is still unclear, but it is quite possible that they had grown up in the highlands which surround the Rhine and Neckar valleys. These highlands might have been exploited by groups who belonged to a remaining forager population. In later centuries migrants might have come from other LBK settlements, or hunter-gatherer populations who lived further to the west, as there LH pottery is still found in LBK settlements (*Lüning, Kloos, Albert 1989*). Moreover, Jeunesse (*2000; 2001*) was recently able to demonstrate that Alsatian LBK sites show a continuous influence from local Mesolithic groups until the end of the Early Neolithic. This influence is particularly visible in ceramic decoration, which would indicate that forager women had joined LBK village communities (Fig. 4).

But contact with hunter-gatherer populations was not only directed towards the West. An eLBK pit at

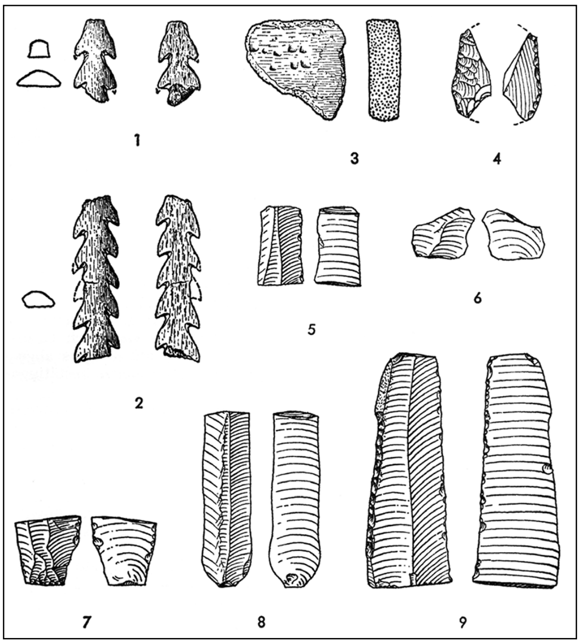


Fig. 3. Archaeological material from Stuttgart-Bad Cannstatt (after* Brunnacker et al. 1967*).

Brüchenbrücken contained a specific type of arrowhead, an oblique transverse arrowhead, which was manufactured out of erratic flint (Fig. 5). The blade was much broader than those usually found in eLBK assemblages (*Gronenborn 1997.99*). This type does have numerous parallels in the northerly European lowlands and in Denmark, and is typically found on Kongemose sites (*e.g. Hartz 1985*). Erratic flint is quite abundant on eLBK sites (*Gronenborn 1997. 114*) and indicates that contacts existed far into territories not traditionally occupied by LBK farming settlements. This interaction towards the north is not new, but traditionally exchange mechanisms and cultural transfer were viewed to have been directed from the southern Neolithic settlements towards the North. Hence farming is believed to have originated from the Early and Middle Neolithic groups in the South (*Hartz, Heinrich, Lübke 2000; Kalis, Meurers-Balke 1998*). Until very recently many scholars would have argued that the typical pottery of the Ertebølle and Swifertbant-traditions also would have been influenced from southern Central Europe.

The Spread of Pottery in Eastern Europe

However, the process of the Mesolithic-Neolithic transition in the European lowlands might have been much more complex. In several recent articles Timofeev (*1998a/1998b*) has argued that the eastern and western Baltic areas were linked through cultural contacts and he has shown that Ertebølle pottery has close stylistic and technological links with

Polish and West Russian traditions. This general idea, still widely neglected in western scholarly circles, had already been expressed by V. I. Danilenko (*1969*), who saw resemblances between Ertebølle and the Ukrainian Surks-Dnepr tradition. Indeed, recent research in Russia has produced new ^{14}C-Dates for a number of ceramic traditions, some of which seem to date to the early 7th millennium cal BC. This is the case for the so-called Elshan tradition, which is distributed along the River Samara and the Lower Volga (*Mamonov 2000*). The published dates group around the turn of the 8th to the 7th millennium cal BC. According to Mamonov (*2000*) two different phases can be distinguished, of which the earlier one still dates to the late Boreal. Vessels of this phase have straight or S-profiled walls, and pointed or flat bases (Fig. 6). Sites are dispersed along river courses and can be interpreted as either just briefly occupied special task camps or larger base camps. But it is unlikely that the latter were occupied all year round. So far there is no evidence for any permanent habitation structures; shelters should have been light and of an ephemeral character. Subsistence was based on mollusc gathering (*Unionidea*), fishing, and hunting forest and steppe species; there clearly is no evidence of any domesticated plants.

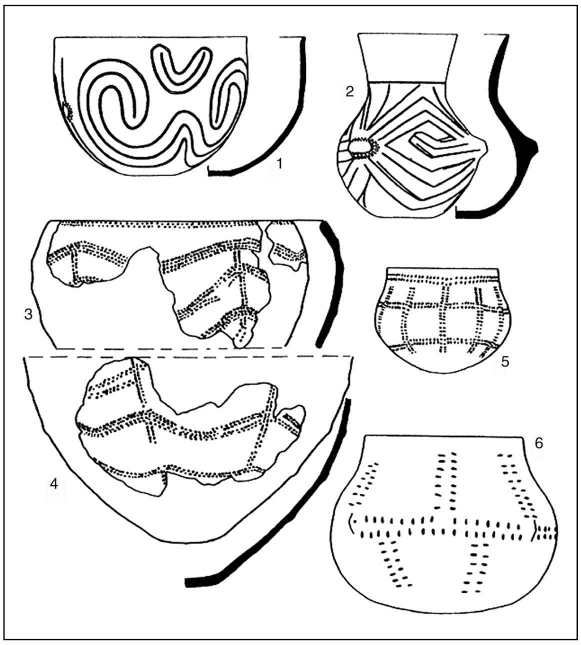


Fig. 4. LBK and La Hoguette vessels with "hybrids forms" (after* Jeunesse 2001*).

The craft of pottery manufacturing spread towards the West and Northwest and reached the Upper Volga area after 6000 cal BC. Pointed base vessels are also known from the Bug-Dniestr tradition (BDK), which should date between 5700 and 5000 cal BC (*Wechler 2001; Zvelebil and Dolukhanov 1991*). But BDK pottery is equally influenced by Körös-Cris pottery from the South-West and also aspects of the Neolithic economy – cattle, sheep/goat, einkorn, emmer – seem to have come from this direction (*Wechler 2001*). Although some habitation structures are documented for the BDK, it is unclear whether settlements were occupied throughout the year. The economy was based on hunting and gathering, and farming was practiced on a minor scale. In a later phase there are also contacts with neighbouring LBK settlements.

More northerly pottery traditions have no indications of a farming economy. Pottery is embedded in cultural entities whose members continue with their traditional hunter-gatherer way of live. Nor are there indications of year-round occupied settlements. Sites along the river courses in the Russian forest belt all show that the economy depended solely on hunting and gathering. Burials, for instance at Zvejnieki in northeastern Lithuania (*Zagorskis 1987*) belonging to the Narva and Comb-and-Pit traditions, are accompanied by hunting gear such as bone harpoons, points and lithic arrowheads. Domestic plants, emmer and cannabis, are only evident from the 3rd millennium onwards. Also in another area, along the Western Dvina – the location of the Serteya, Rudna and Usvyaty traditions – domestic plants appear only very late in the sequence, around the last centuries of the 3rd millennium cal BC, at the time of the local Zhizhtsia- and North-Belarusian traditions. The latter is considered to be a local variant of the pan-European Corded Ware horizon. At this point domestic animals appear in the record, such as sheep/goat, cattle, pig, and horse (*Dolukhanov et al. 1989; Dolukhanov, Timofeev 1993; Kul'kova, Mazurkievich, Dolukhanov 2001*).

Fig. 5. Oblique transverse arrowhead from Bruchenbrücken (after* Gronenborn 1997*).

Pottery with pointed bases spread to the Baltic coast and is known from the site of Dabki, in northern Poland, where it is now considered as a local variant of the Ertebølle tradition (*Czerniak, Kabacinski 2002*). From there the pottery should have spread towards the west, where it appears in Pommerania around 5000 cal BC and in southern Schleswig-Holstein around 5100 cal BC (*Hartz, Heinrich, Lübke 2002*). While in Scandinavia the first indications of

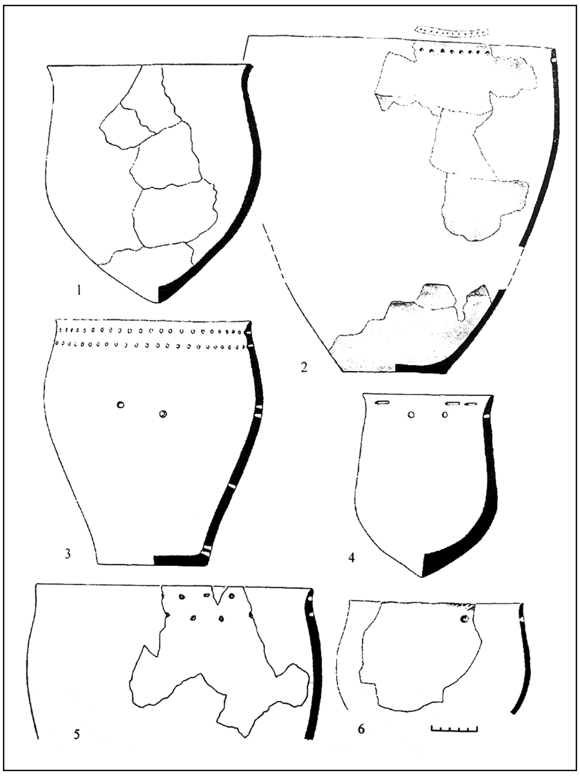


Fig. 6. Pottery from the Elshan Tradition (after* Mamonov 2000*).

a farming economy do not appear before 4200 cal BC, cereal horticulture is attested for Schleswig-Holstein between the 48th and 46th centuries cal BC; also, early cattle date to this period (*Kalis, Meurers-Balke 1998*). Pottery spread from the Ertebølle region towards the west and has, for quite some time, been known from Dutch sites, for instance at Swifterbant (*Raemakers 1999; Lowe Kooijmans 2001*). But recently another group with a similar pottery, everted rims and pointed bases, has been announced from Belgian Flanders, here called the groupe de Melsele (*Crombé 1999; Crombé et al. 2002; van Berg, van Royen, Keeley 1991; van Berg et al. 1992*). ^{14}C-Dates shift the early appearance of pottery to around 5000 cal BC. All these sites have only produced remains of a hunter-gatherer subsistence mode (*Van Neer et al. 2001*). Lastly, Jeunesse and Lefranc (*1999.44–47*) have recently published a pointed base vessel from a pit in an LBK settlement which is dated between 5200 and 4800 cal BC (Fig. 7). The authors argue that this pottery might represent a ware stylistically related to the Ertbølle-tradition, a ware hitherto unrecorded in southern Central Europe. They discuss the possibility of a third indigenous ceramic component, different from La Hoguette and Limburg. Ultimately, while La Hoguette and perhaps also Limburg have stylistic resemblances in southern France (*van Berg 1990a; van Berg 1990b*), this third pottery tradition might have its stylistic ancestors in wares distributed in the Russian forest and steppe belts – a fascinating prospect for future research.

The Neolithization of Temperate Europe Revised

Since Vere Gordon Childe's (*1936*) coining of the term 'Neolithic Revolution' it has become habitual in western archaeology to think of the beginning of the Neolithic as the beginning of farming, and usually this is associated with the LBK or the "Danubian Tradition". Influenced by the functionalistic paradigm of the time and by contacts with Marxist archaeologists in the Soviet Union, Childe understood the adoption of farming and the concurrent technological and economic changes as fundamental prerequisites to social developments.

Before Childe's work, the Neolithic had been mainly defined on typological grounds, namely after Lubbock (*1865*), by the appearance of polished lithic artefacts. Later, pottery became part of the spectrum. This division of the Palaeolithic and Neolithic based on material culture and not on economic criteria has persisted in the Soviet Union and is still practiced in Russia today. The Neolithic here is perceived of as being constituted by the appearance of pottery, sedentism and a certain degree of implied social complexity (*Dolukhanov 1995*). So basically two apparently opposing definitions of the term "Neolithic"

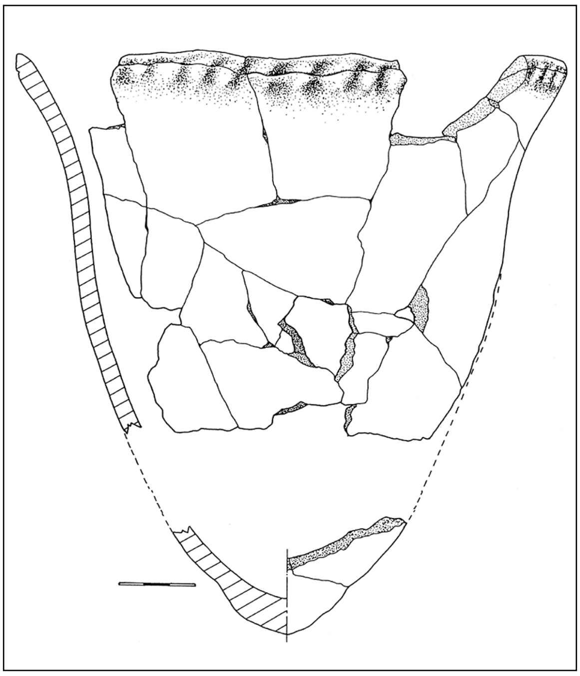


Fig. 7. Pointed base vessel from LBK settlement of Rosheim, Alsace (after* Jeunesse and Lefranc 1999*).

co-exist in Europe (*Dolukhanov 1998*), one based on material culture, one based on economy.

The latter definition, though, begins to pose problems. How do we classify the societies that produced La Hoguette or Limburg pottery? Traditionally, they are subsumed under the term "Terminal Mesolithic" (*Gronenborn 1999*). But how would we see eLBK groups? The faunal material indicates that at least in some communities hunting still played a considerable, sometimes a dominant role (*Uerpmann, Uerpmann 1997; Lüning 2000*). And lately it has become clear that also later LBK villages were composed of social groups, of which some depended on farming, while others seem to have maintained more of a forager economy (*Hachem 2000*), a tradition which continues into the Middle Neolithc Period (*Sidéra 2000*). Perhaps these economic specializations within the societies have something to do with the composition of groups consisting of LBK lineages originating from Transdanubia and local hunter-gatherers. At least the evidence from the LBK site of Vaihingen does suggest such a relation (*Krause et al. 1998*). Here Strien (*in press*) was able to distinguish wards within the settlement which are characterized by differences in pottery decoration and also different microlith types. While some of these microlith types have a wide-ranging distribution, others have evolved out of the local Late Mesolithic tradition. The current interpretation of the pattern is that some lineages living in the settlement were descendents of immigrants from Transdanubia, while others were the heirs of those people who just a few generations before still led lives like the group that camped at Stuttgart-Bad Cannstatt. Apparently, the respective lineages practiced their traditional economy: some were full-scale farmers, while others continued with their transitional forager-horticulturalist way of life. Seemingly, the concept of what constitutes the "Neolithic" must go beyond a simple economic definition and entails socio-political aspects. Lately Renfrew (*2001*) has suggested seeing the demarcation line with the beginning of sedentism; however, what would we do with groups that practice some kind of transhumance, as has been suggested for LBK (*Kalis, Zimmermann 1988*)?

It is not my intention here to further embark on a terminological dispute about concepts of "The Neolithic" or "The Mesolithic". What I want to point out is that between the later 7th millennium and, in some parts of Europe, well into the 4th millennium, we are dea-

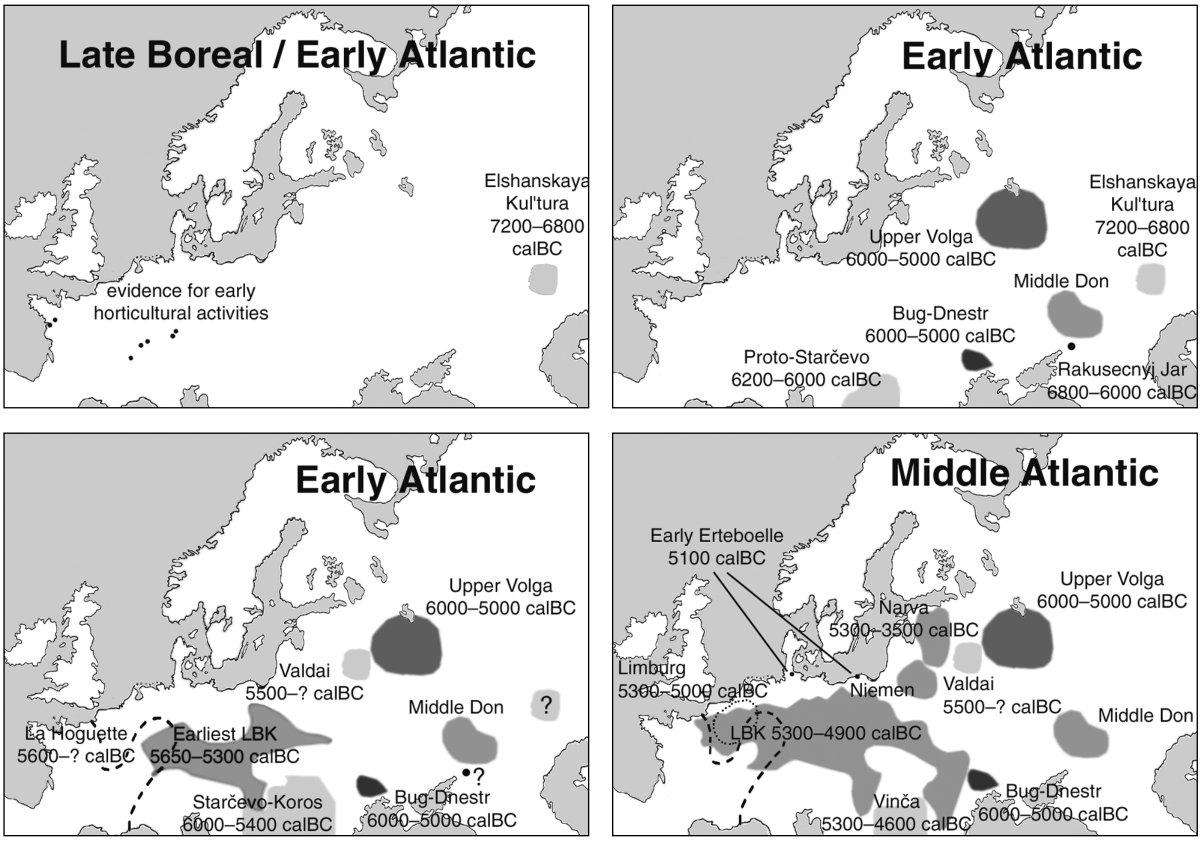


Fig. 8. Revised cartographic representation of the spread of pottery and farming in Temperate Europe and Eurasia.

ling with a transitional period. What currently needs to be stressed is that the "Neolithization of Europe" is a much more complex process than hitherto imagined. This concerns at least three levels of resolution. At the village level we have to account for settlements inhabited by lineages of different cultural backgrounds. How close their ties were on the household level remains to be explored. Current evidence from Vaihingen (*Strien in press*) shows that the social units in this settlement were relatively stable throughout younger LBK, despite the evidence of inter-group fluctuations from other areas. On a regional level we see these – ethnic? – groups again, sharing the same general region, but exploring different economic niches within this region. And on a supra-regional level we may distinguish different horizons of the Neolithization processes, of which presently, admittedly at a very coarse level, we can differentiate three. All of these evolved out of Mesolithic networks (*Gronenborn 1999*), along which pottery styles and farming practices spread (Fig. 8)

The classical Central European network is the one which later evolved into the "Danubian Neolithic" in traditional terminology; the Western or Occidental system may have evolved out of the Mediterranean Neolithic, but also out of local antecedents. In any case, its territorial distribution is again oriented along Late Mesolithic network lines. Thirdly, we have to account for a "Neolithic" in Lubbock's sense, which follows contact networks in eastern Europe and which expands along the Baltic coastline into the north-western European lowlands. This northern to north-eastern facet of the chasseurs ceramisés- or subnéolithique-phenomenon (*van Berg 1990; 1997*) might be subsumed under the term "Hyperborean Horizon". While in Central Europe we gradually begin to understand the complex relationships and interactions between the Danubian and Occidental Horizons, the contribution of the "Russian connection" is still very much unclear, but should by no means be underestimated.

ACKNOWLEDGEMENTS

Research was partly financed by the INTAS grant 2000–00016 "Agricultural Prelude in Russian Forests" and a grant from the Römisch-Germanisches Zentralmuseum Mainz, Germany. For comments on the manuscript and unpublished material I am grateful to Philippe Crombé, Gent (Belgium), Pavel Dolukhanov, Newcastle upon Tyne (UK), Lendeert Louwe Kooijmans, Leuven (The Netherlands), Andrei Mazurkevich, St. Petersburg (Russia), Knut Rassmann, Frankfurt/M. (Germany), who helped with the maps, and Vladimir I. Timofeev, St. Petersburg (Russia).

∴

REFERENCES

BÁNFFY E. 2000. Neue Daten zur Entstehung der Bandkeramik. In S. Hiller, V. Nikolov (eds.), *Karanovo Band III. Beiträge zum Neolithikum in Südosteuropa: 375–382*.

2000. Starčevo und/oder LBK? In H.-J. Beier (ed.), *Varia Neolithica I. Beiträge zur Ur-und Frühgeschichte Mitteleuropas 22: 47–60*.

2000. The Late Starčevo and the Earliest Linear Pottery Groups in Western Transdanubia. In M. Budja (ed.), *7th Neolithic Studies. Documenta Praehistorica XXVII: 173–186*.

BEDNARZ M. 2001. Acheminement du silex "chocolat" pendant le Janislawicien et au Néolithique ancien dans le bassin de la Vistule. In R. Kertész, J. Makkay (eds.), *From the Mesolithic to the Neolithic. Proceedings of the International Archaeological Conference held in the Damjanich Museum of Szolnok, September 22–27, 1996. Archaeolingua 11: 23–54*.

BENTLEY R. A., PRICE T. D., LÜNING J., GRONENBORN D., WAHL J. and FULLAGAR P. D. 2002. Prehistoric migration in Europe: Strontium isotope analysis of early Neolithic skeletons. *Current Anthropology 43(5): 799–804*.

BOGUCKI P. 2000. How agriculture came to north-central Europe. In T. D. Price (ed.), *Europe's First Farmers: 197–218*.

BRUNNACKER M., REIFF W., SOERGEL E. and TAUTE W. 1967. Neolithische Fundschicht mit Harpunen-Fragmenten im Travertin von Stuttgart-Bad Cannstatt. *Fundberichte Schwaben N. F. 18: 43–60*.

CAHEN D., KEELEY L. H., JADIN I., VAN BERG P.-L. 1990. Trois villages fortifiés du Rubané récent en Hesbaye liégois. In D. Cahen u. M. Otte (eds.), *Rubané & Cardial. Actes du Colloque de Liège, novembre 1988. ERAUL 39: 125–146*.

CHILDE G. 1936. *Man Makes Himself*. London: Watts.

CROMBÉ P. 1999. Vers une nouvelle chronologie absolue pour le Méolithique en Belgique. In A. Thévenin (ed.), *L'Europe des derniers Chasseurs. Actes du 5e Colloque International UISPP, Commission XII, Grenoble, 18–23 september 1995: 189–199*.

CROMBÉ PH., PERDAEN Y., SERGANT J., VAN ROYEN J.-P. and VAN STRYDONCK M. 2002. The Mesolithic-Neolithic transition in the sandy lowlands of Belgium: new evidence. *Antiquity 76: 699–706*.

CZERNIAK L. and KABACINSKI J. 2002. The Ertebølle Culture in the Southern Baltic Coast. In D. Król (ed.), *The Built Environment of Coast Areas during the Stone Age. A Symposium at the Centenary of Archaeological Excavations at Rzucewo (Rzucewo-Gdansk) 4–9 October 1994. Gdansk: The Baltic Sea-Coast Landscapes Seminar Session No. 1: 70–79*.

DANILENKO V. N. 1969. *Neolit Ukrainy*. Kiev: Isdatel'stvo "Naukova Dumka".

DOLUKHANOV P. 1995. Archaeology in Russia and its impact on archaeological theory. In P. Ucko (ed.), *Theory in Archaeology: a World Perspective: 342–372*.

DOLUKHANOV P. M., GEY N. A., MIKLYAYEV A. M. and MAZURKIEWICZ A. N. 1989. Rudnya-Serteya, a stratified dwelling-site in the Upper Duna Basin (a multidisciplinary research). *Fennoscandia archaeologica 6: 23–27*.

DOLUKHANOV P. M. and TIMOFEEV V. I. 1993. Est de L'Europe: La zone des forets. In J. K. Kozłowski (dir.) u. P.-L. Van Berg (coll.), *Atlas du néolithique europeen. Vol. 1. L'Europe orientale. Études et recherches Archéologique de l'Université de Liège no. 45: 495–534*.

DOLUKHANOV P. M. 1998. The Neolithic with a human face or dividing lines in Neolithic Europe? In L. Domanska and K. Jacobs (eds.), *Beyond Balkanization. Baltic-Pontic Studies Vol. 5: 13–22*.

ERNY-RODMANN C., GROSS-KLEE E., HAAS J. N., JACOMET S. and ZOLLER H. 1997. Früher "human impact" und Ackerbau im Übergangsbereich Spätmesolithikum-Frühneolithikum im schweizerischen Mitteland. *Jahrbuch der Schweizerischen Gesellschaft für Ur- und Frühgeschichte 80: 27–56*.

FARRUGIA J.-P., GUICHARD Y., HACHEM L. 1996. Les ensembles funéraires Rubanés de Menneville "Derrière le Village" (Aisne). In P. Duhamel (dir.), *La Bourgogne entre les Bassins Rhénan, Rhodanien et Parisien: Carrefour ou frontière? Actes du XVIIIe Collogue interrégional sur le Néolithique. Dijon 25–27 octobre 1991. Revue Archéologique de L'Est. Supplement 14:129–174*.

GOODY J. 1958. The fission of domestic groups among the Lodagaba. In J. Goody (ed.), *The Developmental Cycle in Domestic Groups: 53–91*.

GRONENBORN D. 1990. Eine Pfeilspitze vom ältestbandkeramischen Fundplatz Friedberg-Bruchenbrücken in der Wetterau. *Germania 68: 223–231*.

1994. Überlegungen zur Ausbreitung der bäuerlichen Wirtschaft in Mitteleuropa – Versuch einer kulturhistorischen Interpretation ältestbandkeramischer Silexinventare. *Praehistorische Zeitschrift 69/2: 135–151*.

1997. Silexartefakte der ältestbandkeramischen Kultur. Mit einem Beitrag von Jean-Paul Caspar. *Bonn: Universitätsforschungen zur prähistorischen Archäologie 37*.

1999. A variation on a basic theme: The transition to farming in southern Central Europe. *Journal of World Prehistory 13: 123–210*.

HACHEM L. 2000. New observations on the Bandkeramik house and social organization. *Antiquity 74: 308–312*.

HARTZ S. 1985. Kongemose-Kultur in Schleswig-Holstein? *Offa 42: 35–56*.

HARTZ S., HEINRICH D. and LÜBKE H. 2002. Coastal farmers – the neolithisation of northernmost Germany. In A. Fischer, K. H. Kristiansen (eds.), *The Neolithisation of Denmark. 150 Years of Debate: 321–340*.

JACOTTEY L. 1997. La couche 5 de Bavans (Doubs) et la fin du Mésolithique en Franche-Comté. In C.

Jeunesse (ed.), *Le Néolithique Danubien et ses marges entre Rhin et Seine. XXIIe Colloque Interrégional sur le Néolithique, Strasbourg 27–29 octobre 1995. Cahiers de l'Association pour la Promotion de la Recherche Archéologique en Alsace. Supplément n°3: 313–325*.

JEUNESSE C. 2000. Les composantes autochtone et danubienne en Europe Centrale et occidentale entre 5500 et 4000 av. J.-C.: contacts, transfers, acculturations. In *Les derniers chasseurs-cuilleurs d'Europe occidentale, Actes du colloque international de Besançon, octobre 1998. Presses Universitaires Franc-Comtoises 361 à 378, Annales Littéraires 699, Série "Environnement, sociétés et archaéologie" 1: 361–378*.

2001. Armatures asymétriques, régionalisation, acculturation. Contribution à l'étude des relations entre la Rubané et la composante autochtone dans l'oust de la sphère danubienne. In *Préhistoire de la Grande Plaine du Nord de l'Europe. Actes du Colloque Chaire Francqui interuniversitaire au titre étranger. ERAUL 99: 147–165*.

JEUNESSE C. and LEFRANC P. 1999. Rosheim "Sainte-Odile" (Bas-Rhin), un habitat rubané avec fossé d'enceinte. Première partie: les structures et la céramique. *Cahiers de l'association pour la promotion de la recherche archéologique en Alsace 15: 1–111*.

KALIS A. J. and ZIMMERMANN A. 1988. An integrative model for the use of different landscapes in Linearbandkeramik times. In J. L. Bintliff, D. A. Davidson, E. G. Grant (eds.), *Conceptual Issues in Environmental Archaeology: 145–152*.

KALIS A. J. and MEURERS-BALKE J. 1998. Die "Landnam"-Modelle von Iversen und Troels-Smith zur Neolithisierung des westlichen Ostseegebietes – ein Versuch zu ihrer Aktualisierung. *Praehistorische Zeitschrift 73: 1–144*.

KALIS A. J., MEURERS-BALKE J., VAN DER BORG K., VON DEN DRIESCH A., RÄHLE W., TEGTMEIER U., THIEMEYER H. 2001. Der La-Hoguette-Fundhorizont in der Wilhelma von Stuttgart-Bad Cannstatt. Anthrakologische, archäopalynologische, bodenkundliche, malakozoologische, radiometrische und säugetierkundliche Untersuchungen. In B. Gehlen, M. Heinen, A. Tillmann (eds.), *Zeit-Räume. Gedenkschrift für Wolfgang Taute Band 2: 649–672*.

KEELEY L. and CAHEN D. 1989. Early Neolithic forts and villages in Northeastern Belgium: a preliminary report. *Journal of Field Archaeology 16: 157–176*.

KRAUSE R., ARBOGAST R.-M., HÖNSCHEIDT S., LIENEMANN J., PAPADOPOULOS S., RÖSCH M., SIDÉRA I., SMETTAN H. W., STRIEN H.-C. and WELGE K. 1998. Die bandkeramischen Siedlungsgrabungen bei Vaihingen an der Enz, Kreis Ludwigsburg (Baden-Württemberg). *Bericht der Römisch-Germanischen Kommission 79: 5–105*.

KUBA R. 2001. Marking boundaries and identities: the precolonial expansion of segmentary societies in Southwestern Burkina Faso. In *Proceedings of the International Symposium 1999. Berichte des Sonderforschungsbereichs 268 "Kulturentwicklung und Sprachgeschichte im Naturraum Westafrikanische Savanna" Band 14: 415–426*.

KUL'KOVA M. A., MAZURKEVICH A. N., DOLUKHANOV P. M. 2001. Chronology and paleoclimate of Prehistoric sites in western Dvina-Lovat' area of northwestern Russia. *Geochronometria 20: 87–94*.

LENNEIS E. 2001. Keramik. In E. Lenneis, J. Lüning (eds.), *Die altbandkeramischen Siedlungen von Neckenmarkt und Strögen. Universitätsforschungen zur prähistorischen Archäologie 82: 79–186*.

LENNEIS E., STADLER P., WINDL H. 1996. Neue ^{14}C-Daten zum Frühneolithikum in Österreich. *Préhistoire Européenne 8: 97–116*.

LENNEIS E., STADLER P. 2002. ^{14}C-Daten und Seriation altbandkeramischer Inventare. *Archeologické rozhledy 54: 191–201*.

LOUWE KOOIJMANS L. P. 2001. Synthese. In L. P. Louwe Kooijmans (ed.), *Archeologie in de Betuweroute, Hardinxveld-Giessendam Polderweg. Een mesolithisch jachtkamp in het rivierengebied (5500–5000 v. Chr.). ROB Rapportage Archeologische Monumentenzorg 83: 441–470*.

LUBBOCK J. 1865. *Pre-historic Times, as Illustrated by Ancient Remains, and the Manners and Customs of Modern savages*. London: Williams and Norgate.

LÜNING J., KLOOS U. and ALBERT S. 1989. Westliche Nachbarn der bandkeramischen Kultur: Die Keramikgruppen La Hoguette und Limburg. Mit Beiträgen von J. Eckert und Chr. Strien. *Germania 67: 355–393*.

LÜNING J. 2000. *Steinzeitliche Bauern in Deutschland. Die Landwirtschaft im Neolithikum*. Universitätsforschungen zur prähistorischen Archäologie 58. Bonn: Habelt.

MAMONOV A. E. 2000. Rannij Neolit. Elshanskaja Kultura. In P. S. Kabetov, Vasil'eb I. B, Dubman Z. L., Smirnov J. H., Chramkov L. B. (eds.), *Istorija Samarskogo Powolsch'ja: 147–176*.

MEIER-ARENDT W. 1972. Die Ältere und Mittlere Linienbandkeramik im westlichen Mitteleuropa. Ein Überblick. *Fundamenta Va: 66–76*.

MEURERS-BALKE J. and KALIS A. J. 2001. Früh-, alt- und jungneolithische Landnutzung -archäopalynologische Bearbeitung der Wilhelma-Travertine von Bad Cannstatt. In B. Gehlen, M. Heinen and A. Tillmann (eds.), *Zeit-Räume.Gedenkschrift für Wolfgang Taute Band 2: 631–648*.

PETRASCH J. 2000. "Seid fruchtbar und mehret euch und füllet die Erde und machet sie euch untertan": Überlegungen zur demographischen Situation der bandkeramischen Landnahme. *Archäologisches Korrespondenzblatt 31(1): 13–26*.

2002. Religion in der Jungsteinzeit. Glaube, der die Gemeinschaft zusammenhält. In *Menschen, Zeiten, Räume. Archäologie in Deutschland. Begleitband zur gleichnamigen Ausstellung: 142–145*.

PIGGOTT S. 1965. *Ancient Europe*. Edinburgh: Edinburgh University Press.

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

RAEMAKERS D. C. M. 1999. *The Articulation of a 'New Neolithic'. The Meaning of the Swifterbant Culture for the Process of Neolithisation in the Western Part of the North European Plain (4900–3400 BC)*. Leiden: Archaeological Studies Leiden University. Faculty of Archaeology, University of Leiden.

RENFREW C. 2001. Commodification and institution in group-oriented and individualizing societies. In W. G. Runciman (ed.), *The Origin of Human Social Instutions. Proceedings of the British Academy 110: 93–117*.

SAHLINS M. D. 1961. The segmentary lineage: an organization of predatory expansion. *American Anthropologist 63, 1961: 322–345*.

SCHMIDT B., GRUHLE W. 2003. Wuchshomogenität als ein neues Analyseverfahren zur Verbesserung der dendrochronologischen Datierungsmethode. Die Hölzer der neolithischen Brunnen von Erkelenz-Kückhoven, Zwenkau und Mohelnice sowie vom Fundplatz Kaster. In J. Eckert, U. Eisenhauer and A. Zimmermann (eds.), *Archäologische Perspektiven. Analysen und Interpretationen im Wandel. Festschrift für Jens Lüning zum 65. Geburtstag. Internationale Archäologie Studia honoraria 20: 49–60*.

SCHWEIZER A. 2001. *Archäopalynologische Untersuchungen zur Neolithisierung der nördlichen Wetterau/Hessen*. Dissertationes Botanicae 350 Berlin/Stuttgart: Cramer.

SIDÉRA I. 2000. Animaux domestiques, bêtes sauvages et objets en matières animales du Rubané au Michelsberg. *Gallia Préhistoire 42: 107–194*.

STÄUBLE H. 1995. Radiocarbon dates of the earliest Neolithic in Central Europe. In G. T. Cook, D. D. Harkness, B. F. Miller and E. M. Scott (eds.), Proceedings of the 15th International ^{14}C Conference. *Radiocarbon 37/2: 227–237*.

STÖCKLI W. 2002. *Absolute und relative Chronologie des Früh- und Mittelneolithikums in Westdeutschland (Rheinland und Rhein-Main-Gebiet)*. Basler Hefte z. Arch. 1. DGUF-Verlag.

STRIEN H.-C., TILLMANN A. 2001. Die La-Hoguette-Fundstelle Stuttgart-Bad Cannstatt: Archäologie. In B. Gehlen, M. Heinen u. A. Tillmann (eds.), *Zeit-Räume. Gedenkschrift für Wolfgang Taute Band 2: 673–681*.

STRIEN H.-C. in press. Familientraditionen in der bandkeramischen Siedlung bei Vaihingen/Enz. *Proceedings of the Symposium Die Bandkeramik im 21. Jahrhundert, Brauweiler bei Köln, September 2002*.

TICHY R. 1998. The context of the Early-LBK well at Mohelnice. In H. Koschik (ed.), *Brunnen der Jungsteinzeit. Internationales Symposium in Erkelenz 27. bis 29. Oktober 1997: 45–50*.

TIMOFEEV V. I. 1998a. The Beginning of the Neolithic in the Eastern Baltic. In M. Zvelebil, L. Domanska and R. Dennell (eds.), *Harvesting the Sea, Far-*

ming the Forest. The Emergence of Neolithic Societies in the Baltic Region: 225–236.

1998b. The east – west relations in the Late Mesolithic and Neolithic in the Baltic Region. In L. Domanska and K. Jacobs (eds.), *Beyond Balkanization. Baltic-Pontic Studies Vol. 5: 44–58.*

UERPMANN H.-P. 1983. Die Anfänge von Tierhaltung und Pflanzenanbau. In H. Müller-Beck (ed.), *Urgeschichte in Baden-Württemberg: 405–428.*

UERPMANN M. and UERPMANN H. P. 1997. Remarks on the faunal remains of some early farming communities in Central Europe. *Anthropozoologica 25/26: 571–578.*

VAN BERG P.-L. 1990 a. Céramique du Limbourg et Néolithisation en Europe du Nord-Ouest. In D. Cahen and M. Otte (eds.), *Rubané & Cardial. Actes du colloque de Liège, novembre 1988. Études et Recherches Archéologiques de l'Université de Liège 39: 161–208.*

1990 b. La ceramique Néolithique Ancienne non rubanée dans le nord-ouest de l'Europe. *Bulletin de la Societé Préhistorique Luxembourg 12: 107–124.*

VAN BERG P.-L., VAN ROEYEN J.-P., KEELEY L. H. 1991. Le site a cèramique de Melsele (Flandre-Orientale), Campagne de 1990. *Notae Praehistoricae 10: 37–47.*

VAN BERG P-L., KEELEY L., VAN ROEYEN J-P., VAN HOVE R. 1992. Le gisement Mésolithique de Melsele (Flandre-Orientale, Belgique) et le Subnéolithique en Europe Occidentale. In Ch-T. Le Roux (ed.), *Paysans et Batisseurs. L'emergence du neolithique Atlantique et les origines du megalithisme. Actes du 17ème Colloque interrérionale sur le Néolithique Vannes, 28–31 oct. 1990. Revues Archéologique de l'Ouest, supplément n°: 93–99.*

VAN BERG P.-L. 1997. La céramique et son décor en Eurasie In Chr. Jeunesse (ed.), *Le Néolithique Danubien et ses marges entre Rhin et Seine. XXIIe Colloque Interrégional sur le Néolithique, Strasbourg 27–29 octobre 1995. Cahiers de l'Association pour la Promotion de la Recherche Archéologique en Alsace. Supplément n°3: 223–264.*

VAN NEER W., ERVYNCK A., LENTACKER A., CROMBÉ P., SERGANT J., PERDAEN Y., VAN STRYDONCK M., VAN ROEYEN J-P. 2001. Dierenresten uit een vroege Swifterbant-nederzetting te Doel-Deurganckdok (Vlaanderen, België): jachtweld, maar vooral veel vis. *Notae Praehistoricae 21: 85–96.*

VISSET L., CYPRIEN A.-L., CARCAUD N., OUGUERRAM A., BARBIER D., BERNARD J. 2002. Les prémices d'une agriculture diversifiée à la fin du Mésolithique dans le Val de Loire (Loire armoricaine, France). *Cahiers Revistes Palevol 1, 2002, 51–58.*

WECHLER K.-P. 2001. *Studien zum Neolithikum der osteuropäischen Steppe*. Deutsches Archäologisches Institut. Eurasien-Abteilung. Mainz: von Zabern.

ZILHÃO J. 2001. Radiocarbon evidence for maritime pioneer colonization at the origins of farming in west Mediterranean Europe. *Proceedings of the National Academy of Sciences of the United States of America 98: 1480–1485.*

ZIMMERMANN A. 2002. Der Beginn der Landwirtschaft in Mitteleuropa. Evolution oder Revolution? In M. Nawroth, R. von Schnurbein, R.-M. Weiss and M. Will (eds.), *Menschen – Zeiten – Räume. Archäologie in Deutschland. Begleitband zur gleichnamigen Ausstellung. Konrad Theiss: 133–135.*

ZVELEBIL M. and DOLUKHANOV P. 1991. The transition to farming in eastern and northern Europe. *Journal of World Prehistory 5/3: 233–278.*

UDK 903'12/'15(438)"634"
Documenta Praehistorica XXX

Hunter-gatherers and farmers: neighbours in north-eastern Kuiavia, Poland

Lucyna Domańska
Institute of Archaeology, University of Łódź, PL
lucynad@krysia.uni.lodz.pl

ABSTRACT – *The aim of this paper is to discuss the new discoveries made in the Tążyna-Parchania valley, in north-eastern Kuiavia, Poland. These discoveries put into a new light the problem of contacts between hunter-gatherers and farmers from the Polish Lowland.*

IZVLEČEK – *V članku razpravljamo o novih odkritjih iz doline Tążyna-Parchania v severovzhodnem delu regije Kuiavia na Poljskem. Ta odkritja na novo osvetljujejo vprašanje stikov med lovci-nabiralci in kmetovalci v poljskem nižavju.*

KEY WORDS – *Late Mesolithic; LBK; contacts; Kuiavia; Poland*

INTRODUCTION

Kuiavia is located in the eastern part of the pre-valley zone of the Polish Lowland (Fig. 1), between two pre-valleys: Toruń-Eberswalde to the north and Warsaw-Berlin to the south (*Kobusiewicz 1999*). In the area between the pre-valleys, two geographical zones can be distinguished: the Kuiavian Lake District and the so-called Kuiavian Plateau.

The north-eastern part of Kuiavia consists of two geographical districts: the Pre-valley (which is part of the so-called Toruń-Eberswalde pre-valley) and the Kuiavian Plateau. Sandy soils dominate in the first region, whereas black soils are a characteristic feature of the Plateau (Fig. 2). The Pre-valley can be described as hunter-gatherers' land and the Kuiavian Plateau as farmers' land.

In the southern part of the Kuiavian section of the Toruń-Eberswalde pre-valley many of the Mesolithic campsites have been recorded (Fig. 2). The especially favourable conditions for hunter-gatherers in this area are due to the Noteć and Zielona Struga rivers. The surface of sites seems to testify to a degree of penetration of this area by hunter-gatherer groups in the early Holocene. Surface surveys and excavations of the area over several thousand square metres near Kolankowo did not allow the fixing of a definite limit to the sites (*Domańska 1995*). Flint artefacts appeared almost everywhere, among which,

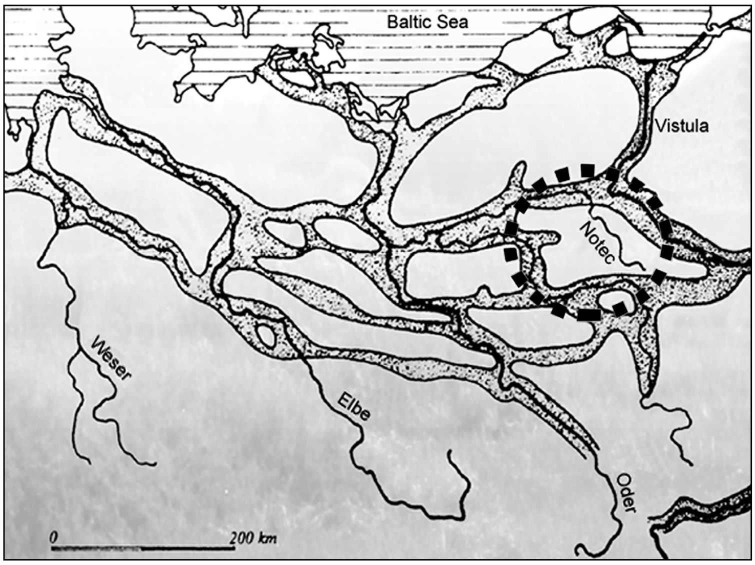


Fig. 1. Location of Kuiavia region in the pre-valley zone of the North European Lowlands.

late Mesolithic products decidedly dominated.

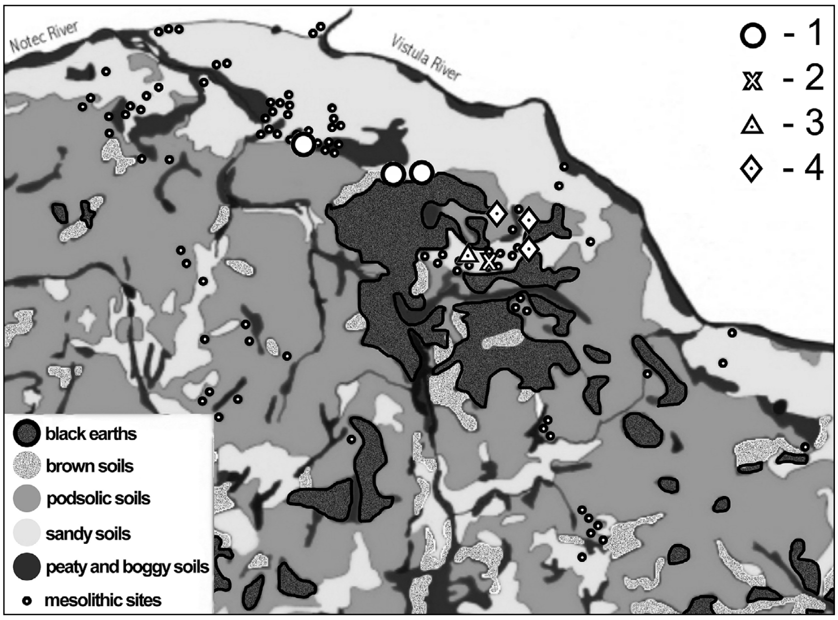


Fig. 2. Distribution of sites in the north-eastern part of Kuiavia: 1 – the late Mesolithic base camps, 2 – the Dąbrowa Biskupia 71 site, 3 – the Chlewiska 132 site, 4 – the Podgaj type of sites.

The late Mesolithic assemblages (Fig. 3, 4) from this region culturally belonged to the so-called Postmaglemosian groups (*Kozłowski 1989*). The actually available ^{14}C dates for these groups in Poland are no earlier than the beginning of the VII millennium b.p. According to S. K. Kozłowski in the VI millennium b.p. there occurs a peculiar cultural uniformity in Poland (*Kozłowski 1989*). This process is characterized by a gradual replacement of slim microliths by increasingly more numerous trapezes and dominant, irregular micro-side-scrapers among the tools on flakes. Such a taxonomic change is visible among the materials discovered on the borderline between the pre-valley of the Noteć River and the Kuiavian Plateau. The late chronology of the sites from this area was also confirmed by two radiocarbon dates (the site Glinki 7 – 6280 b.p., the site Stara Wieś 9A – 5820 b.p.; after *Prinke & Szmyt 1990*). On the other hand, the Kuiavian black soils may be described as the most important ecological niche of the Linear Band Pottery culture (LBK) in the Polish Lowland. More than 20 sites of the LBK were discovered in the north-eastern part of Kuiavian Plateau (*Czerniak 1994*). Among them the Grabie 4 site represents the oldest phase of the LBK in Kuiavia. On the grounds of the pottery (Fig. 5) the site should be recognized as contemporary with Flomborn-ačkova-Zofipole phase (*Czerniak 1994*) from the upland region. The basic raw material for tool production was Jurassic flint from southern Poland (Fig. 6).

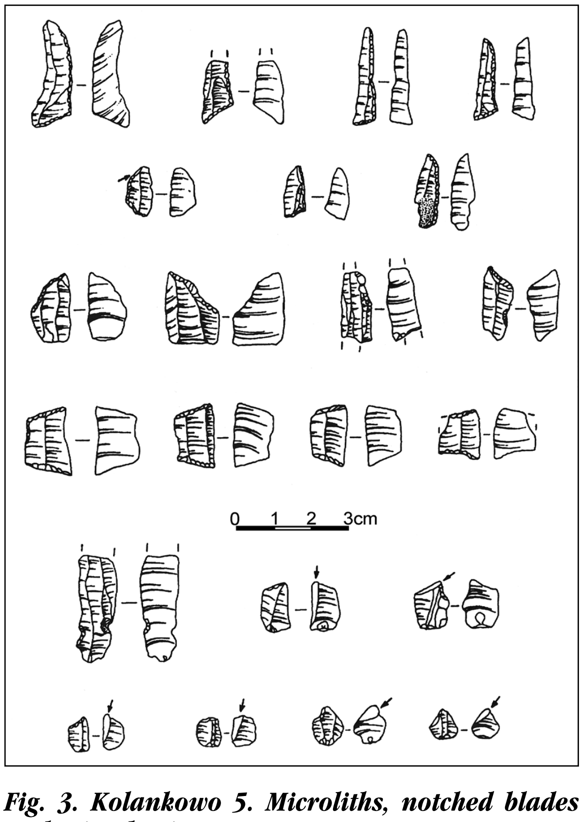


Fig. 3. Kolankowo 5. Microliths, notched blades and microburins.

For our studies, the concentration of the late Mesolithic and the LBK sites found on the sandy bottom of the Tążyna-Parchania rivers valley (Fig. 2), which joins the Pre-valley and Kuiavian Plateau, is the most important. Different hunter-gatherer and LBK task groups have been identified in this area.

The Mesolithic task groups from the Tążyna-Parchania rivers valley

The Dąbrowa Biskupia 71 site is an example of such a task group. The excavated area of this site is about 80 square meters, on which were found 243 artefacts, microliths being the most frequent (Fig. 7). The group of tools is only slightly varied functionally (Fig. 8), and support a hypothesis that we are dealing with a special task group at this site. It

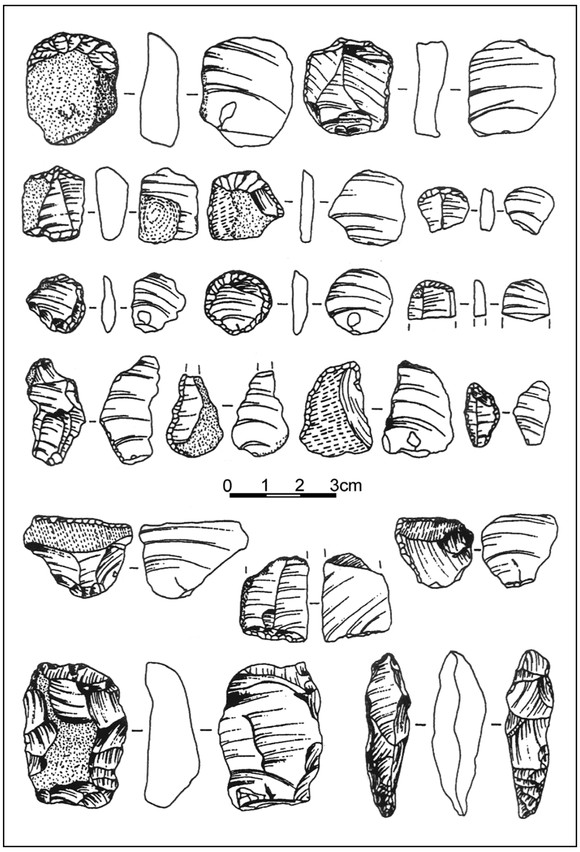


Fig. 4. Kolankowo 5. Tools.

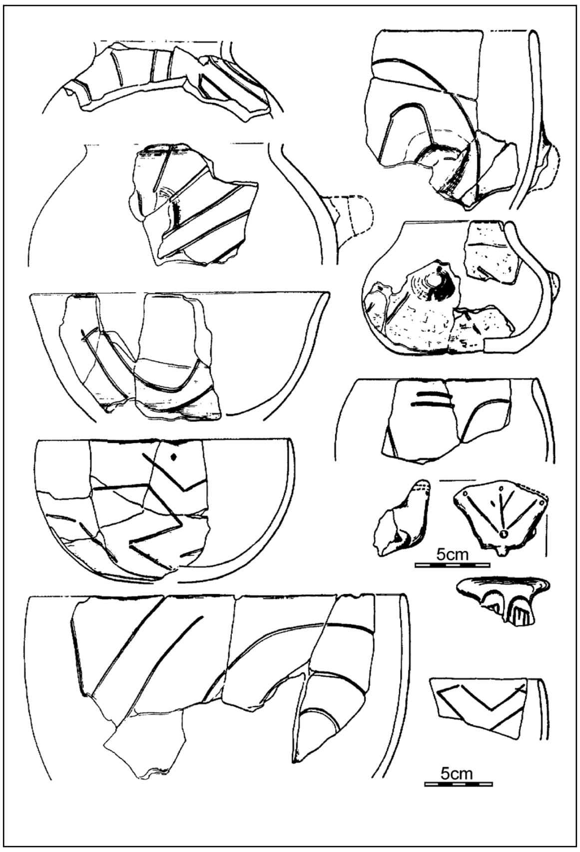


Fig. 5. Grabie 4. Pottery (after s*).*

should also be stressed that from the Tążyna-Parchania valley we know several surface collections (Fig. 2), which are characterized by the domination of microliths and an absence of side-scrapers, end-scrapers, and other types of tool. According to this material we may state that the Tążyna-Parchania valley was an area of special interest to hunters from the Pre-valley. We are dealing here only with special hunting camps; no traces of the base camps have been found. The base-camps were located on the southern bank of the pre-valley district only e.g. the Glinki 7 (*Domańska 2003a*) and Kolankowo 5 (*Domańska 1989; 1995*) sites. The diversity of the flint assemblages discovered on these sites (Fig. 9) speaks for the diversity of tasks performed with them.

Linear band pottery culture task groups from Tążyna-Parchania rivers valley

Two types of LBK sites were investigated on this area. Both of them can be dated to the II phase (so-called note phase) of LBK. The first type (eg. the Podgaj 32 site) is a small campsite situated on the sandy bottom of the Tążyna River valley (*Czerniak 1994*). The characteristic feature of the materials from this type of site is the specific technological

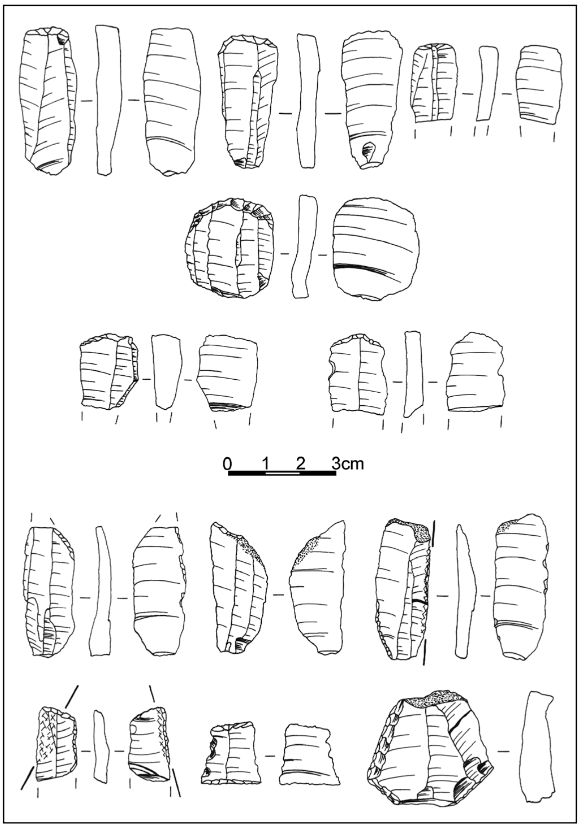


Fig. 6. Grabie 4. Flint tools.

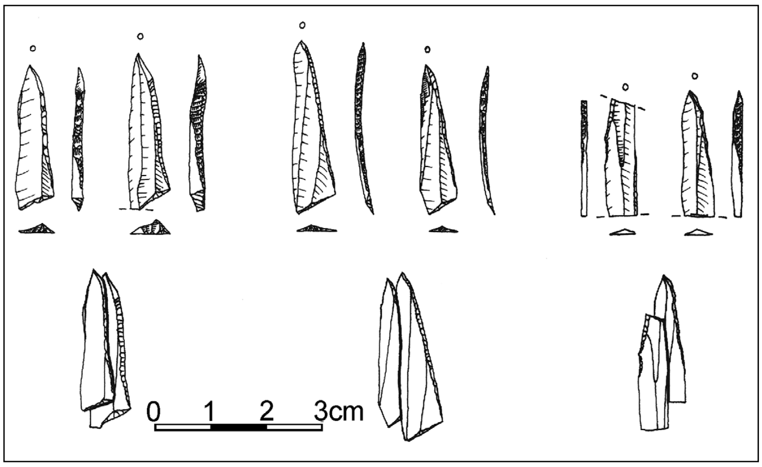


Fig. 7. Dąbrowa Biskupia 71. Microliths.

ley. Unlike at the Podgaj site, the pottery and flint artefacts here are similar to the finds at the LBK sites on the Kuiavian Plateau (Fig. 12). On the site there were found about 100 stone artefacts, among them grinding tools (ready and semi-finished) predominate. They were made from the local raw materials. So, this type of site can be interpreted as a workshop where grinding tools were produced. It should be stressed that on the Kuiavian Plateau, where most of the LBK settlements were located, stone raw materials are very rare.

structure (Fig. 10) of pottery (the predominance of so-called kitchen ware) and the structure of the flint materials (*Domańska 1995*), which are distinguished by the use of local, and lack of imported, raw material, and by reference to the Mesolithic tradition of flint processing (Fig. 11). This type of site has been quoted as an example of a seasonal campsite. All sites of the Podgaj type form a concentration lying outside the main cluster of Mesolithic sites. The second type of site is known from the Chlewiska 132 site, and is located in the Parchania River val-

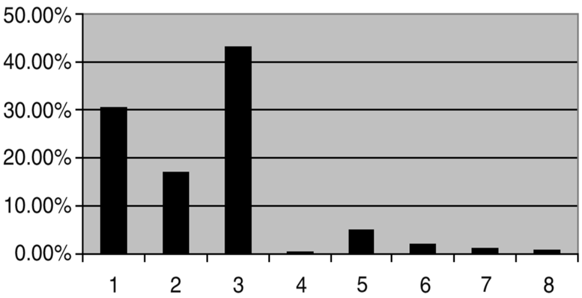


Fig. 8. The structure of the assemblage from the Dąbrowa Biskupia 71 site (1– blades, 2 – flakes, 3 – microliths, 4 – notched blade, 5 – microburins, 6 – chips, 7 – chunks, 8 – technical wastes).

The results of contacts between Postmaglemosian hunter-gatherers and the LBK communities

The long history of hunter-gatherers and LBK communities in the north-estern part of Kuiavia is hardly legible in an archaeological record. Nevertheless, the zone of contacts between these communities can be distinguished in this part of Kuiavia. This zone was situated on the border between two types of landscape. One of these is a characteristic pre-valley, the second is typical of the Kuiavian Plateau. Within this zone an exchange of technological innovations and imports took place (*Domańska 2003b*):

❶ *The exchange of raw flint materials*: The Mesolithic hunter-gatherers and early farming communities of Kuiavia used different flint raw materials. The late Mesolithic communities used mainly local flint resources obtainable on river banks and processed on the terrain of settlements, although several artefacts of chocolate flint are recorded for the Kolankowo 5 site, which is located in the pre-valley at the Kuiavian Plateau border. The artefacts seem to correspond with the LBK tradition, and their presence at this site may confirm contact between these two populations.

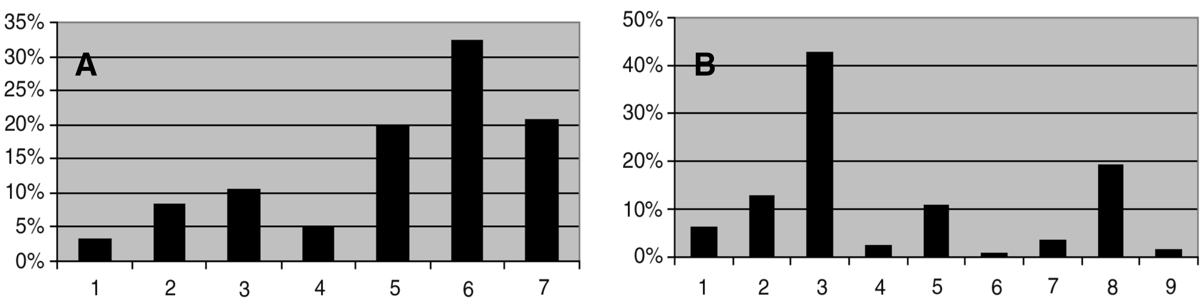


Fig. 9. The structure of the assemblage from the Glinki 7 site (A: 1 – cores, 2 – blades, 3 – flakes, 4 – microliths, 5 – other tools, 6 – chips, 7 – chunks) and the Kolankowo 5 site (B: 1 – cores, 2 – blades, 3 – flakes, 4 – microliths, 5 – other tools, 6 – microburins, 7 – chips, 8 – chunks, 9 – technical wastes).

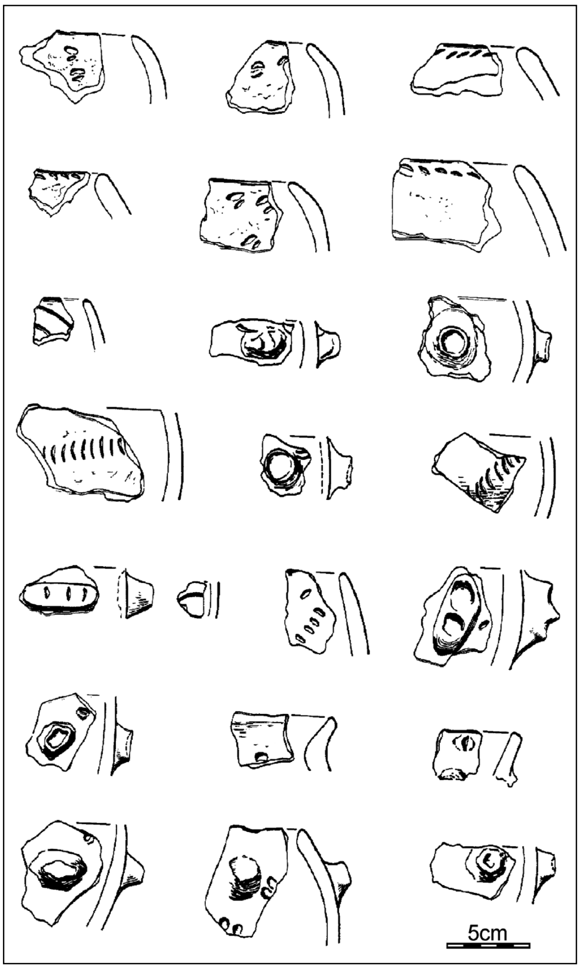


Fig. 10. Podgaj 32. Pottery (after **Czerniak 1994***).*

❷ *The exchange of working techniques*: The exchange of experience in local flint processing was confirmed by the LBK sites of the Podgaj type. Flint assemblages from these sites are distinguished by the use of local, and a lack of imported, raw material and

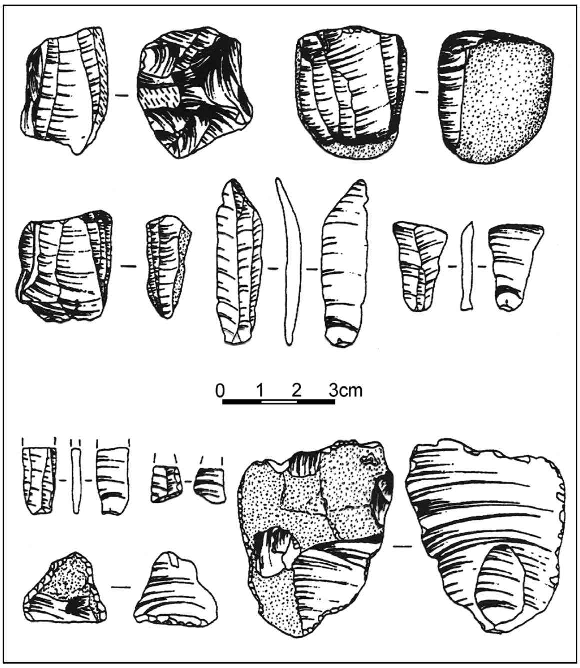


Fig. 11. Podgaj 32. Flint tools.

by reference to the Mesolithic tradition of flint processing.

❸ *The exchange of ready tools*: The exchange of ready tools is confirmed by the finds of shoe-last adzes at sites lying outside the Kuiavian concentration of LBK sites. Many such products have been recorded around Kuiavia (*Zvelebil 1998*).

CONCLUSIONS

The development of contacts between late Mesolithic hunters and the LBK farmers within that zone is characteristic, according to Dennell or Zvelebil, of a stationary frontier (*Dennell 1985; Zvelebil 1998*). This type of the agricultural frontier develops in stable or slowly changing situations, allowing the development of contact and exchange between foragers and farmers. In the development of this frontier the main role was played by the Tążyna-Parchania valley – the borderland between the Pre-valley area, where several dozen late Mesolithic base camps have been discovered, and the Kuiavian Plateau, distinguished by black soils and colonized by the LBK farmers.

Fig. 12. Chlewiska 132. Pottery.

REFERENCES

CZERNIAK L. 1994. *Wczesny i środkowy okres neolitu na Kujawach, 5400–3650 p. n. e.* Poznań.

DENNELL R. 1995. The hunter-gatherer/agricultural frontier in prehistoric temperate Europe. In Green S. & Perlman S. M. (eds.), *The archaeology of frontiers and boundaries: 113–140*.

DOMAŃSKA L. 1985. Elements of a food-producing economy in the Late Mesolithic of the Polish Lowland. In Bonsall C. (ed.), *The Mesolithic in Europe: 447–455*.

1989. Cultural development of Kuiavian communities in the Late Mesolithic. *Archaeologia Interregionalis 10: 25–39*.

1995. *Geneza krzemieniarstwa kultury pucharów lejkowatych na Kujawach*. Łódź.

2003a. Materiały krzemienne KPL ze stanowisk Glinki 7, Jezuicka Struga 17 i Tarkowo 42, gm. Rojewo, woj. bydgoskie. In D. Prinke (ed.), *Społeczności neolitu i wczesnej epoki brązu w Kotlinie Toruńsko-Bydgoskiej* (in print).

2003b. *Interactions between the late Mesolithic hunter-gatherers and farming communities in Northern Poland*.

KOBUSIEWICZ M. 1999. *Ludy łowiecko-zbierackie północno-zachodniej Polski*. Wydawnictwo Poznańskiego Towarzystwa Przyjaciół Nauk.

KOZŁOWSKI S. K. 1989. *Mesolithic in Poland. A new approach*. Wydawnictwo Uniwersytetu Warszawskiego.

PRINKE D. and SZMYT M. 1990. Pozycja kultury amfor kulistych w procesie zasiedlania Kotliny Toruńsko-Bydgoskiej. In A. Cofta-Broniewska (ed.), *Kultura amfor kulistych w rejonie Kujaw: 115–148*.

ZVELEBIL M. 1998. Agricultural frontiers, Neolithic origins, and the transition to farming in the Baltic Basin. In Zvelebil M., Domańska, L. and Dennell R. (eds.), *Harvesting the sea, farming the forest: 9–27*.

UDK 903'12/'15(495)"634"

Documenta Praehistorica XXX

An alternate (and old-fashioned) view of Neolithisation in Greece

Catherine Perlès

Institut Universitaire de France, Université Paris X, F

perles@mae.u-paris10.fr

ABSTRACT – *Despite the recent renewal of indigenous models for the Neolithisation of Greece, this paper will go back to more old-fashioned models, and argue in favour of colonisation processes by small, maritime, pioneer groups that later interacted with local populations. This argumentation rests first on an analysis of the presently available data on the Mesolithic, which shows that none of the prerequisites of a local process is met. Second, it rests on the consideration of often-neglected aspects, such as the theoretical and practical knowledge implied by the adoption of agriculture together with the adoption of new crafts and architectural techniques. Third, it rests in the need to explain the random, but strong parallels between the Near-Eastern and Greek Neolithic.*

IZVLEČEK – *Kljub sodobnim avtohtonističnim modelom neolitizacije Grčije se v članku vrnemo nazaj k bolj staromodnim modelom in zagovarjamo kolonizacijski proces z majhnimi, morskimi pionirskimi skupinami, ki so kasneje prišle v stik z lokalnim prebivalstvom. Naše dokazovanje temelji, prvič, na analizah trenutno dostopnih podatkov o mezolitiku, ki kažejo, da ni izpolnjen nobeden od pogojev za lokalni proces. Drugič, temelji na razmišljanju o pogosto spregledanih vidikih, kot je na primer ta, da so s prevzemom teoretičnega in praktičnega znanja kmetovanja prevzeli tudi nove obrti in arhitekturne tehnike. In tretjič, naše dokazovanje temelji na potrebi, da bi razložili naključne, toda močne paralele med bližnjevzhodnim in grškim neolitikom.*

KEY WORDS – *Greece; Neolithization; migration*

INTRODUCTION

When he recently discussed, in this same Seminar, the introduction of the Neolithic in Greece, Kostas Kotsakis (*2001*) strongly rejected classical migrationists models, and expressed doubts even on the "moderate colonisation hypothesis". In other words, even the presence of "scattered immigrants" remained, in his eyes, at best conjectural (*Kotsakis 2001.68*). In my view, to the contrary, the analysis of the data, especially from an anthropological and cognitive point of view, makes the presence of small groups of immigrants an inescapable conclusion (*Perlès 2001*).

By stating this, I acknowledge that I have still not disengaged myself, in my approach to the Neolithic of Greece, from "its usual archaeological referents i.e. domesticates and material culture" (*Kotsakis 2001.69*). However, I do not, for that matter, consider myself as a crude "materialist" or "positivist phenomenalist" of the 70's (*idem*). It is one thing to claim that Neolithic transformations were induced by economic or materialistic factors. It is an entirely different thing to claim, as I do, that economic and technical transformations go hand in hand with profound social transformations, and are amongst the best evidence we have to analyse these transformations. Thus, even if our models of interpretation aim at understanding, first and foremost, social processes rather than transformations in the material culture, they must, nevertheless, fully account for the observed data.

In this respect, we shall first examine briefly the available data for the Mesolithic in Greece. Despite severe taphonomic problems, the overall picture is coherent and congruent with what is known in most of the Balkans and Mediterranean areas. On this basis, I shall argue that the Mesolithic, as known of today, does not meet the prerequisites for a purely local social and economic dynamic towards the Neolithic. Secondly, and despite some claims to the contrary, all key elements of the Neolithic socio-economic system and symbolism seem to appear simultaneously in Greece, without demonstrated local antecedents or "pre-adaptations". In these conditions, I shall argue that the hypothesis of simple exchanges between local groups and foreign farmers, without any direct demic contribution, raises severe problems.

Finally, I shall try to solve some long-pending problems about the origins of potential colonisation movements, by supporting a model of "insular colonisation" from multiple origins, the only model, in my opinion, that can solve the "perplexities of material culture that seem to vex diffusionists and migrationists", as aptly expressed by Kotsakis (*2001.68*).

Although this paper will thus focus on the non-indigenous elements in the constitution of the Neolithic in Greece, I do not claim that the new settlements were created in a human and social void. Zvelebil has recently presented a refined model of the various kinds of interaction that could take place between hunter-gatherers and farmers, whichever their origin, and which can usefully be applied to Greece (*Zvelebil 2000; 2001*). The earliest farmers in Greece readily adopted the local transverse arrowheads, and seemingly exploited already established procurement systems for obsidian[1] (*Perlès 1988; 1989*). They may also have adopted from local groups the cremation of the body, a funerary ritual virtually unknown in the Near-East, but already practised in the Mesolithic of Greece. As underlined by Jeunesse (*2000*), referring to the Danubian, the adoption of such highly symbolic cultural elements demonstrates a strong and balanced interaction between the two communities. Nevertheless, I do not consider this to imply that the "autochthonous component", to retain Jeunesse's term, was itself engaged in a process towards more complex societies and a productive economy.

AN ANALYSIS OF THE PRESENTLY AVAILABLE DATA FROM THE MESOLITHIC IN GREECE

I shall here use the term Mesolithic in its chronological sense, to designate early Holocene hunter-gatherer assemblages, between ca 8700 to 7000 BC in calendar years. The sites identified are scarce (a dozen at most), and consist of caves and small open-air settlements. Although these settlements reveal diverse adaptations to varied environments, including the intensive exploitation of marine resources, the Mesolithic from Greece shows none of the conditions that Gebauer and Price, after the analysis of a world-wide survey, have considered to be "necessary for the transition to agriculture" (*Gebauer and Price 1992.8–9*).

"Agriculture first appears in areas with an abundance of resources – the land of plenty – rather than scarcity". Was thus Greece a "land of plenty" in the early Holocene?

The first noteworthy element is the limited role played in the subsistence system by the hunting of large or medium-size ungulates such as deer, boar and wild capra, according to the data from Franchthi Cave, Klissoura, Theopetra, Sidari and Kyklop's Cave. Large and medium-size game seems to have been scarce or of difficult access. This was only partially compensated by the exploitation of smaller mammals, such as hares and foxes, or by the exploitation of birds, which sometimes make up a large proportion of the hunted spectrum (*Trantalidou 2003*). On the other hand, a diachronic analysis of the Franchthi data shows a dramatic increase, in the Mesolithic, of the density of plant remains and a broad spectrum of collected species: wild legumes, wild cereals (oats and barley), fruits, bulbs and roots, land snails, marine molluscs, tortoises, etc (*Hansen 1991*). Fishing is also intensively practised on coastal sites, in particular at Franchthi, Kyklop's Cave and Sidari. Yet, claiming that the Greek Mesolithic as a whole was turned towards the exploitation of marine resources would be too extreme: several sites, further away from the coast, do not practice fishing. Even at Franchthi, intensive tuna fishing is only temporary. According to the ^{14}C dates, it corresponded to a few hundred years (2 or 3 centuries), as compared with the two millennia covered by the Mesolithic. Only Kyklop's cave, most probably a specialised site, shows a continuous emphasis on fishing,

1 The process may have been akin to that suggested by Gronenborn (*1997*) with the procurement of flint from the Maas valley by the earliest LBK colonists which reached the upper Rhine valley.

but on smaller species such as the sea bream (*Mylona 2003; Powell 2003*). Thus, in most cases the resources exploited were small "r-selected" resources, of limited energetic yield compared with the cost of procurement and processing. This predominance of r-selected resources, be they small seeds, molluscs, hare or medium sized fish, is indicative, in my opinion, of a lack of higher-ranked species, such as tuna or large game. Similarly, the diversity of the collected plants and molluscs shows that none was available in large enough quantity to allow for intense exploitation and storage, contrary to what obtained, for instance, in the Natufian. The diet was broad and certainly balanced, but the acquisition and processing costs were high[2]. There is no indication that Greece, at the time, could have been considered "a land of plenty".

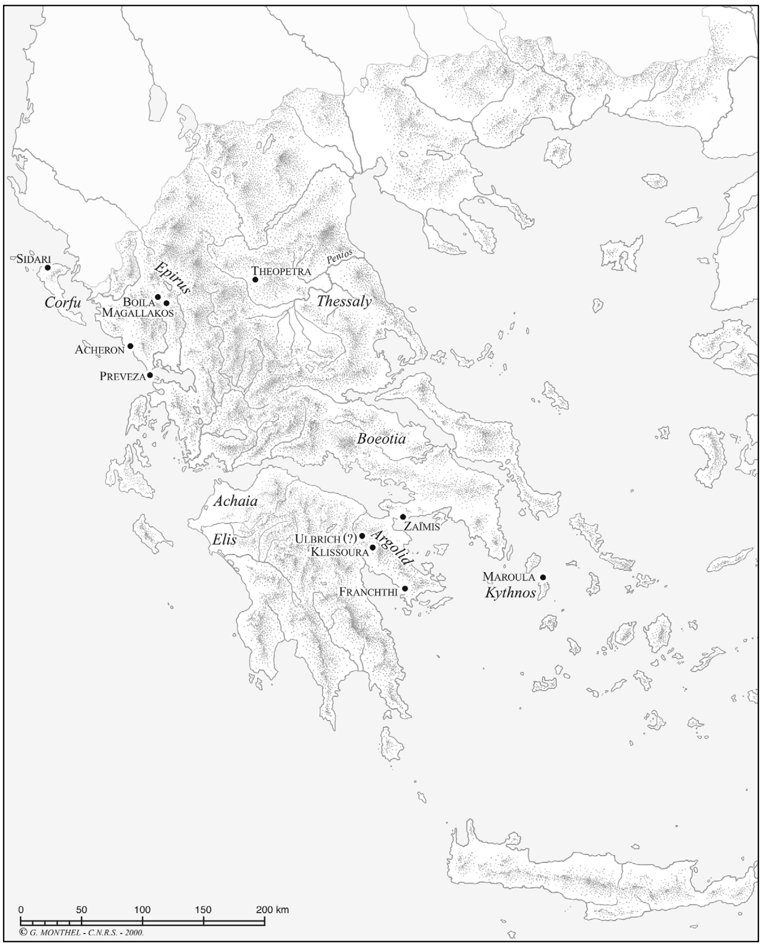


Fig. 1. Map of Mesolithic sites in Greece (after* Perlès 2001*).

"Agriculture appears and spreads quickly in areas where hunter-gatherers already occupy all of the inhabitable eco-zones"

The distribution of Mesolithic sites in Greece, as known of today, reveals a very low overall density and a preference for locations providing access to varied environments. Aside from Kyklop's Cave, located on a small island and probably a specialised site focussing on the exploitation of marine resources, all sites give access to hilly interiors, coastal plains, marshes, lakes or to the sea. Significantly, the large inner alluvial basins seem to have been deserted. However, the minute number of sites known implies, if only for demographic reasons, that a much greater number of sites have been destroyed or not recovered. Yet Greece is a well-surveyed country, and many inner basins have been intensely fieldwalked. In several areas, including Thessaly, the natural sections along the rivers have also been systematically explored (*Chavaillon et al. 1967; 1969; Runnels 1988; 1994; Wells 1996*, etc.). Middle Palaeolithic sites, buried under deep alluvium, have been discovered during these surveys. The fact that no late Upper Palaeolithic or Mesolithic sites came to light is thus significant. It is also significant that all Upper Palaeolithic settlements from Epirus were deserted at the dawn of the Holocene and that no Mesolithic occupation was ever discovered at the basis of Neolithic settlements. The absence or low density of Mesolithic sites in well-surveyed basins and in stratified shelters can be considered as established. Even in areas were Holocene alluviation was limited in extent, no Mesolithic site was identified (*Jameson et al. 1994; Cavanagh et al. 1996; Wells 1996*). Large areas were clearly devoid of settlements, and even if we are missing a large number of sites, we are far from a situation whereby one could state that "hunter-gatherers already occupy all of the inhabitable eco-zones".

"Agriculture appears initially among more sedentary and complex groups of hunter-gatherers"

There is no evidence in Greece, during the Mesolithic, for either semi-sedentary or complex hunter-gatherers. None of the Mesolithic sites in Greece has

2 It will be recalled than a kilogram of wild lentils contains approximately 100 000 seeds from about 10 000 plants (*Ladizinsky 1989*).

produced the architectural features, storage features, heavy equipment, remarkable artistic productions and diversified techniques associated with the sedentary hunter-gatherers of the Natufian or with the rich Mesolithic settlements of Northern Europe. No architectural remains have been uncovered, and the archaeological inventories show, on the whole, little variety and minimal technical investment. There is no indication whatsoever that these groups were involved in a process of sedentism or intensification of resources exploitation. The chipped stone tools reflect the isolation of Greece at that period, a point to which I shall come back. Flake tools, such as crude endscrapers, sidescrapers, notches, and denticulates dominate these assemblages. The latter are either almost devoid of microliths (i.e. the Lower Mesolithic and Final Mesolithic at Franchthi) or full of microliths (the Upper Mesolithic of Franchthi, Sidari), but of shapes and techniques unknown elsewhere.

Bone tools are known from Franchthi and Kyklop's cave. At Franchthi, they comprise awls and heavy points, but no implement that can be associated with fishing. To the contrary, Kyklop's Cave has yielded a number of fine bipoints and fish-hooks of complex manufacture (*Moundrea-Agrafioti 2003*)[3]. Despite the presence of wild cereals, grinding tools are very rare and mostly consist of hand stones on natural pebbles. No mortar or grinding slab has been securely attributed to the Mesolithic so far. A large number of beads were found associated with the Mesolithic burials at Franchthi, but they mostly consist of unworked *Dentalia* and pierced *Cyclope neritea*.

The few burials known, from Franchthi and Theopetra, (*Cullen 1995; Kyparissi-Apostolika 2000; 2003*) yielded no conspicuous grave goods. There is no indication of social differentiation between individuals, and nothing, given the available data, that would indicate a complex social organisation. This essential condition for the development of a local dynamics of Neolithisation is also not met.

"There is a long period of availability of cultigens and/or domesticated animals prior to full adoption of agriculture"

This statement refers to the long phase of "stasis" observed, in all contexts of primary Neolithisation, between the first presence of domesticated species and the adoption of a fully developed farming economy (*Gebauer and Price 1992; Hayden 1992*). In the Near East, for instance, more than a millennium separates the first presence of domesticated plants from the full adoption of an agro-pastoral economy (*Cauvin 1997*), and the time gap since the first attempts at plant cultivation must be even longer (*Gopher et al. 2001*).

In Greece, the presence of wild cereals and pulses in Mesolithic assemblages, well before any trace of agriculture was introduced, has often been quoted as an evidence of a "pre-adaptation" stage to agriculture (*i.e. Chapman 1994; Halstead 1996*). However, there is no sign that these species were intensely exploited or preferred to others. Oats and barley make up only a small proportion of the seed assemblages at Franchthi (ca 15%), and the latter actually disappears in the latest phase of the Mesolithic, prior to the appearance of a domesticated form (*Hansen 1991*). As for the "wild einkorn" which was recently found in Greece (*Zamanis et al. 1988*) and which could have been locally domesticated (*Kotsakis 2001*), it has been shown beyond doubt to be a domesticated wheat returned to the wild (*Heun et al. 1997; 1998*). Finally, let us note that if the mere exploitation of wild species, be they wild goats, wild boars, wild cereals or wild legumes, is to be considered as a "pre-adaptation" to their domestication, then most of the Palaeolithic also should be considered as a pre-adaptation stage to the Neolithic.

After the introduction of domesticated plants and animals, no "stasis" is observed, either. There, as in most Mediterranean countries, agriculture, once introduced, is very rapidly adopted and generalised (*Dennell 1992*). In all newly founded settlements, domesticated plants and animals heavily predominate in the seed and bone assemblages (*Perlès 2001*). There is evidence, nevertheless, that at that stage late Mesolithic hunter-gatherers did have access to domesticates. At least, this is how I have interpreted the "Initial Neolithic" at Franchthi, with its strong Mesolithic traditions and selected domesticates (*Perlès 2001*), or the presence of domesticates with unusual pottery sherds at Sidari. Bones of domesticated mammals have also been found in late Mesolithic levels at Theopetra and Kyklop's Cave. However, given the stratigraphic problems in both sites, direct dating of the bones will be needed before contamination can be ruled out (*Newton 2003; Trantalidou 2003*). In any case, none of these cases would establish that

3 Although, considering their strong resemblance to Neolithic hooks and the disturbances at the site, direct AMS dating of these pieces would make their dating more secure.

cultigens and domesticated animals were available "long before" the full adoption of agriculture. In all these sites the late Mesolithic ^{14}C dates are contemporaneous with the earliest dates for fully agro-pastoral settlements. The presence of domesticated species can just as well be taken as evidence for the expected interactions between the first farming communities and the local hunter-gatherers.

"The transition to agriculture appears to be accompanied by a shift from a communal to household level of organisation"

Given the nature of the remains pertaining to the Mesolithic in Greece, not much can be said about the nature of the socio-economic organisation. Nevertheless, two points can be made. First, the collective burial at Franchthi that Tracey Cullen brought to light recently (*Cullen 1995*) contained the inhumations of four adults (one male and three females), an infant, plus two cremations (two young adults, one male and one female). This might fit the hypothesis of a communal, rather than household, level of organisation. Secondly, and contrary to what obtains in the Near East from the Natufian to the PNA, no shift can be perceived in the nature of sites, organisation of sites, or organisation of activities throughout the Greek Mesolithic. Overall, the Mesolithic in Greece, as known of today, reflects a mobile way of life by groups that exploited a wide array of seasonally available resources. Some at least were skilled seafarers, able to navigate difficult seas, bring back obsidian from Melos, and catch heavy prey such as tuna-fish. Nevertheless, none of the conditions that Gebauer and Price identified as necessary for the transition to agriculture on the basis of their world-wide ubiquity is met in Mesolithic Greece.

Obviously, this evaluation rests on the presently available data, and the latter is extremely limited. Andreou and his colleagues (*1996*) consider that, on this basis, no valid comparison may be drawn between the Mesolithic and the Neolithic and no conclusion can be reached regarding the origins of the latter. Even more recently, Kotzakis reaffirmed the possibility that Mesolithic (or transitional Mesolithic/Neolithic sites) could be buried under alluvium or submerged by the rise in sea level (*Kotsakis 2001. 66*), thus obscuring a local dynamic towards more complex societies. However, I have already said that Greece was a well-surveyed country. In addition, 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. This is well exemplified, not only by the Near and Middle East with the Natufian and Quermezian settlements, but also, for instance, with the Iron Gates Mesolithic (*Radovanović 1996*) or the Ertebølle complex (*Larsson 1990*).

I thus concur with Jacobsen (*1993*) or Runnels (*1995*), for instance, in considering that:

- Greece was sparsely populated during the Late Palaeolithic and the Mesolithic.
- Most sites were located in areas with access to varied environments, including coastal or inland plains and hilly hinterlands. To the contrary, I consider that the absence of sites in the centre of the large alluvial basins reflects a real archaeological pattern. In this respect, I do not consider Theopetra as an exception: though it belongs administratively to Thessaly, it is located on the very margin of the Thessalian plain, in a diversified environment backed by the Meteores and the Pindus mountains.
- The low visibility of the Mesolithic (except, of course, in caves) is a reflection of a mobile way of life, leaving behind short-term camps with a low density of remains.

In these conditions, I also consider that the contrast with Early Neolithic sites, in terms of density of sites, settlement patterns, economic basis, and technology is significant and not merely the outcome of recovery biases.

THE INTRODUCTION OF THE NEOLITHIC AS A FULL "PACKAGE"

By 7000 BC indeed, we start to find permanent villages with built houses and with an entirely new technological inventory that includes pressure-flaked blades of obsidian and flint, polished axes, diverse bone tools, manufactured ornaments, fired clay artefacts, figurines, etc. The economy is based almost exclusively on the exploitation of domesticated plants and animals, most of them of definite Near Eastern origin: sheep, goats, pigs and cattle for the animals, wheat (*Triticum monococcum, T. dicoccum, T. aestivum*), barley (*Hordeum vulgare ssp. distichum*), pulses (*Lens culinaris, Vicia ervilia, Pisum sativum*) for the plants (see *Gopher et al. 2001 and Lev-Yadun et al. 2000* for a synthesis of genetic analyses of the origins of the domesticated plants).

Pottery (but not baked clay objects) is the only typically Neolithic element that might be missing in the earliest Neolithic sites, i.e. during the phase that I prefer to call "Initial Neolithic" rather than "Aceramic Neolithic" (see discussions in *Bloedow 1991; 1992/1993; Perlès 2001*).

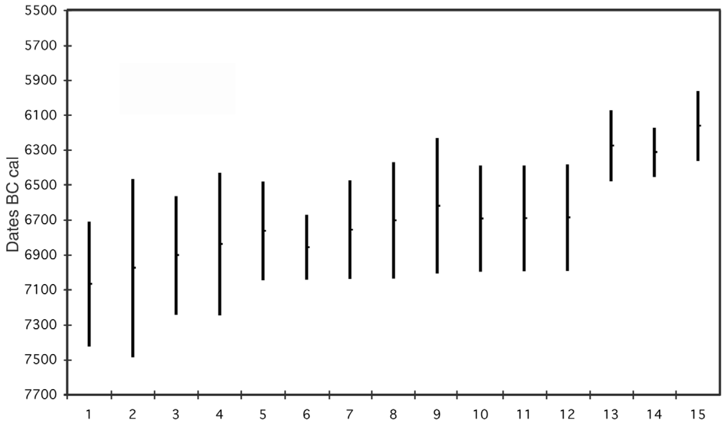


Fig. 2. ¹⁴C dates (cal BC, two standard-deviations) of "Initial Neolithic" levels in Greece. Samples no. 1, 9 and 12, 13 come from Argissa, sample no. 11, 14 and 15 from Sesklo. Aside from the three latest, they fit perfectly with the dates from Knossos (no. 2, 5, 6) and Franchthi (no. 4, 7, 8 and 10).

Not surprisingly, the notion that the Neolithic was introduced as a "package" is best exemplified at Knossos. Knossos is the only Initial Neolithic site that has benefited from recent and very careful excavations, and the results, according to the excavators, are unambiguous (*Efstratiou et al. in press*).

"*The Neolithic settlement of Knossos was founded on the Kephala hill at the end of the 8th millennium BC, sometime around 7000 BC, as the new ^{14}C/AMS early date coincides with Evans's dates (Fig. 7). The first occupants, a small community, arrived in the area bringing with them the full Neolithic 'package', but not pottery. All the bones retrieved indicate fully domesticated animals such as goats, sheep (*ovis/capra*), pigs (*Sus scrofa*), cows (*Bos*), and dogs (*Canis familiaris*), all belonging to small-sized animals showing no signs of any proto-domestication process. The agricultural economy is characterised by fully domesticated plants such as cereals (*Triticum sp.*) and legumes (*Pisum sp.*) – and not just cereals as Helbaek reports (*Evans 1968.269*) – that show no evidence of any transitional stage from wild to cultivated plants (wild einkorn and barley). A. Sarpaki who examined the pertinent material emphatically stresses that while systematically exploiting trees, specifically almonds (*Amygdalus communis*) and figs (*Ficus carica*), the first Knossians were well advanced in cultivation practices and not mere beginners*".

This sudden appearance of a "Neolithic package" is a key element in the argumentation in favour of a colonisation process, and it can hardly be challenged in the case of Crete. To the contrary, it has recently been challenged for Continental Greece (*Kotsakis 2001; Thissen 2000a; 2000b*). As pointed out by Kotsakis, there is little overlap between the Mesolithic and Neolithic dates in Greece, taken as a whole. Following Thissen, he suggested, nevertheless, that the Neolithic was introduced to Thessaly several hundred years after its introduction to Crete and to the Peloponese (*Kotsakis 2001.67*). He thus concluded that "in any case, even if migrationists hypotheses are justified for Thessaly, there was enough time scope for these scattered immigrants to build a relation with local populations and surroundings and interact with them in local palimpsests", although he admits that the "the early sites that would potentially picture this interactive process are still missing from the archaeological record" (*ibid.*). I fail to see, however, which are the arguments for a later Neolithic occupation of Thessaly. Fifteen radiocarbon dates can be attributed to "Aceramic" or "Initial Neolithic" levels in Greece, coming from four different sites[4]. As observed by Bloedow (*1992/1993*), none of these dates is individually devoid of a problem, but the same would apply to any series of Neolithic dates, especially from long-duration, stratified settlements. Aside from three late samples, all the dates cluster between 7050 and 6500 calBC (calibrated at 2 sigma). Two of the four dated Initial Neolithic sites are located in Thessaly: Sesklo and Argissa. The dates of these deposits do not depart from those of Franchthi and Knossos. Argissa gave four dates with maximum probabilities between 7422 and 6544 calBC, and Sesklo gave one date with a maximum probability at 6542 cal BC (*Perlès 2001.Tab. 5.3*).

Significantly, all these dates come from deposits located at the bases of long sequences and underlie classic "Early Neolithic" deposits, as defined by their pottery. I do not intend to discuss here the presence of pottery in Initial Neolithic levels, but they do represent, in my opinion, an early phase of the Neolithic in Greece, already characterised by a fully developed agro-pastoral economy and typically Neolithic

4 I thank N. Efstratiou for providing me the new AMS date from Knossos.

assemblages. This early phase is followed by the classic "Early Neolithic" (pre- and proto-Sesklo in Thessaly), dated, by more than 50 samples, to ca 6500 to 5900 calBC, and in complete continuity with the Initial Neolithic dates. Thus, the Initial and Early Neolithic extend approximately one millennium, half the duration of the Mesolithic. There is no convincing evidence for a process of diffusion in steps having occurred on a large scale. For instance, the suggestion that the Early Neolithic at Franchthi consisted of two separate episodes, as the ^{14}C dates might suggest (*Thissen 2000a; 2000b*), cannot be substantiated, since the thick Early Neolithic deposits on the Paralia could not be radiocarbon-dated.

EXCHANGES OR COLONISATION?

How, then was this Neolithic package introduced into Greece? Since no one can deny that a majority, if not all domesticated species, come from the Near East, the alternative to colonisation is that of acquisition through exchanges. In this case, no movement of Near-eastern groups needs to have taken place. In this sense, the spread and development of the Neolithic in Greece would have remained a strictly indigenous phenomenon, based on the internal dynamics of these groups (*Kotsakis 1992; 2001; Kyparissi-Apostolika 2003*). It seems, though, that too little thought has been given to the very notion of "exchanges" and to their practicability. First, exchanges with whom? There are no indications of contacts between Greece and the Near East during the Mesolithic. In addition, it must be recalled that the dates for the earliest Neolithic settlements in Western Anatolia and Turkish Thrace are substantially later than the dates of the Initial Neolithic in Greece (*Thissen 2000c*). Second, "exchanging" live domesticates is not like exchanging a pot, a meat-joint or an ornament. As underlined by Zilhão (*1993.54*): "*...it might be difficult for hunter-gatherers to reconcile the possession of domestic animals with their traditional economy, given the incompatibilities in terms of mobility and timing of resource acquisition that such a possession might imply...*"

In a longer-term perspective, a knowledge of the habitats, specific requirements, breeding, cultivation and storage techniques for approximately 15 new domesticated species would have been needed if these species were to survive and develop, as they did. Considering the breadth of knowledge, know-how, experience, and skills implied by the simultaneous introduction of domesticated plants and animals, as well as the current lack of evidence for a "pre-adaptation" stage, I find it doubtful that such abstract and especially practical knowledge could have been "exchanged" and passed on, along with the animals and plants, without the active participation of the original farmers. In addition, it must be recalled that the new elements introduced into Greece also concern building techniques, chipped and polished stone tools, bone tools, stone vases, clay firing, etc. The breadth of knowledge this implies is quasi-encyclopaedic, and is certainly severely underestimated under the hypothesis of simple exchanges. Furthermore, the communication of abstract knowledge and subtle practical skills requires far more common linguistic background than the mere exchange of artefacts. Such bilingualism could only have been acquired through repeated contacts, of which Mesolithic Greece offers no indication. Thus, the "simple" hypothesis of exchanges actually raises many more problems than that of small groups of colonists, who would have brought along their animals, their plants, their knowledge and their skills.

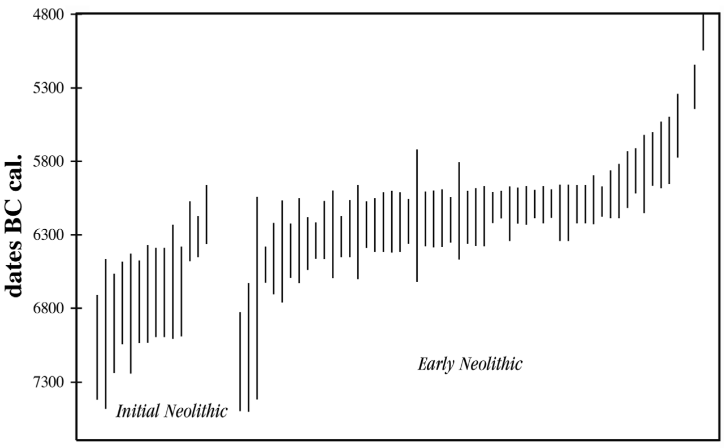


Fig. 3. ^{14}C dates (cal BC, two standard-deviations) of "Initial Neolithic" and Early neolithic sites in Greece. The new date "Initial Neolithic" date from Aceramic Knossos has not be added.

Although the supporting arguments might have been different, this position is not new (*Weinberg 1970*). To the contrary, it might almost be deemed old-fashioned. There has thus been ample time for criticisms, and one of the most powerful was the impossibility of pinpointing a clear origin for these presumed colonists. It is indeed easy to find parallels between the Near-Eastern PPN Neolithic and the earliest Greek Neolithic, but these parallels do not converge towards a single, core area.

THE PARALLELS BETWEEN GREECE AND THE NEAR EAST

These parallels pertain to two different levels. First, the structural analogies, second the artefactual analogies.

Structural analogies

Structural analogies underline the fact that the similarities concern not only which plants and animals were exploited, but more fundamentally, how they were exploited, how space was exploited and socialised, how the world was organised. In other words, to use a fashionable expression, the "domestication of space" is the same in the Near East and in Greece:

- First, the settlements in both regions consist of clustered, permanent, villages.
- Within the village, houses are of the same quadrangular shapes and similar dimensions, which seem to correspond to individual domestic units.
- The architecture is also comparable, with a prevalence of clay for the walls (mud-bricks or daub), but also for clay benches, hearths, and basins. The "furniture" is integrated into the very architecture of the house.
- Outside the settlement proper, similar parallels can be found in the way space was exploited. The most striking aspect is the opposition between a small, well-defined, permanent exploitation territory and a "procurement" area of extremely vast dimensions. In Thessaly, the area of densest settlement during the Early Neolithic, the theoretical territory around each village does not exceed 450 hectares, judging by the mean distance between first-order nearest neighbours (*Perlès 2001*). By contrast, some goods such as obsidian and flint blades circulate an area that extends over hundreds of kilometres, over lands and seas.

A shared characteristic with the Near East (*Cauvin and Cauvin 1982.48*) is the absence of an intermediate zone, or "saltus", between this vast procurement zone and the very small village territory. Contrary to what obtains in other regions of Europe, there is no indication during the Early and Middle Neolithic in Greece of a complex organisation of activities on an intermediate scale, with hunting camps, transhumant sites, animal pens, fishing grounds, etc. The absence of "saltus" may be related to ideological factors as much as to economic factors. On the whole, Early and Middle Neolithic communities in Greece seem to have systematically ignored or even rejected wild resources, whether plants, animals, raw materials, or shelters. Wild fauna in EN sites rarely exceeds 5% in number of rests, local raw materials are often a minority, and caves are neglected. The accent is put on humanly controlled resources, on humanly built dwelling, on man-made geometric ornaments, on raw materials acquired through exchange rather than from local sources. That this is a choice is indicated by the fact that all the "wild" or "natural" elements will regain importance later, during the Late Neolithic and Bronze Age. As though, in those early phases of the Neolithic, it was necessary, for symbolic reasons, to emphasise the human control of nature[5]. Early Neolithic communities exploited an environment that they had artificially created, with species that they had themselves introduced, and that closely reproduced the Near-Eastern domestic ecosystem. No species was lacking, no species had been added. The two plants domesticated in Europe, the poppy and the oat, are precisely absent. I would thus conclude that the most relevant argument in favour of Near-Eastern origins is the fact that the first Neolithic communities in Greece recreated, with very little modification, not only their original biological environment, but also their conception of space. However, these features are common to most of the Near East. Thus, they cannot by themselves provide a more precise answer to the question: where from?

Stylistic analogies, taken in a broad sense (*Sackett 1977*) should logically point towards a more specific area of origin. There are, undoubtedly, numerous analogies between Greek and Near Eastern artefacts. But in truth these stylistic or technical analogies create more problems than solutions. The parallels, sometimes very striking, can be found in many domains: amongst the early schematic figurines, the pebble figurines, or the later coffee-bean eyed figurines; amongst the stone vases, the ear plugs, the geometric stamps; amongst the bone hooks, the cut-sherd spindle whorls, the sling bullets, the so-called "tokens", etc (*Perlès 2001*). More generally, the very abundance and diversity of what is often called "small finds" is a characteristic shared by both regions, and their mere presence opposes them to Western Europe. To these formal resemblances can be added technical analogies, such as the specific methods for pressure-flaking obsidian, and the already mentioned similarities in building techniques.

5 The same phenomenon can be observed in the early phases of the Danubian (*Jeunesse 2002*).

But what can we do with such lists? Some of these similarities pertain to categories of artefacts with wide distributions, such as the cut-sherd spindle whorls, the sling bullets, the polished axes and adzes, which bear little stylistic investment. Consequently, they cannot help in solving the problem of origins. The same can be said of techniques such as the use of plaster or mud bricks, of very large distributions.

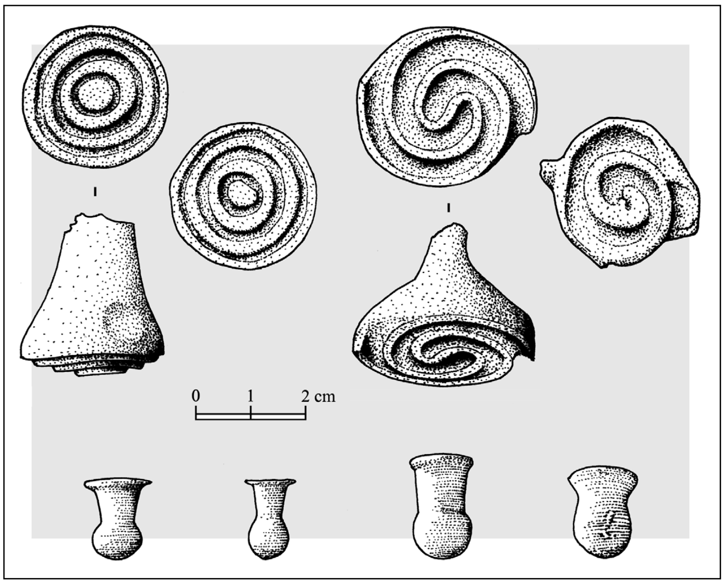


Fig. 4. Stamps and ear-plugs from Near-Eastern and Greek sites (after* Perlès 2001*).

Secondly, there are similarities between artefacts that are stylistically very distinctive: the figurine, the bone hooks, the earplugs, the stamps, for instance. The similarities are strong, and often very striking. But their interpretation in terms of direct filiation raises severe problems:

- Most similarities remain contextually isolated. Undoubtedly, the bone hooks, the stamps and earplugs from Hacilar and Çatal Hüyük strongly resemble those of Thessaly. But what about the architecture, the paintings, the bulls-heads, and the obsidian mirrors of Çatal, which have no equivalent in Greece? Can we isolate one or two categories of artefacts, and ignore all others?
- There are, in some instances, important chronological differences between the specimens under comparison.
- More generally, these formal analogies cover a wide time-range and a wide region, from Anatolia to the Jordan valley. They do not converge towards a coherent spatial, temporal, and cultural unit.

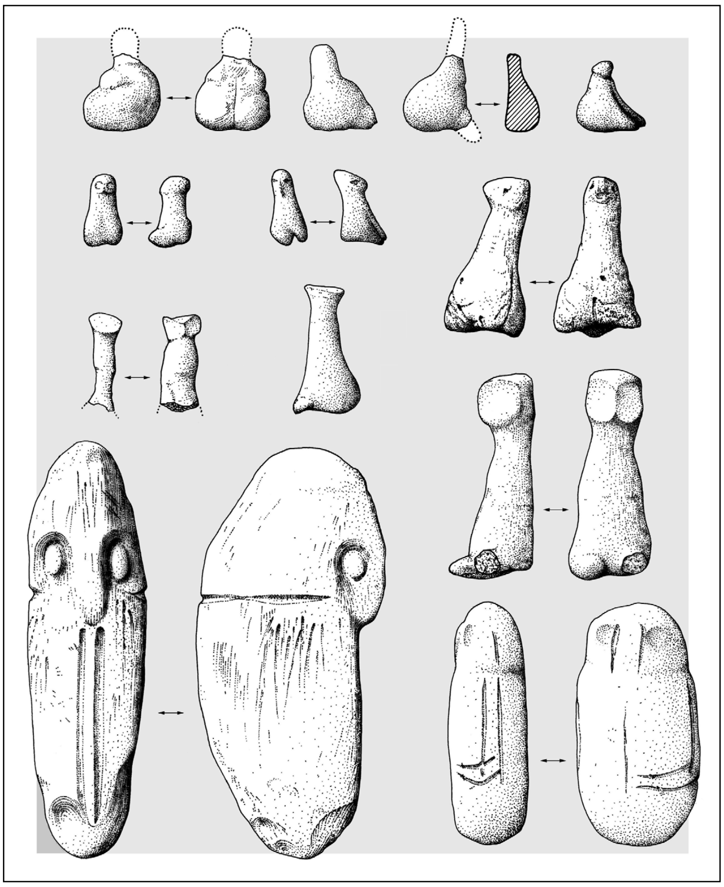


Fig. 5. Early anthropomorphic figurines from Near-Eastern and Greek sites (after* Perlès 2001*).

It might thus seem that, as advocated by its opponents, the model of a Near Eastern colonisation cannot be substantiated, or that the problem was conceived in the wrong terms and requires, to be solved, a different model of colonisation.

A MODEL OF INSULAR COLONISATION

The radiocarbon dates from the earliest Neolithic in Greece show that, chronologically speaking, the colonisation of Greece could be a late outcome of what Cauvin called the "great exodus" of the PPNB (*Cauvin 1997*). Indeed, the displacement of small groups of farmers took place first and foremost within the Near East itself. These movements of colonisation were frequently accom-

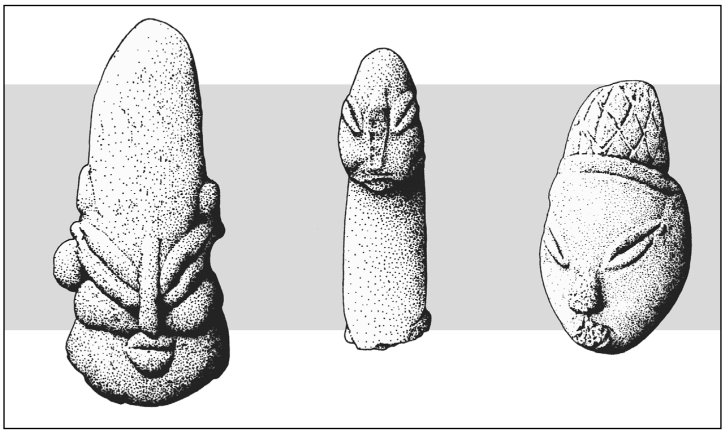


Fig. 6. "Coffee-bean" eyed figurines from Near-Eastern and Greek sites (after* Perlès 2001*).

cussed by *Broodbank and Strather 1991*), of the second process. Long distance re-settlements during the Early Neolithic are also exemplified by more intricate situations, such as the coastal Impressa settlements isolated amidst Cardial settlements in the Languedoc (*Manem 2002; Roudil and Soulier 1983*).

The hypothesis of long-distance expeditions certainly fits the Greek data better than that of a gradual advance. We know of no Early Neolithic settlement between Turkish Thrace and the Giannitsa basin, and no definite Early Neolithic settlement has ever been found in any of the small Cycladic islands. The well-known absence of early Neolithic sites in Greek Thrace, Eastern and Central Macedonia, has frequently been attributed to the effects of deep alluviation (*Efstratiou in press*). However, the areas affected by such alluviation are localised, and Palaeolithic industries have been brought to light in Eastern Macedonia (near Drama) and Central Macedonia (near Saloniki). So why are there no Early or Middle Neolithic settlements? It is also clear from the pottery that the Western Macedonian Early Neolithic sites have strong Balkan affinities (*Chrisostomou 1996 (1997); Lichardus-Itten et al. 2002.130*) and were probably settled from the North, not from the East. I doubt, therefore, that Eastern Macedonia was a road of penetration into Greece.

In consequence, the settlement of mainland Greece cannot, in my opinion, be compared with the slow movement of populations characteristic of the Danubian "waves of advance". There is evidence neither for a continental movement, nor for a slow progression. On the other hand, navigation was practised in the Mediterranean since the Late Pleistocene, as indicated by the presence of Melian obsidian in the Final Pleistocene and Early Holocene levels from Franchthi (*Perlès 1979; 1987; Renfrew and Aspinall 1990*). It is probable that regular navigation in the Aegean, whether for fishing or procuring raw materials, led to a widespread knowledge of the landmasses that existed far away. As stated by Davis (*1992.702*): *"The recognition that the Aegean was being navigated long before the introduction of agriculture to Greece has obvious and important repercussions for how the process by which agriculture was spread from the Near East to Greece is viewed: clearly an absence of evidence for settle-*

panied by radical transformations in material culture, even when no local influences could be invoked (*Cauvin 1997*). If the colonisation of Greece were part of the same process, similar transformations could then be expected. More specifically, the colonisation of Greece could be linked to the collapse of the complex societies that mark the transition between the PPNB and the PNA, as advocated by Özdoğan (*1997*) or Zilhão (*2000*). This would explain why the Early Neolithic societies in Greece retained many technical elements of the Near East, but clearly departed from the PPNB societies in their social organisation, settlements patterns and collective symbolism (*Özdoğan 2001*).

In fact, as noted above, artefactual analogies between Greece and the Near East display two main characteristics: these are selective on the one hand, heterogeneous on the other. This obviously makes no sense if one envisions the spread of the Neolithic through the regular advance of small communities that progressively founded new villages near their original settlements. That is, if one follows the gradual "wave of advance" model of Ammerman and Cavalli-Sforza (*1984*), or if one follows the model usually put forward for the spread of the Danubian.

Runnels and van Andel have recently put forward an alternate model that fits the Near-Eastern data better: the rapid displacements over long distances of small groups that ultimately settled in favoured environments far from their original homes (*Runnels and van Andel 1995*). This model parallels, for inland areas, the "maritime leap-frog" process of colonisation suggested by Zilhao for the Mediterranean area (*Zilhão 1993; 2001*). The colonisation of the Levantine Coast is a good example of the first process, that of Cyprus, and even more so, of Crete (dis-

ment in the earlier phase of the Neolithic in the Greek islands no longer requires us to postulate the existence of a more northern route of migration for Neolithic immigrants, for which there has been precious little evidence. The Aegean sea of the later Palaeolithic was navigable and navigated."

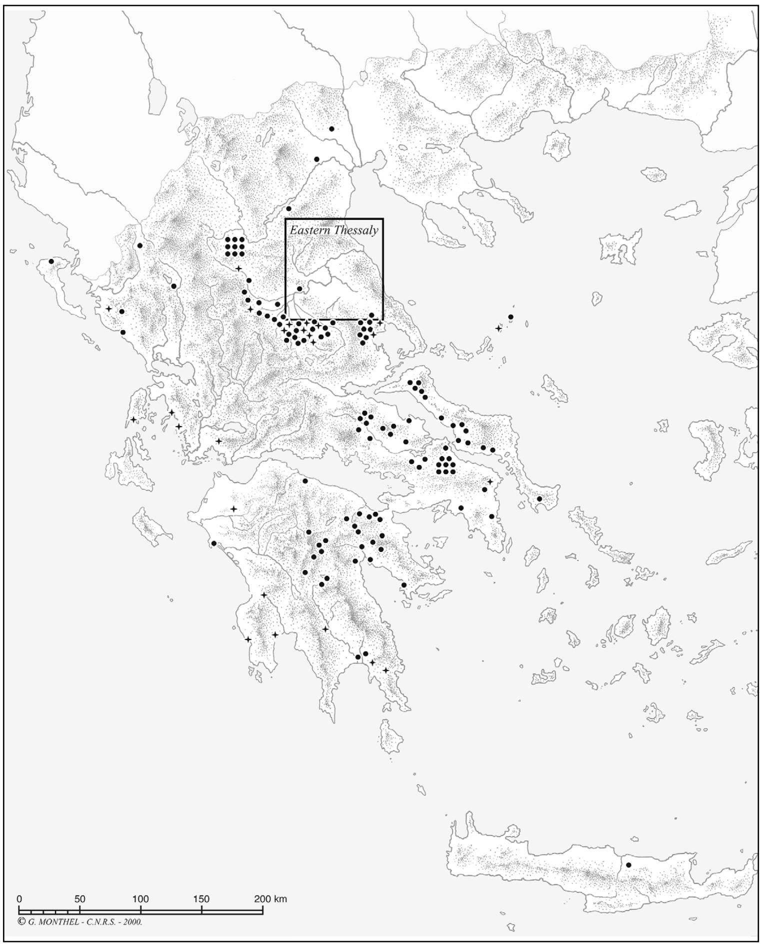


Fig. 7. Map of Early Neolithic sites in Greece (after* Perlès 2001*). Dots: EN sites or groups of sites. Crosses: sites of uncertain EN attribution. For Eastern Thessaly, see Fig. 8.

Good knowledge of navigation would have been necessary since, as convincingly argued by Broodbank and Strather in particular, the colonisation of islands such as Crete could only be successful if it resulted from planned and organised expeditions: *"The maritime transfer of a nucleus of humans and domesticates suitably balanced to establish a farming community would demand sufficient planning to indicate a deliberate intent to colonise somewhere (whether the point eventually reached or not). Models of passive, accidental dispersion through stochastic or natural processes, that have been successfully applied to the colonisation of islands by certain animal and plant species, may explain some early hunter-gatherer maritime dispersions (...), but present an implausible scenario for the movement of agriculturalists together with their attendant fauna and flora" (Broodbank and Strasser 1991.237).*

There is, in addition, no reason such expeditions should have proceeded as far as Crete, without reaching, at one point or another, mainland Greece. I thus suggest that the colonisation of mainland Greece, too, relates to these long-distance expeditions, well exemplified not only by the colonisation of Crete, but also of Cyprus, Corsica, or the Balearic islands. This conceptual framework, in turn, sheds new light on the problems of origins. First, these long-distance expeditions were, undoubtedly, difficult and fraught with risk (*Broodbank and Strather 1991*). I doubt very much that everyone would have been willing to embark in such expeditions, or that a whole Anatolian or Levantine community, for instance, would have suddenly decided to move to Thessaly![6] They would instead have concerned small groups of rather adventurous individuals, which did not carry, possess or choose to retain the whole technical and cultural heritage of their original communities. Hence the selective aspect of what analogies can be found. Secondly, these expeditions may well have been undertaken by groups of different origins. There are many different sea-routes linking the Levant and Turkey to Greece, and I see no reason to postulate a single original area. Repeated displacements of small groups, in all directions, are well exemplified in the Neolithic of the Near East (see *Cauvin 1997; Huot 1994*). After all, most historically documented cases of colonisation, including the Greek colonies themselves, did involve groups

6 One could, instead, recall what Platon said of those sent to create new colonies: "Tous ceux que le manque de ressources dispose et destine à suivre des meneurs pour s'emparer des biens des possédants, ces prolétaires constituent une sorte de mal intérieur de la cité. Pour s'en débarrasser sous un beau nom, on crée ce que l'on appelle une colonie. C'est la forme la plus bénigne d'expulsion." (*Platon, Les Lois, 735e-736a*).

of different origins... These multiple origins would explain the heterogeneity in the parallels that can be drawn between Greece and the Near East.

My hypothesis, consequently, is that the first pioneers of Greece would have been (adventurous) individuals, continuing the PPNB "great exodus", who followed different pathways from their original ancestral "home" to their ultimate settlement in Greece. Each would have retained some, but some only, of their most valuable symbols or techniques, and this would explain the selectivity and heterogeneity of our analogies.

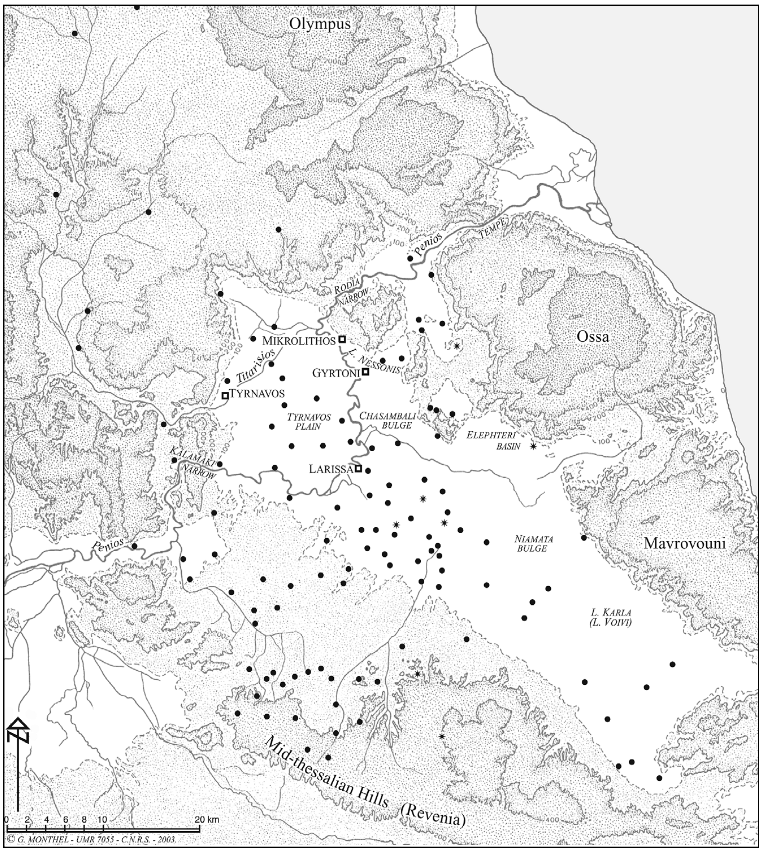


Fig. 8. Early Neolithic sites in Eastern Thessaly (after* Perlès 2001*). Dots: EN 2 sites. Stars: unspecified EN sites.

CONCLUSION

I shall thus conclude: (a) that the presence of foreign colonists is a necessary hypothesis when one considers the cognitive aspects of the simultaneous introduction of the whole array of Neolithic domesticates and techniques and, (b) that this hypothesis has been rejected, in part, because Greece has been considered as part of the Continent, and, therefore as colonised through familiar colonisation processes. I contend that, paradoxically, Greece should be viewed as a far-off island, settled by small groups of varied origins, who rapidly assimilated themselves with the local hunter-gatherers.

I know that this view raises strong objections amongst several Greek scholars, but I fail to see why. Such long distance displacements of small groups of farmers are demonstrated in the Near East at least since the early PPNB. They are well exemplified by the colonisation of the islands, and they are clearly recorded within Europe itself during the Neolithic. It is also now widely acknowledged that the Neolithic in Europe, as a whole, is the result of complex interactions between colonist groups and local populations. I see no reason, looking at the data, to claim Greece as an exception.

∴

REFERENCES

AMMERMAN A. J. and CAVALLI-SFORZA L. L. 1984. *The Neolithic Transition and the Genetics of Populations in Europe*. Princeton University Press, Princeton.

ANDREOU S., FOTIADIS M. and KOTSAKIS K. 1996. Review of Aegean Prehistory V: The Neolithic and Bronze Age of Northern Greece. *American Journal of Archaeology 100: 537–597.*

BLOEDOW E. F. 1991. The 'Aceramic' Neolithic phase in Greece reconsidered. *Mediterranean Archaeology 4: 1–43.*

1992/1993. The date of the earliest phase at Argissa Magoula in Thessaly and other Neolithic sites in Greece. *Mediterranean Archaeology 5/6: 49–57.*

BROODBANK C. and STRASSER T. F. 1991. Migrant farmers and the Neolithic colonisation of Crete. *Antiquity 65: 233–245*.

CAUVIN J. 1997. *Naissance des divinités, naissance de l'agriculture. La révolution des symboles au Néolithique*. Paris, CNRS Editions, 2ème éd. révisée.

CAUVIN J. and CAUVIN M.-C. 1982. Origines de l'agriculture au Levant: facteurs biologiques et socio-culturels. In Young T. C., Smith P. E. L. and Mortensen P. (eds.), *The Hilly Flanks. Essays on the prehistory of Southwestern Asia presented to R. J. Braidwood. Studies in ancient oriental civilization no. 36*: *43–53*.

CAVANAGH W., CROUWEL J., CATLING R. W. V. and SHIPLEY G. eds. 1996. *Continuity and change in a Greek rural landscape: The Laconia Survey, vol. II.* British School at Athens. London.

CHAPMAN J. 1994. The origins of farming in south east Europe. *Préhistoire Européenne 6: 133–156*.

CHAVAILLON J., CHAVAILLON N. and HOURS F. 1967. Industries paléolithiques de l'Elide. I – Région d' Amalias. *Bulletin de Correspondance Hellénique XCI: 151–201*.

1969. Industries paléolithiques de l'Elide. II – Région du Kastron. *Bulletin de Correspondance Hellénique XCIII: 97–151*.

CHRISOSTOMOU P. 1996 (1997). I Neolithiki katoikisi sti voreia paraktia zoni tou allote Thermaïkou Kolpou (eparchia Giannitson). *To Archaiologiko Ergo sti Makedonia kai Thraki 10 A: 159–172*.

CULLEN T. 1995. Mesolithic mortuary ritual at Franchthi Cave, Greece. *Antiquity 69(263): 270–289*.

DAVIS J. L. 1992. Review of the Aegean Prehistory I: the islands of the Aegean. *American Journal of Archaeology 96(4): 699–756*.

EFSTRATIOU N. and AMMERMAN N. J. in press (2003). Survey in Aegean Thrace: exploring the landscape. In Iacovou M. (ed.), *Archaeological field survey in Cyrpus. Past history, furure potentials.*

EFSTRATIOU N., KARETSOU A., BANOU E. and MARGOMENOU D. in press. *The Neolithic settlement of Knossos. New light on an old picture*. British School at Athens Supplement Series.

GEBAUER A. B. and PRICE T. D. (eds.) 1992. *Transitions to Agriculture in Prehistory.* Prehistory Press, Madison, (Monographs in World Prehistory no. 4).

GOPHER A., ABBO S. and LEV-YADUN S. 2001. The "when", the "where" and the "why" of the Neolithic revolution in the Levant. In M. Budja (ed.), *Documenta Praehistorica XXVIII: 49–62*.

GRONENBORN D. 1997. *Silexartefackte der ältestbandkeramischen Kultur*. Universitäts-forschungen zur prähistorischen Archäologie Band 37. Verlag Dr. Rudolf Habelt GMBH, Bonn.

HALSTEAD P. 1996. The development of agriculture and pastoralism in Greece: when, how, who and what? In Harris D. R. (ed.), *The Origins and Spread of Agriculture in Eurasia: 296–309*.

HANSEN J. M. 1991. *The Palaeoethnobotany of Franchthi Cave, Excavations at Franchthi Cave, Greece, fasc. 7*. Indiana University Press, Bloomington and Indianapolis.

HAYDEN B. 1992. Contrasting expectations in theories of domestication. In A. B. Gebauer and T. D. Price (eds.), *Transitions to Agriculture in Prehistory: 11–20*.

HEUN M., BORGHI B. and SALAMINI F. 1998. Einkorn wheat domestication site mapped by DNA fingerprinting. In M. Budja (ed.), *Documenta Praehistorica XXV: 65–77*.

HEUN M., SCHÄFER-PREGL R., KLAWAN D., CASTANA R., ACCERBI M., BORGHI B. and SALAMINI F. 1997. Site of einkorn wheat domestication identified by DNA fingerprinting. *Science 278: 1312–1314*.

HUOT J.-L. 1994. *Les premiers villageois de Mésopotamie: du village à la ville*. Armand Colin, Paris.

JACOBSEN T. W. 1993. Maritime mobility in the Prehistoric Aegean. Paper presented at the XXth meeting on Maritime Archaeology, Nafplion (manuscr).

JAMESON M. H., RUNNELS C. and VAN ANDEL T. H. 1994. *A Greek Countryside: the Southern Argolid from Prehistory to Present Day*. Stanford University Press, Stanford.

JEUNESSE C. 2000. Les composantes autochtones et danubienne en Europe centrale et occidentale entre 5500 BC et 4000 av. J. C.: contacts, transferts, acculturations. *Les derniers chasseurs-cueilleurs d'Europe occidentale, actes du colloque international de Besançon, Besançon octobre 1998. (Annales littéraires 699; Série: Environnement, sociétés et archéologie, 1): 361–378.*

2002. La coquille et la dent. parure de coquillage et évolution des systèmes symboliques dans le Néolithique danubien (5600–4500). In Guilaine J. (ed.), *Matériaux, productions, circulations du Néolithique à l'Âge du Bronze: 49–64.*

KOTSAKIS K. 1992. O neolithikos tropos paragogis. Ithagenis i apoikos. *Diethnes synedrio gia tin Archaia Thessalia sti mnimi tou Dimitri P. Theochari, Ekdosi Tameiou archaeiologikôn porôn kai apallotrioseôn: 120–135.*

2001. Mesolithic to Neolithic in Greece. Continuity, discontinuity or change of course? In M. Budja (ed.), *Documenta Praehistorica XXVIII: 63–73.*

KYPARISSI-APOSTOLIKA N. 2000. *Theopetra Cave. Twelve years of excavation and research 1987–1998*. Proceedings of the International Conference, Trikala, 6–7 november 1998, Athens 2000.

2003. The Mesolithic in Theopetra Cave: new data on a debated period of Greek Prehistory. In Galanidou N. and Perlès C. (eds.), *The Greek Mesolithic, British School at Athens Studies (BSA series, no. 10): 189–198.*

LADIZINSKY G. 1989. Origin and domestication of the Southwest Asian grain legumes. In D. R. Harris and G. C. Hillman (eds.), *Foraging and Farming. The evolution of plant exploitation (One World Archaeology): 374–389.*

LARSSON L. 1990. The mesolithic of southern Scandinavia. *Journal of World Archaeology 4(3): 257–309.*

LEV-YADUN S., GOPHER A. and ABBO S. 2000. The craddle of agriculture. *Science 288: 1062–1063.*

LICHARDUS-ITTEN M., DEMOULE J.-P., PERNICEVA L., GREBSKA-KULOVA M. and KULOV I. 2002. The site of Kovacevo and the beginnings of the neolithic period in southwestern Bulgaria. In Lichardus-Itten M., Lichardus J. and Nikolov V. (eds.), *Beiträge zu jungsteinzeitlichen Forschungen in Bulgarien: 99–158.*

MANEM C. 2002. Structure et identité des styles céramiques du Néolithique ancien entre Rhône et Èbre. *Gallia Préhistoire 44: 121–165.*

MOUNDREA-AGRAFIOTI A. 2003. Mesolithic fish hooks from the Cave of Kyklops. In Galanidou N. and Perlès C. (eds.), *The Greek Mesolithic, British School at Athens (BSA series, no.10): 131–141.*

MYLONA D. 2003. The exploitation of fish resources in Mesolithic Sporades: Fish remains from the Cave of Kyplops, Yioura. In Galanidou N. and Perlès C. (eds.), *The Greek Mesolithic, British School at Athens (BSA series, no. 10): 181–188.*

NEWTON S. 2003. The mesolithic fauna from Theopetra. In Galanidou N. and Perlès C. (eds.), *The Greek Mesolithic, British School at Athens no. 199–205.*

ÖZDOĞAN M. 1997. The beginning of the Neolithic economies in Southern Europe: an Anatolian perspective. *Journal of European Archaeology 5(2): 1–33.*

2001. The Neolithic deity: male or female? In Boehmer R. M. and Maran J. (eds.), *Lux Orientis. Festschrift für Harald Hauptmann: 313–318.*

PERLÈS C. 1979. Des navigateurs méditerranéens il y a 10 000 ans. *La Recherche 96: 82–83.*

1987. *Les industries lithiques taillées de Franchthi (Argolide, Grèce). Tome I: Présentation générale et industries paléolithiques, Excavations at Franchthi Cave, fasc. 3.* Indiana University Press, Bloomington/Indianapolis.

1988. New ways with an old problem: chipped stone assemblages as an index of cultural discontinuity in the early Greek Prehistory. In E. B. French and K. A. Wardle (eds.), *Problems in Greek Prehistory. Papers presented at the Centenary Conference of the British School of Archaeology at Athens, Manchester, April l986: 477–488.*

1989. La néolithisation de la Grèce. In O. Aurenche and J. Cauvin (eds.), *Néolithisations: Proche et Moyen Orient, Méditerranée orientale, Nord de l'Afrique, Europe méridionale, Chine, Amérique du Sud, British Archaeological Reports, Int. Series. 516: 109–127.*

2001. *The Early Neolithic in Greece. The First Farming Communities in Europe*. Cambridge

University Press, Cambridge (Cambridge World Archaeology).

POWELL J. 2003. The fish bone assemblage from the Cave of Kyklops, Yioura: evidence for continuity and change. In Galanidou N. and Perlès C. (eds.), *The Greek Mesolithic, British School at Athens (BSA series, no.10): 173–179*.

RADOVANOVIĆ I. 1996. *The Iron Gates Mesolithic*. International Monographs in Prehistory, Ann Arbor (Archaeological series 11).

RENFREW C. and ASPINALL A. 1990. Aegean obsidian and Franchthi Cave. In C. Perlès (ed.), *Les industries lithiques taillées de Franchthi (Argolide, Grèce). Tome II: Les Industries du Mésolithique et du Néolithique initial, Excavations at Franchthi Cave, fasc. 5: 257–270*.

ROUDIL J.-L and SOULIER M. 1983. Le gisement néolithique ancien de Peiro Signado (Portiragnes, Hérault): étude préliminaire. *Actes du XXIe congrès préhistorique de France, Quercy, 1979: 258–279*.

RUNNELS C. 1994. A Palaeolithic survey of Thessaly. *La Thessalie. Quinze années de recherches archéologiques, 1975–1990. Bilans et perspectives, Tome 1: 55–56*.

1995. Review of Aegean Prehistory IV: The Stone Age of Greece from the Palaeolithic to the advent of the Neolithic. *American Journal of Archaeology 99: 699–728*.

1988. A Prehistoric survey of Thessaly: new light on the Greek Middle Palaeolithic. *Journal of Field Archaeology 15: 277–290*.

SACKETT J. 1977. The meaning of style in archaeology. *American Antiquity 42(3): 369–380*.

THISSEN L. 2000a. A Chronological framework for the Neolithisation of the Southern Balkans. *Karanovo. III. Beiträge zum Neolithikum in Südosteuropa: 193–212*.

2000b. Thessaly, Franchthi and Western Turkey: clues to the Neolithisation of Greece? In M. Budja (ed.), *Documenta Praehistorica XXVII: 141–154*.

2000c. *Early village communities in Anatolia and the Balkans, 6500–5500 BC*. Ph.D. diss., University of Leiden.

TRANTALIDOU K. 2003. Faunal remains from the earliest strata of the Cave of Kyklops (Youra, northern Sporades): recording the data. In Galanidou N. and Perlès C. (eds.), *The Greek Mesolithic, British School at Athens (BSA series, no. 10): 142–179*.

VAN ANDEL T. and RUNNELS C. N. 1995. The earliest farmers in Europe. *Antiquity 69(264): 481–500*.

WEINBERG S. S. 1970. *The Stone Age in the Aegean. Cambridge Ancient History I, Part 1*. Cambridge University Press, Cambridge, revised. ed.: 557–618, 664–672.

WELLS B. ed., with the coll. of Runnels, C. 1996. *The Berbati-Limnes Archaeological Survey 1988–1990*. Acta Instituti Atheniensis Regni Sueciae, series in 4°, XLIV: 457–458.

ZAMANIS A., SAMARAS S., STAVROPOULOS N. and DILLE J. 1988. Report of an expedition to rescue germplasm of wild species of wheat and relatives in Greece. *Greek gene bank scientific bulletin*, North Greece agricultural research center.

ZILHAO J. 1993. The spread of agro-pastoral economies across Mediterranean Europe: a view from the far West. *Journal of Mediterranean Archaeology 6(1): 5–63*.

2000. From the Mesolithic to the Neolithic in the Iberian peninsula. In Price T. D. (ed.), *Europe's first farmers: 144–182*.

2001. Radiocarbon evidence for maritime pioneer colonozation at the origins of farming in West Mediterranean Europe. *Proceedings of the National Academy of Sciences 98(24): 14180–14185*.

ZVELEBIL M. and LILLIE M. 2000. Transition to agriculture in eastern Europe. In Price T. D. (ed.), *Europe's first farmers: 144–182*.

ZVELEBIL M. 2001. The agricultural transition and the origins of Neolithic society on Europe. In M. Budja (ed.), *Documenta Praehistorica XXVIII: 1–26*.

UDK 903'12/'15(4/5)"633/634"
Documenta Praehistorica XXX

Seals, contracts and tokens in the Balkans Early Neolithic: where in the puzzle

Mihael Budja
Department of Archaeology, University of Ljubljana, SI
miha.budja@uni-lj.si

ABSTRACT – *Paper discusses Early Neolithic seals, contracts and tokens in the context of Neolithization processes in southeastern Europe. Paper analyses the assemblages, contexts and the patterns of regional and interregional distributions. The results contradict traditional models as the objects appearance and distributions can no longer support the models of colonization, demic diffusion and population replacement in the context of the transition to farming in the Balkans. The paper argues they were well embedded in the Early Neolithic Balkans* koine*, where the transformation of hunter-gathering into farming societies took place in an arena of selective integration of the new technologies and social practices as much as the result of intensive connections and exchange networks.*

IZVLEČEK – *V članku obravnavamo pečatnike in druge predmete simbolnega pomena v procesu neolitizacije jugovzhodne Evrope. Povezujemo jih z menjavo dobrin in socialnimi stiki. Analiziramo kontekste v katerih se pojavljajo in njihove distribucije. Te ne podpirajo modelov demske difuzije, kolonizacije in menjave populacij, na katerih sicer temeljijo razlage prehoda h kmetovanju. Ugotavljamo, da so dobro umeščeni v zgodnjeneolitski balkanski* koine*, kjer je bilo preoblikovanje lovskih skupnosti v poljedelske posledica selektivnega prevzema novih gospodarskih strategij, tudi s pomočjo stikov in menjav.*

KEY WORDS – *Neolithization; Balkans; social networks; seals; contracts and tokens*

PRELUDE

Asia Minor

In the late twenties of the previous century at the Nuzi site, north of Babylon in northern Iraq, a hollow, egg-shaped envelope was recovered. When opening it the excavators found that, as they described, it held forty-nine "pebbles". The envelope (bulla) bearing the surface cuneiform inscription as follows: "*21 ewes that lambed, 6 female lambs, 8 full-grown rams, 4 male lambs, 6 nanny-goats that kid, 1 billy goat, 2 female kids. Seal of Ziqarru (the shepherd)*. The number of listed animals corresponds to the number of "pebbles", and it was hypothesised they represent the counters "*abnati*" mentioned in the text. Neither their shapes, nor the material of which they were made were described. They were simply referred to as "pebbles" and separated from their envelope, and can no longer be identified. However, the counters, the list of animals, and the explanatory cuneiform text were believed to have been used for book-keeping, each animal of the flock being represented by a stone held in an office in a container (*cf. Schmandt-Besserat 1992.8–9*).

In the 'sixties and 'seventies small clay cones, spheres, and tetrahedrons enclosed in a globular clay envelope from Susa, dated to a proto-literate period, bearing well preserved seal impressions have been interpreted as calculi, counters that stood for commodities. It became broadly accepted that that the first impressed signs of writing reproduced the shape of the former calculi.

In the 'eighties it was recognized that identical small clay artefacts – but not envelopes – were found at Near Eastern Neolithic sites. They were identified as tokens that might have been used as counters in an accounting system with no discontinuity between 8000 and 3000 BC, and it was hypothesised also that they represent a prelude to writing (*Schmandt-Besserat 1992*).

Southeastern Europe

In European Neo-Eneolithic contexts almost identical artefacts were determined as gaming pieces and "coniform figurines" since the second volume of *The Prehistoric Vinča* was published in the thirties (*Vasić 1936*).

In the 'sixties and 'seventies some of them were identified as "ear studs", "ear plugs", "nose plugs", "decorative and other objects", "spheres and button beads" (*Milojčić 1960.335; Theocharis 1973.299, 301, Fig. 212, 238, 270*). They have been discussed (in eighties) as the markers of an early farming settlement in the Balkans, whether in the contexts of demic diffusion spread of farming in Europe or the genesis of the Balkan-Anatolian complex of the Early Neolithic (*Makkay 1984; Renfrew 1987*). The signs incised on the round base of a Karanovo (VI) stamp seal have been recognized as the earliest European writing system (*Mikov, Georgiev 1969.10–12, 13*).

A set of clay and stone artefacts described as "*pintaderas*" (*Cornaggia Castiglione 1956*) were re-defined as "stamp seals" in the 'eighties (*Makkay 1984*, but see also *Dzhanfezova 2003.97–108*). The Karanovo seal was determined as the bearer of the "Linear Old European Script" (*Gimbutas 1982.87*; but see also *Makkay 1984.31*). In the settlement context of the Vinča culture at Ratina a hollow zoomorphic figurine was found. X-rays were used to investigate the contents and, after opening, it was found to contain 28 black and 4 white pebbles(!). It was hypothesised that they represented the lunar calendar as the moon's cycle (28 nights) and 4 lunar phases (*Valović 1987.219–226*).

It was pointed out in the nineties that the Aegean Bronze Age stamps maintained a long tradition, as their conical shape and motifs, especially the meanders, spirals, zigzag lines, dots and cross and its variants had not changed since the Early Neolithic as they appeared in south-eastern Europe (*Younger 1992.35–54*). Numerous small ceramic and stone objects were determined as tokens used in systems of exchange and devices for recording information in the context of the transition to farming and secondary products scenario (*Budja 1992.95–109; Talalay 1993.45–46*).

Discussing the Greek Neolithic figurines, Talalay hypothesised that the "split-leg figurines" served as economic contracts or identifying tokens. They were intentionally designed so that the two attached halves could be easily separated and united. Ethno-historical analogies indicate that the artefacts designed for intentional splitting serve either as contractual devices or as identifying tokens between individuals or groups. The archaeological evidence in Peloponnesus shows the pattern of six Neolithic sites where approximately twenty such fragments were found. The sites are all accessible to another, lying one-half to several days journey away, and the artefacts are supposed to have symbolized an agreement, obligation, friendship and common bond. This means, in consequence, that the sites/communities were bound into an interactive unit, and the artefacts – contractual devices or identifying tokens – could have been used in a variety of contexts as a "down the line" mode of exchange, or to identify messengers between villages, particularly in times of crisis (periodic floods), as symbols of future obligations among groups or individuals and as the markers of inter-village marital connections (*Talalay 1993.45–46*).

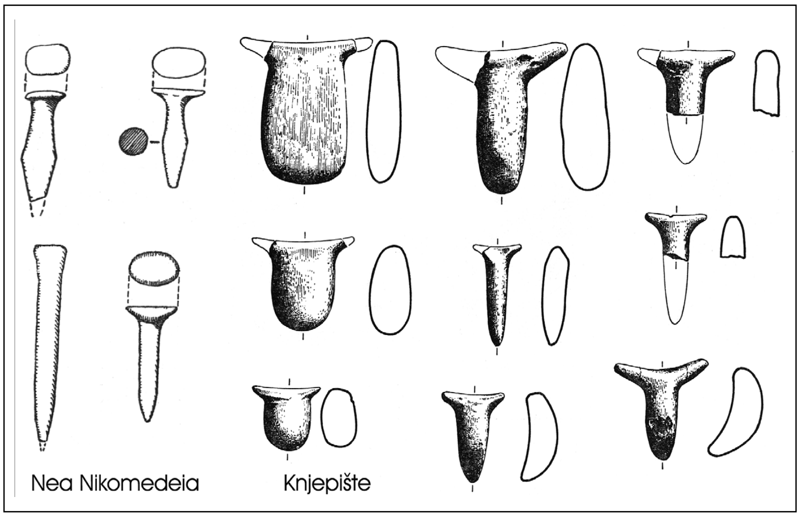


Fig. 1. "Pins " (left) and "zoomorphic amulets" (right) (After* Stanković 1989/1990(1991).35–42, T.1 *and* Rodden 1962.209–288, Fig.11*).

Tokens in Levantine Neolithic contexts

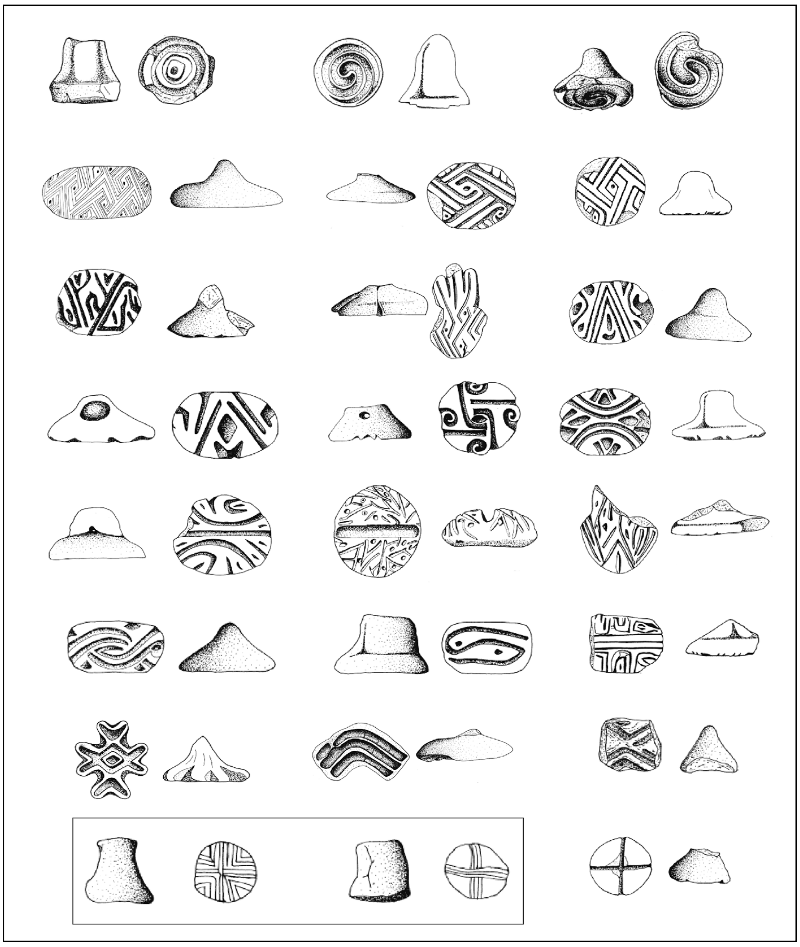
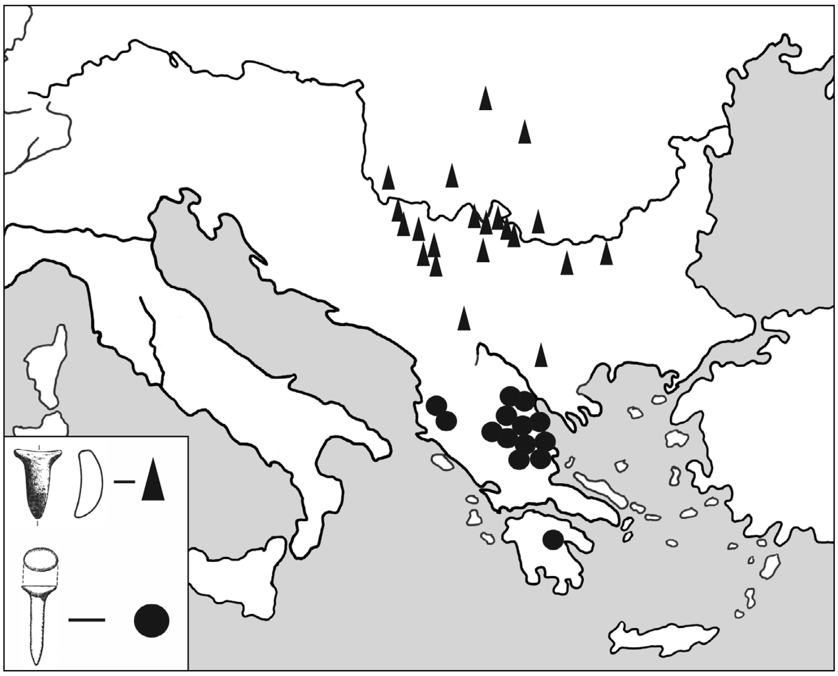


Fig. 2. Catalhüyük "seals" assemblage (after **Türkcan 1997, on-line***).*

As Schmandt-Besserat pointed out, the token system appeared around 8000–7500 BC, and the first assemblages of counters consisted mainly of cones, spheres, disks, and cylinders. These plain tokens continued to be used to the very end of the system in the third millennium. The cones represent eighteen, and the spheres forty percent of a collection of some 9000 tokens collected over the entire Near East. Both shapes were also among the tokens most frequently stored in archives in clay envelopes. The appearance of plain tokens coincided not only with agriculture, but with a new settlement pattern characterized by larger communities, which suggests that a system of counting and record-keeping of goods became necessary when survival depended on the domestication of grains and accumulating agricultural produce. Tokens occur in the third phase (Mureybet III) ca. 8000–7500 BC, when the hamlet had grown to become a village covering 2 or 3 hectares. It is estimated that the community then exceeded the number of individuals manageable in an egalitarian system. The first token assemblage probably coincided with the advent of a ranked society characterized by a new type of leadership overseeing the community resources. In numerous sites the counters were located in storage areas. At the sixth millennium BC site of Hajji Firuz in Iran a cluster of six cones were located in a structure showing no trace of domestic activities such as cooking or flint chipping. The building itself differed from the usual domestic architecture. It was smaller, consisting of a single room, instead of the normal two-roomed units. Moreover, unusual features, such as a low platform and two posts, were erected inside. It was hypothesised on the basis of sequential deposits in a rubbish pit that the layers of trash that could be distinguished according to the seasons revealed that tokens were most often associated with early summer deposits. The excavator noted, therefore, that the counters were discarded in the traditional season for plenty, after the harvest and threshing, when the crops would be stored. It might suggest that transactions were made in the course of the year to be completed at the time of the harvest. These plain tokens continued to be used to the very end of the system in the third millennium.

The token system was a medium of communication, and the tokens were frequently found in clusters varying in size from two to about one hundred counters. The clusters seem to indicate that the accounts kept in archives by means of tokens dealt with small quantities of different kinds of commodities. The system worked according to the most simple and basic principle of one to one correspondence, as in matching each unit of a set to be recorded with a token. The evolution of the token system seems to reflect an ever increasing need for accuracy. This is exemplified by tokens dealing with livestock, as the early plain cylinders and lentoid disks apparently stood for "heads of livestock", whereas the fourth millennium complex tokens indicated the species, sex, and age. The transition from counters to script occurred when tokens were stored in an envelope (bulla), and impressed signs on the outer sur-



Map 1. Spatial distributions of "zoomorphic amulets" (▲) and "pins" (●) (after* Stanković 1991.35–36; Jovanović 1968.15–16; Garašanin 1979. 104; Karmanski 1987.101–106; Matsanova 1996.109; Kalicz 2000.309; Perlès 2001. 288*). List of sites plotted on the map: Gediki, Magoula Koskinas, Sesklo, Soufli, Achilleion, Zappeio, Ayios Georgios, Larisas, Elasson, Nea Nikomedeia, Yannitsa, Dendra, Rudnik, Divostin, Lug kod Zvečke, Kozluk Kremenjak, Grivac, Banja, Dobanovci, Kučajna, Drenovac, Donja Branjevina, Lepenski Vir, Kamenicki potok, Knjepište, Velešnica, Rakitovo, Vaksevo, Koprivec, Cuina Turcului, Ocna Sibiului, Gura Baciului.

face appeared to record not only the numbers, but also the shape of tokens inside: circular impressions for discs and spheres, conical impressions for cones. The graphic symbols on the surface of the envelope thus mark the transition between tokens and the first system of writing in the context of the evolution from tokens to markings on envelopes and impressed signs on tablets (*Schmandt-Besserat 1992.161–165*).

Seals, contracts and tokens in south-eastern European Early Neolithic contexts

It is rather obvious that contracts and tokens have been a neglected subject in European Neolithic studies. As we have mentioned elsewhere, their significance was due to an interpretative taphonomic filter marginalised to the level of decorative objects. The Thessalian objects have been described as "earplugs" and "decorative and other objects" and some researchers still believe the "stamp seals" were used to decorate cloth with stained or dyed patterns, a practice which flourished in Greece until fairly recently (*Perlès 2001.252–253*). From this point of view, however, it is impossible to ignore the fact that there is no evident correlation in the early Neolithic household context of warp-weighted looms and stamp seals, although it was postulated that textile art in the context of early Starčevo-Körös culture appeared in late 7th millennium BC (*Barber 1991. 93–94*) and that there was a well-defined distribution of stamp seals attested in the region (*Makkay 1984*). We should not overlook in the Aegean a several thousands year tradition in the manufacturing of clay cone seals with standardized motifs almost identical to those in the Balkans Early Neolithic. In the Helladic Period the function of these stamps was part of an industry that took place less within bureaucratic structures, but mainly in areas of domestic activities. Stamps carrying spirals, zigzags, crosses, and dots decorated storage vessels, hearth rims, frying pans and exported pottery (*Younger 1992. 35–54*).

There are undoubtedly technical and individual stylistic analogies between the Anatolian and Balkans "earplugs" and "stamp seals" and it is broadly accepted that the latter originated in Central Anatolia, since the Çatalhüyük and Bademagaci stamps predate all the others. But it is also true that the motifs on Early Neolithic stamps in the Balkans were more heterogeneous. It can be indicative, if we accept the idea that the incised patterns on the face sides of the stamps are the indicators to understand the relevant function and meaning behind the concepts which constitute the patterns or symbols, that the Balkan patterns regularly consist of zigzags, spirals, dots and labyrinth patterns, while the Anatolian comprises pseudo-meanders, meanders, and fragments of curvilinear ornaments in fantastic styles (Fig. 2).

Seal production and their distribution in central and south-western Anatolia did not change very much over the 7th and 6th millenniums, as the series with a rectangular-shaped stamp surface disappeared in this region about 5500 cal BC. No traces of paint or dye were found, and any sealing is available or any positive evidence which can show on which material were they applied. It was hypothesised, therefore, that the seals at Çatalhüyük, Bademagaci, Höyücek, Kuruçay and Hacilar were used to stamp perishable or edible items, as the village or neighbourhood bread was made communally, and each family stamped the ones belonging to them. They might have been applied on baskets or bags to show ownership or to classify the contents in the communal store rooms of the settlements. Two small stamps (Fig. 2), on the other hand, directly contradict the notion of seal use with their smooth patterns which does not leave a recognizable mark or trace, and it is reasonable to suggest they were used as "calculi" or the tokens as a counting devices (*Türkcan 1997*).

However, "earplugs", "pins" and seals maintain a central position in the context of Neolithization of the Balkans as the indicators of the initial links to the Near East in general and to Hacilar and Çatalhüyük in particular, since Milojčić (*1959(1960).6; 1960.327–328*) conceptualized the pre-pottery Neolithic in Greece. It is well known that, in modelling the cultural and linguistic transformations during the early spread of farming in Europe, used the "studs", "nails" and "stamp seals" as signifiers of a "marine version of the wave of advance model", and markers of early farming settlements in the Balkans (*Renfrew 1987.169–170*). Perlès (*2001; see also in this volume*) actualized recently the idea they were well embedded in the baggage of the immigrants as stated that they could have been correlated with the late outcome of the Near Eastern PPNB exodus. The first pioneers of Greece have been hypothesised as adventurous individuals, continuing the "great exodus", who followed different pathways from their original ancestral home to their ultimate settlement in Greece, bringing their most valuable symbols and objects. The latter relates to "earplugs" and "pins", and it was suggested that they were personal ornaments, which "clearly indicates that few individuals, in fact, wore them" (*Perlès 2001.288, Note 8*). The restricted geographical distribution of the objects that was hypothesised in Thessaly is being used as a key argument in modelling the "insular colonisation" and rapid displacements over long distances of small groups that ultimately settled in favoured environments, far from their original homes (*Perlès 2001. 288–89*; in accordance with *van Andel and Runnels 1995.481– 500*).

Similar objects made of burnt clay, bone and various fine rocks have been identified in numerous Early Neolithic sites in the northern Balkans. They have been described as "zoomorphic amulets", "la-

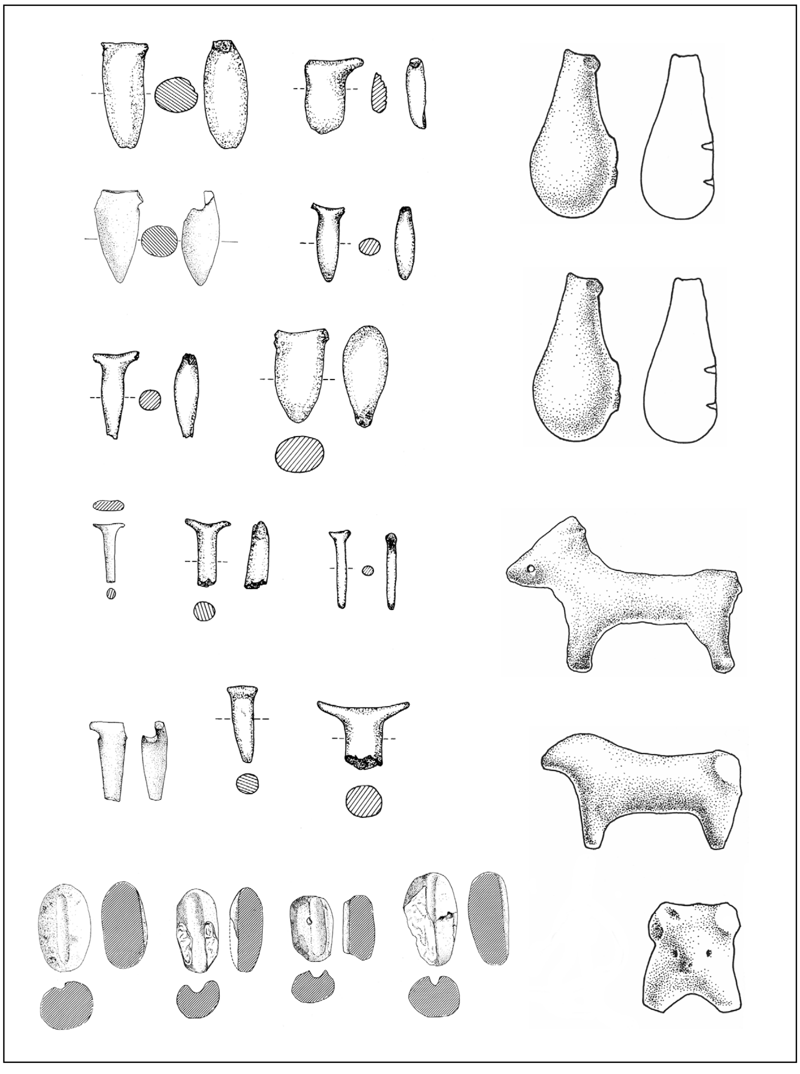


Fig. 3. Divostin. Assemblage consists of "zoomorphic amulets", "split-legs figurines", miniature "zoomorphic figurines", and "ceramic cereal-grain shapes" was deposited in a "trapezoidal shaped hut 4" (**Letica 1988.173–201; McPherron et al. 1988.325–336; Bogdanović 1988. 35*****).***

brets" and "bucrania" connected with a cult in which the bull "represents the centre of all power" (*Stanković 1989/90(1991).35–42; Matsanova 2003.65*). They are extremely standardized in shape, and as the upper parts terminate in schematic horn projections, they do reflect the image of bull heads on the one hand and separate them from the Thessalian "pins" on the other (Fig. 1). We have already pointed out elsewhere that their appearance corresponds well with the dispersal of monochrome-impresso pottery in the Balkans (*Budja 1999; 2001; 2003; Kalicz 2000.298–299*), but this does not mean they did not appear in later contexts of the Starčevo and Körös cultural complexes in the Balkans, the Carpathian Basin and Transylvania (Map 1). A well-defined series is embedded in the Donja Branjevina settlement context associated with monochrome pottery (6080–5890 cal BC at 1σ) that was stratigraphically and chronologically separated from the layers with white painted pottery (*Karmanski 1987.T 1; Whittle et al. 2002.72, 81–82*).

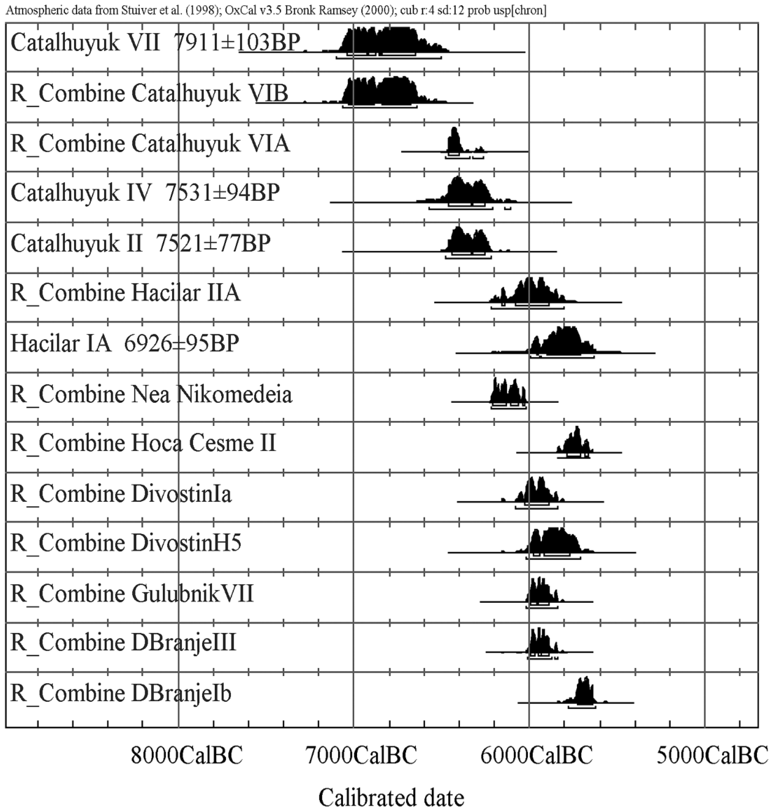


***Fig. 4. ¹⁴C. Probability distribution plot of radiocarbon dates correlating with the contexts and assemblages at Catalhüyük, Hacilar, Nea Nikomedeia, Hoca Çesme, Divostin, Donja Branjevina and Gālābnik mentioned in the text*[1].**

At Divostin there were 35 ceramic and marble zoomorphic amulets found in an Early Neolithic settlement context. The majority of them were deposited in a "semi-subterranean trapezoidal shaped hut 4" located in the central part of the site. They are associated there with "split-legs figurines", miniature zoomorphic figurines, and "ceramic cereal-grain shapes" (*Letica 1988.173– 201; McPherron et al. 1988. 325–336; Bogdanović 1988.35*) (Fig. 3). There were a few fragments of white painted pottery found, as was noted recently, but it is still not clear whether they correlate to the earliest settlement phase and trapezoidal huts, or later rectangular houses (*Perić 1998(1999).11–33; Tasić 2003.181–191*). The assemblage can be indirectly radiocarbon dated, as the neighbouring hut 5 was embedded in the period 6090–5740 cal BC at 1σ (phase Ib) (*McPherron et al. 1988.380, Table 14.1, Sample No. 1–3*). It is worth remembering the local domestication of aurochs was hypothesised at the site, and that the practice of keeping large numbers of cattle might have been an indicator of status (*Bökönyi 1988.431*).

However, the primary colonized area in the Balkans was marked by the eight sites in Thessaly, where the "earplugs" and "pins" seem to be well embedded in the "Initial Neolithic" (*Perlès 2001.287–288*). It seems that, ironically, for the time being the almost

1 ***Nea Nikomedeia*** (OxA-4281, 7100±90; OxA-4280, 6920±120; OxA-3876, 7370±90; OxA-3875, 7280±90; OxA-3874, 7370±80; OxA-3873, 7300±80; OxA-1606, 7400±100; OxA-1605, 7400±90; OxA-1604, 7340±90; OxA-1603, 7050± 80); ***Catalhuyuk VII*** (P-1363 7911±103), ***VIA*** (P-1375, 7661±99; P-772, 7572 ±99; P-827, 7579± 86; P-778, 7538±89; P-769, 7507±93), ***VIB*** (P-1364, 7936±98; P-1362, 7904 ±111), ***IV*** (7531±94), II (7521 ±77); ***Hacilar IA*** (P-315, 6926±95) and ***IIA*** (P-316, 7170±98); ***Hoca Cesme II*** (GrN-19310, 6890±280; GrN-19311, 6890±65; GrN-19780, 6920±90; GrN-19781, 6900±110; GrN-19782, 6890±60; GrN-19356, 6520±110); ***Divostin Ia*** (Bln866, 7060±100; Bln866a, 7200±100; Bln931, 7050±100); ***Divostin Hut 5*** (Bln823, 7050±180; Bln824, 6970±100); ***Donja Branjevina III*** (OxA8557, 7080±55; GrN15974, 7155±50; GrN15975, 6955±50; GrN15976, 7140±90) and ***Ib*** (OxA8556, 6775±60; OxA8555, 6845±55), ***Gālābnik VII*** (Bln3579, 7030±70; Bln3579H, 7220±80; Bln3580, 7120±70; Bln3582, 6950±70). After *Pyke and Yiouni. 1996.195; Thissen et al. on-line; McPherron et al. 1988.380. Table 14.1, Sample No.1–3; Whittle et al. 2002.2, 81–82; Boyadziev 1995.180*).

identical items (earplugs) at Hacilar, Mellaart (*1970.160*) determined as a pestles for grinding cosmetics. At Hoca Çeşme, on the other hand, there were no "earplugs", "pins" or "stamp seals" found in the phase IV that is believed to objectify the exodus of Anatolian farmers and the establishing of their settlement by the estuary of the Maritza River in Eastern Thrace (*Özdoğan 1997.19–27*). There were seven seals, found together with white-on-red painted pottery that is recognised as a "significant innovation" in the later phase II (*Özdoğan and Başgelen 1999.218–219, Fig. 25; Özdoğan, personal communication*).

It has been hypothesised that the stone and clay stamp seals testify to a similar pattern of restricted geographical distribution in the southern Balkans (*Perlès 2001.252, 288–289*), but mark a distinctively wider dispersal in the north, in the context of the Starčevo-Körös and Karanovo cultures (*Makkay 1984*). While they are in Thessaly and western Macedonia in Greece embedded in a later period of initial colonization and linked to painted pottery appearance, they are believed to indicate in the northern and eastern Balkans and the southern Carpathian Basin "a breakthrough of the elements of the Balkan-Anatolian complex of the Early Neolithic" (*Garašanin 1979.103*), and that they were connected there with the "general emergence of the earliest South-East European pottery industry under formative Anatolian influences" (*Makkay 1984.100–101*).

On present evidence stone and clay seals in the "Protosesklo" period (*Onassoglou 1996.163*) occur only as isolated and sporadic finds in Argissa, Nesonis, Sesklo, and Pyrasos (*Perlès 2001.252*), but it is not the same in Greek Macedonia, where at Nea Nikomedeia they appear in large numbers. There were twenty-one seals found in the settlement and all are of clay. The site was hypothesised to have a central position in transmitting "influences" from Anatolia to the Balkans and the Carpathian Basin (*Makkay 1984.81*).

In discussing the seals' appearance and distribution in the contexts of "connections" and "cultural similarities" between the early farming site of Nea Nikomedeia and farming centres in Anatolia it has to be pointed out that the Nea Nikomedeia seals package predates the Hacilar seals. There is no doubt, however, that the Çatalhöyük clay seals predate both (Fig. 4). There were thirty-two seals found at Çatalhöyük, mainly coming from Mellaart's excavation in the 'sixties, and only 4 of them have come from the ongoing excavation. The majority of them are from Level II, III, IV, VI, while one is from Level VII (*Türkcan 1997 on-line*; for dating see *Thissen et al. on-line*). They seem to have been used for stamping, but

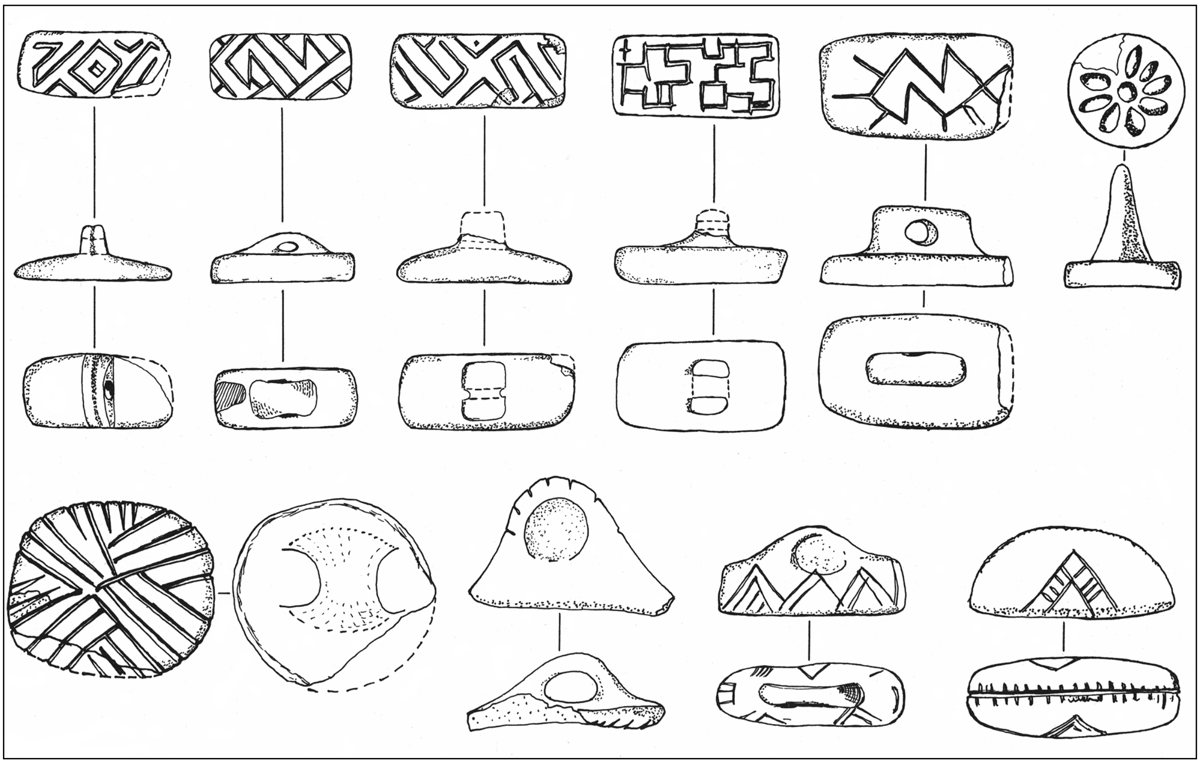


Fig. 5. Hacilar "seals" assemblage (after* Mellaart J. 1970.164, Fig. 187*).

there are some small cylindrical stamps that contradict the seal use, as they have smooth patterns which do not leave a recognizable mark. We noted above that they might have been used as counting devices (*cf. Türkcan 1997 on-line*).

In Hacilar, three of the seven seals are unstratified, and the others all come from Hacilar IIB (Fig. 5). The settlement phase was not direct radiocarbon dated, but the terminus post-(IIA) and ante quem (IA) can be easily anchored, since the comments on the Hacilar ^{14}C dates are available. The seals are embedded in a narrow time niche determined by the dates 6090–5890 (for the IIA) and 5900–5720 cal BC at the 1σ (for the IA) settlement building levels (*Mellaart 1970.164*; for dating see *Thissen on-line*).

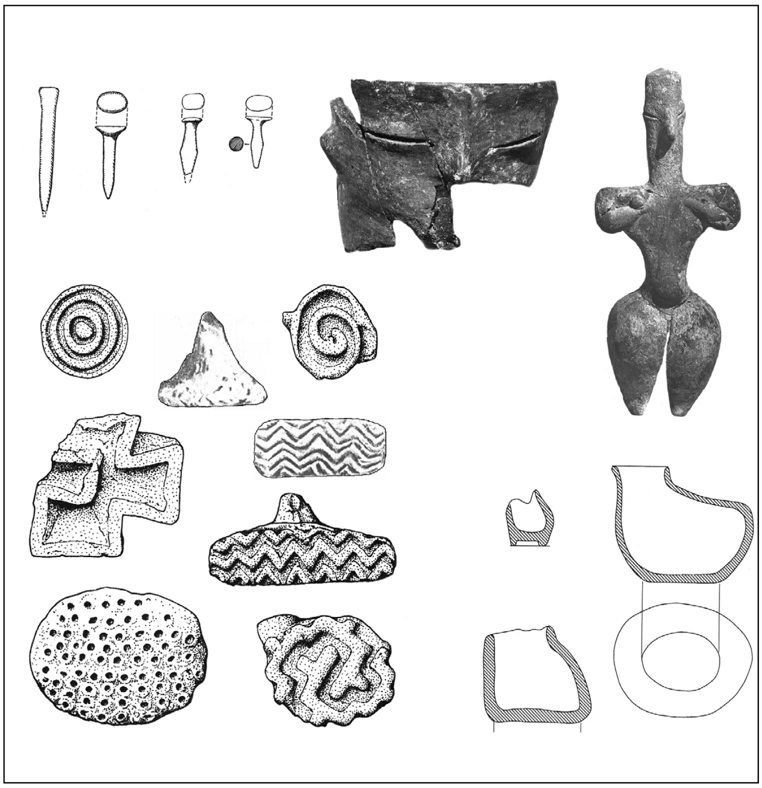


Fig. 6. Nea Nikomedeia assemblage consists of "pins", "seals", anthropomorphic vessels and figurine and askoid vessels (after* Theocharis 1973.Figs. 18, 219; Rodden 1962.209–288, Fig.11; Perlès 2001.Fig. 11.6; Makkay 1984.Fig.4.6*).

At Nea Nikomedeia there are twenty-one seals embedded in the settlement context of "a relatively short period of occupation" in the interval of 6170– 6060 cal BC, as the sum probability distributions of the calibrated dates at the 1σ confidence show (*Pyke and Paraskevi 1996.48; Thissen 2000. 291–203*). They are contextually associated with red and white painted pottery, anthropomorphic vessels, and a large vessel most probably used for the long term storage of foodstuffs and stone pins in general, but we do not know how they relate to a large building in particular, since it was recognized as a "shrine" supposedly having ritual and cultic functions. Beside five female figurines, outsized greenstone axes, unused large flint blades, askoid vessels, and several hundred clay 'roundels' of unknown function" were found in the corner of the building (*Perlès 2001.271; Pyke and Paraskevi 1996.88–89, 191, 103, 191–192*) (Fig. 6). However, on the base of "exotic flint", Halstead, to the contrary, hypothesised that the house belonged to a family involved in long-distance trade (*Halstead 1995.13*).

Not far to the north a similar assemblage was embedded in the settlement context at Rakitovo in the West Rhodopi Mountains. The site, located at 800 m above sea level, is believed to be of a short period of occupation that correlates to the Karanovo I phase (*Matsanova 1996.105–128; Macanova 2000.59–74*). Two clay seals, identical in shape, size and ornamentation (a horizontal zigzag and shallow holes arranged in columns) to those at Nea Nikomedeia, were found in an almost identical context. The settlement consists of surface buildings with trapezoidal plans, and in some of them, evidence of food grain processing and storage is available. But there are three buildings that differ from the others. Two have been interpreted as "shrines", the third as a communal building. Seals were found in both contexts. What is to be pointed out is that the associated assemblage consists of anthropomorphic (askoidal) and zoomorphic vessels, clay and marble anthropomorphic and zoomorphic figurines, split-leg figurines, clay tripods and tables, a model house, white painted pottery and thirty-three zoomorphic, clay amulets (*Matsanova 1996.105–127; 2003.66–70; Radunčeva et al. 2002*) (Figs. 7.1, 2). Further to the north, in the Danube region, in the context of the Starčevo culture, an almost identical assemblage can be reconstructed at Donja Branjevina, even though the stratigraphy was not well defined due to unsystematic and inconsistent research procedures. However, there was a seal bearing a zigzag pattern identical to the seals at Rakitovo and Nea Nikomedeia. It was contextually associated with white painted pottery, anthropomorphic and zoomorphic figurines, split-leg figurines, numerous clay zoomorphic amulets, and clay tables (*Trbuhović, Karmanski 1993. T 3, 12; Karmanski 1875.Slika 33; 1987.T 1; 1978a.T 1.4–6*; see also *Whittle et al. 2002.72, 81–82; Perić 1998 (1999).11–33; Tasić 2003.181–191*) (Figs. 8. 1, 2). We can hypothesise a similar pattern even in the Carpathian Basin in the Tisza region, where five clay stamps were found at Hódmezövásárhely-Vata site of the Körös culture. They differ from each other regarding shape and decoration. Ornamental patterns of zigzags, meanders, and chevrons clearly link the site to the Balkans in general and Nea Nikomedeia in particular. The lack of excavation records does not permit a reconstruction of the precise contexts and associated finds, but there were anthropomorphic and zoomorphic figures, split-leg figurines ad clay tables found in the settlement (*Makkay 1984. 27–28, 37.Figs. 5, 7, 9, 10, 11; Kutzian 1947. Plates 35, 36, 43, 44, and 46*). A similar context can be recognized even in the Šar-Pindus mountain range, west of Nea Nikomedeia. A clay seal at the Vashtëmi Early Neolithic site was contextually associated with white painted and impresso pottery, anthropomorphic and zoomorphic figurines, split-leg figurines, clay tables, clay pins, and bi-conoid clay token. The ornamentation, a flower in the centre of the seal base, links the site to south-west Anatolia, where a similarly shaped and ornamented seal was found at Hacilar (*Korkuti 1995.41–57, Taf. 14–15*, for the token see *Schmandt-Besserat 1992.222. 9:1, 4; Mellaart 1970.187. 6*) (Fig. 9).

Before we continue, it must be pointed out that numerous Early Neolithic seals in the Balkans can not be dated precisely. They are still laxly embedded in the Early Neolithic contexts (*Makkay 1984*), but as was displayed recently, they do not appear in the initial Neolithic, whether it is identified as the "Monochrome stage of the Balkan early Neolithic" in Bulgaria, "Proto-Starčevo" in Serbia, "Achileion", or "Initial and Early Neolithic I" in Greece. It seems that their appearance in the region correlates chronologically and geographically well with white painted pottery distribution in the central, eastern and northern Balkans (*Todorova 1995.83; 1998.37; Korkuti 1995.41–57; Onassoglou 1996.163; Perlès 2001.112, 289*) and, that they must have been well embedded in regional social patterns and traditions, maintaining a long presence, whether in the household, or cult and ritual contexts.

Interpreting the typological parallels in shapes and decorative patterns with Anatolian seals in terms of direct filiation, Makkay (*1984.73–75; Todorova & Vajsov 1993.233–234, Figs. 227–228*) has already pointed out regional differences, as the labyrinthine motifs that are the common characteristic in the Balkans are completely lacking in Çatalhöyük. It is instructive at this point that they did appear at Hacilar, in Anatolia, within a very narrow time niche, and the Nea Nikomedeia seals (at least) predate them, as we mentioned above (see Fig. 4). The patterns of "clockwise spirals" and "the cruciform design that form a quadranted circle", however, form very close parallels with the Çatalhöyük seals of levels VII–VI and IV, which evidently predate the seals from the Balkans. It is broadly accepted that they represent the first precursors of their kind in Anatolia, and very probably, in south-eastern Europe. The Early Neolithic dispersals of the others, such as

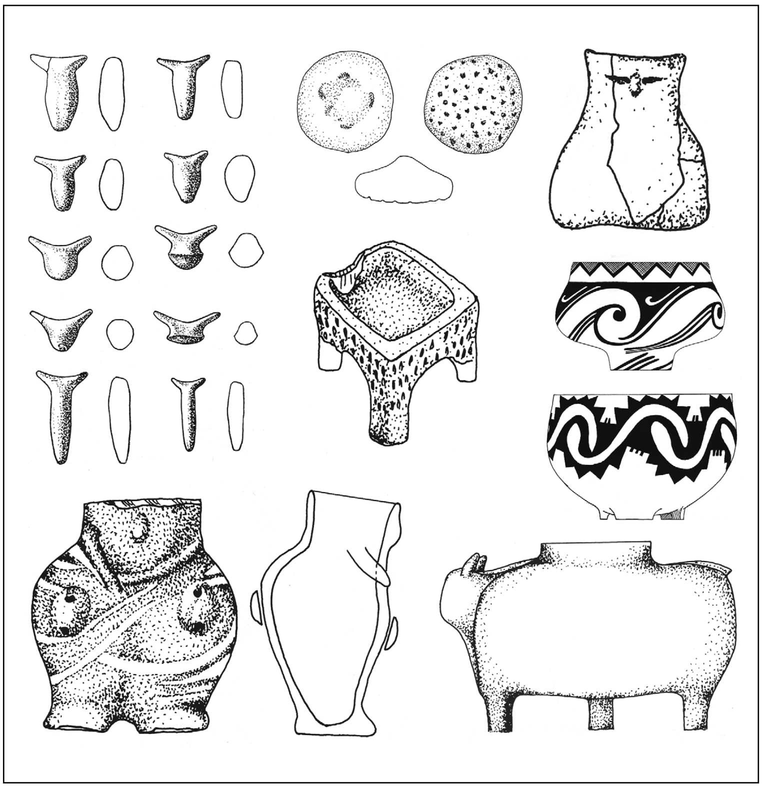


Fig. 7.1 Rakitovo. Assemblage consists of "zoomorphic amulets" and "seal", "altar", "anthropomorphic and zoomorphic vessels" and "white painted pottery" was deposited in trapezoidal shaped "Building No. 8" (after* Matsanova 1996.Tabs. 3, 4, 6, 8–10, 12; 2003.65.Figs. 1–4; *see also* Radunčeva et al. 2002.17–22, 32–33*).

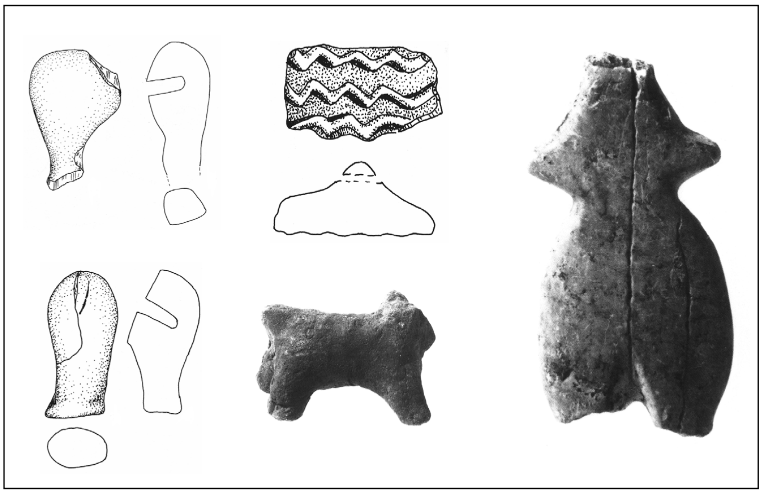


Fig. 7.2. Rakitovo. Assemblage consists of "seal", "split-legs figurines", "zoomorphic figurines" and female figurine (after **Matsanova 1996.Tabs. 3–4, 12***).*

horizontal wavy and zigzag lines and impressed shallow holes arranged in columns and lines, were regionally bounded within the Balkans. However, the manner, mechanism and contexts of their dispersals and functions are still subjects of discussion.

Assemblages, contexts and inter-regional distributions

Three patterns can be recognised in the palimpsest. The first relates to the regional dispersal of "earplugs", pins, and zoomorphic amulets. The objects were hypothesised as being directly connected with the colonisation of south-eastern Europe. The spatial distribution of "earplugs" does show a pattern of inter-regional dispersal, since they have been found outside Thessaly on the Adriatic coast (Vrbica) and in the northern Balkans (Divostin). The spatial distribution of pins and zoomorphic amulets were exclusive (Map 1). While the pins were clustered in the southern Balkans (Thessaly), the zoomorphic amulets were dispersed in northern regions. It was hypothesised that the pattern might have been linked to social networks that predate farming and maintained a long tradition (*Budja 1998.219–235; 2003.357; Kalicz 2000.309*). It is not by coincidence they are evidently clustered in Danube region in the areas that had been settled initially by hunters and gatherers. The assemblages at Lepenski Vir, Divostin and Rakitovo were incorporated in the trapezoidal shaped buildings that clearly maintain the regional hunter-gatherers architectural principles.

The second relates to the seal assemblages sketched above. They are integrated into sets of prestige or symbolic objects found in settlement deposits and in a few building contexts. Their appearance may have been connected to *female figurines, anthropomorphic vessels, and clay tables or "altar"* phenomena. It might have not been by coincidence, but by function that they are associated with *pins, zoomorphic amulets and split-leg figurines*. We mentioned above that the latter were intentionally designed so that the two attached halves could be easily separated and united. It has been hypothesised already (*Talalay 1987.161–169; 1993.45–46*) that they could have been used as contractual devices or identifying tokens in a variety of contexts as a "down the line" mode of exchange, or to identify messengers between villages, particularly in times of crisis (periodic floods), as symbols of future obligations among groups or individuals, and as markers of inter-village marital connections. We have to point out also that the seals were associated with *zoomorphic vessels* and numerous miniature clay *zoomorphic figurines* in the form of cattle, sheep, and goats. It is not only that they might have represented the practice of keeping a large numbers of animals or indicating status, but a system of animal counting and record keeping. What is to be pointed out is the fact that the most intriguing assemblages at Nea Nikomedeia, Rakitovo and Divostin were embedded in settlement contexts of relatively short periods of occupation (*see above and cf. Pyke & Yiouni 1996; Macanova 2000; McPherron & Srejović 1988*). They were related to buildings different from the usual domestic architecture. At Nea Nikomedeia the large building was recognized as a "shrine" supposedly with ritual and cultic functions (*cf. Perlès 2001*). At Rakitovo they were found in two buildings. The first (No. 8) was identified as a cult structure and the second (No. 10) as a communal building. The excavator noted that of the whole village only in the first building was a large concentration of painted pottery found beside two anthropomorphic vessels, a clay table or altar, twelve zoomorphic figurines and a seal (*Radunčeva et al. 2002; Matsanova 2003.65–70*) (Fig. 7.1).

The third pattern relates to the spatial distribution of seals (Map 2). It should be emphasised from the very beginning that the Nea Nikomedeia clay seals assemblage consists of almost all the shapes and 10 of 21 ornaments that circulated in the Balkans in the Early Neolithic (see *Todorova & Vajsov 1993.Figs.*

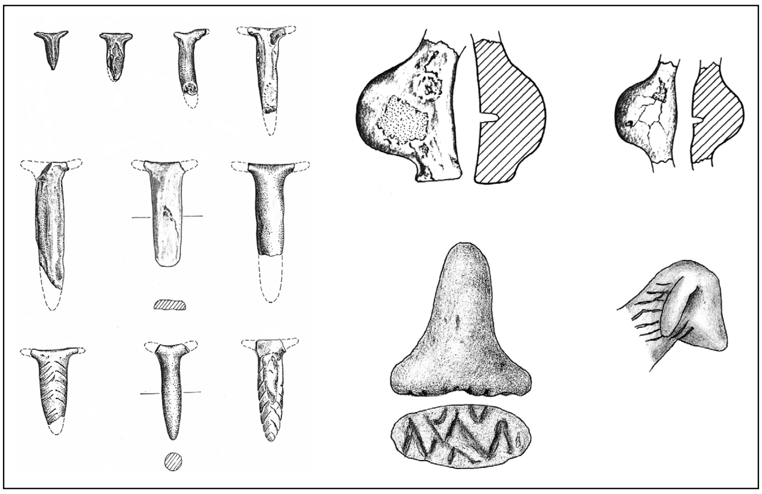


Fig. 8.1. Donja Branjevina. Assemblage consists of "zoomorphic amulets", "seal", "split-legs figurines" and "zoomorphic figurines" (after **Karmanski 1987.T. 1; 1987a.T1.4–5; Trbuhović and Karmanski 1993.T4.3, 5.6*)*.**

227, 228). From this point of view the assemblage can be understood as paradigmatic and embedded in a narrow span of 6170–6060 cal BC at 1σ (see above).

In plotting the Early Neolithic seals it is evident that they crossed a line where the pins' distribution stopped and expanded towards the northern and eastern Balkan borders. They entered into the Carpathian Basin as well (*cf. Makkay 1984*). However, evident differences appear if we plot the seal ornaments separately (Map 2). Seals bearing horizontal wavy and zigzag lines, impressed shallow holes and spirals (but not concentric circles) did not enter the southern Balkans regions, as on contrary the distribution of well known Thessalian stone seals with labyrinthine design remains (with two exceptions at Tečić and Endrőd) confined to the south. The spatial patterns do not overlap, but we can speculate that they were in circulation simultaneously, since they met at Nea Nikomedeia and, as the scarce radiocarbon dates show. We may consider the tell location in between the regional seal distributions as a juxtaposition point in inter-regional social networks. It is beyond all doubt that all the settlements mentioned above participated in the networks, whether it ran on a regional or interregional level. However, the seal distributions were more intensive in central and northern Balkans. The dispersals of spiral and horizontal wavy and zigzag ornaments show overlapping patterns of interregional seal distribution. The impressed shallow holes ornament show on contrary regionally bounded distribution that may indicate a social links between Nea Nikomedeia and Rakitovo.

We are still not able to decipher the messages they bear connecting the settlements within a hundreds or even more than thousand kilometres as the stamps embedded in the settlement contexts at Tečić and Endrőd or Vashtëmi and Hacilar show. It is believed that they correlate with an Early Neolithic social elite, as they were contextually associated with prestige items such as a half-metre long nephrite sceptre at Gălăbnik (*Todorova & Vajsov 1993.104; Todorova 1998.37*), or painted pottery, anthropomorphic and zoomorphic vessels, figurines, clay tables and altars, and "exotic flint" as sketched above. However, they might have been objects for identifying an individual or a group (clan), or to identify personal or common property for its security or a prehistoric information system which we can not yet decipher.

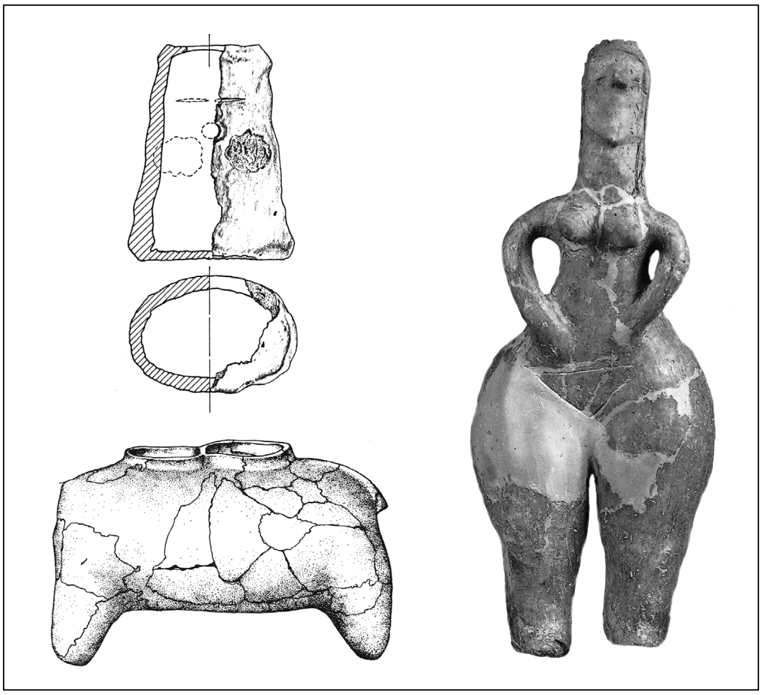


Fig. 8.2. Donja Branjevina. Assemblage consists of "anthropomorphic and zoomorphic vessels" and female figurine (after **Karmanski 1975.Sl. 33; 1987a.T 1.6; 1996.Fig. 4*)*.**

We need to point out the great relevance of the dispersal of split-leg figurines, since they appeared in settlement contexts where the seals were absent. They do not seem to be bounded within regional distributions, as they were found in the northern Balkans associated with zoomorphic amulets (Divostin), and in the Šar-Pindus Mountains (Podgori) with pins (*Korkuti 1995.Taf. 8. a–d*). The social networks may thus have been even more intensive and not necessarily correlative to prestige items only.

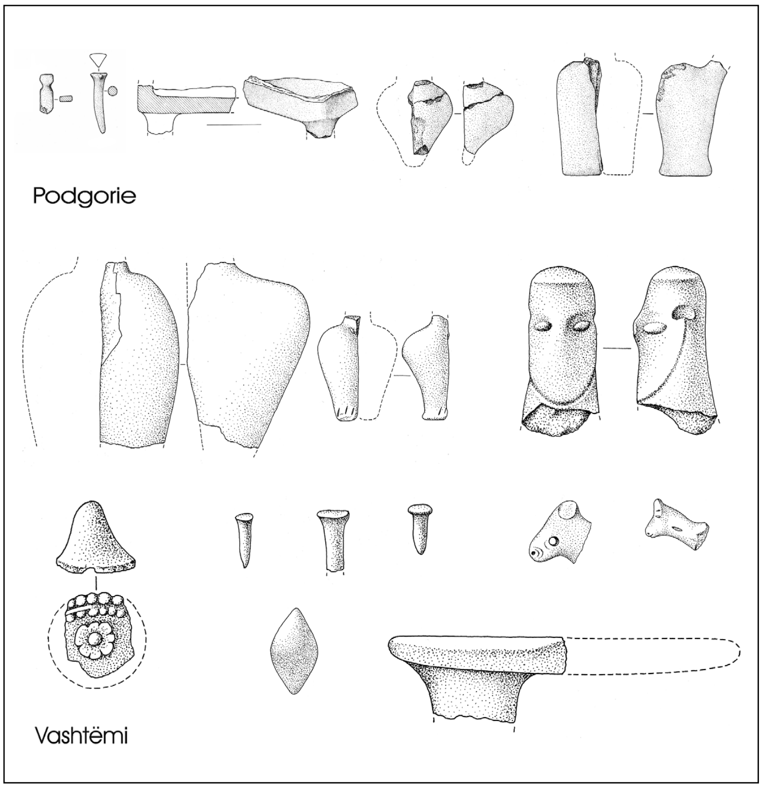
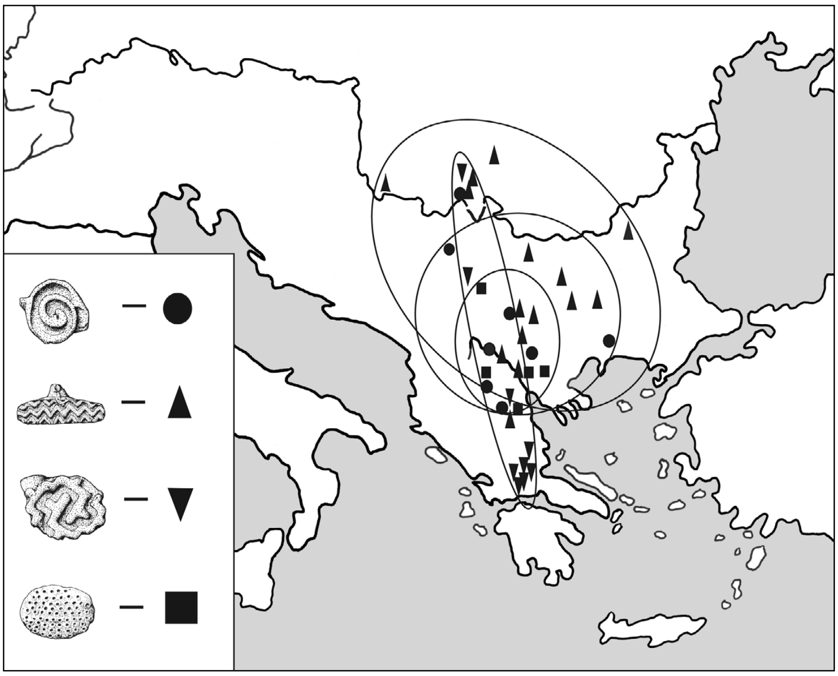


Fig. 9. Vashtëmi and Podgorie. Assemblages consist of "split-leg figurines", "clay pins", "bi-conoid" clay token, "anthropomorphic and zoomorphic figurines" and "clay tables" (after* Korkuti 1995. Taf. 8.a–d; 14–15*).

In place of concluding remarks

The objects and assemblages discussed are well standardized and distributed in the area where evidence of long-distance connections and trans-Aegean exchange networks are available well after 7000 BC (*Cherry 1990; Perlès 2001*). We may speculate, therefore, that they were intentionally incorporated in processes of social ties of reciprocity and obligation, contract and partner exchange that mostly involved single individuals or small groups within the framework of established kinship ties, marriage alliances, trading and exchange partnerships. This means, in consequence, that the objects and assemblages were embedded in a variety of contexts where sites and communities were bound into an interactive regional unit and could have been used as contractors, identifying tokens, or tokens for counting. The tokens in the Levant were frequently found in clusters varying in size from two to about one hundred counters. The assemblages were hypothesised as indicating that the accounts kept in archives by means of tokens referred to small quantities of different kinds of commodity. The system worked according to the most simple and basic principle of one to one correspondence, as in matching each unit of a set to be recorded with a token. Perhaps we may speculate that several hundred clay "roundels" deposited in the "shrine" at Nea Nikomedeia and, three miniature zoomorphic figurines, three ceramic cereal-grain shapes, six split-leg figurines and twenty-one ceramic and marble zoomorphic amulets deposited in trapezoidal shaped hut 4 at Divostin can be interpreted as identifying tokens or tokens as counting devices and contractors of reciprocity and obligation.

We have pointed out elsewhere (*Budja 2001; 2003*) that their appearance and scatters correspond well with monochrome-impresso and painted pottery distributions, and that the zoomorphic amulets correlate with hunter-gatherer societies in the northern Balkans. The patterns we recognized in the spatial and chronological distributions of pins, zoomorphic amulets and seals contradict the models of colonization, demic diffusion and population replacement in the context of the transition to farming in the Balkans. We believe they were well embedded in the Early Neolithic Balkans *koine*, where the transformation of hunter-gathering into farming societies took place in an arena of selective integration of the new technologies and social practices as much as the result of intensive connections and exchange networks. None of the objects have entered on the eastern Adriatic coast and Dinaric hinterland. We may speculate therefore that the region although adopting farming did not enter into a network of reliable integrative mechanisms through interregional exchanges and, there were social barriers that stopped the circulation of goods and/or people over middle and long-distances. The isolationism may be seen as a strong dominance of social and ideological continuity that slowed down the processes of social and



Map 2. Spatial distributions of seals (after **Makkay 1984; Todorova & Vajsov 1993*****). List of sites plotted on the map. Spiral (●): Bălgarčevo, Kurdžali, Slatino, Grabovac, Hódmezővásárhely, Rug Bair, Trn, Nea Nikomedeia. Horizontal wavy and zigzag lines (▲): Tùrkeve, Hódmezővásárhely, Donja Branjevina, Bălgarčevo, Čavdar, Gradešnica, Kazanlik, Slatino, Karanovo, Azmaška mogila, Anzabegovo, Maluk Preslavec, Rakitovo, Gălăbnik, Nea Nikomedeia. Labyrinthine design (▼): Nea Nikomedeia, Sesklo, Pyrasos, Tsangli, Philia, Achilleion, Nessonis, Tečić, Endrőd. Impressed shallow holes (■): Supska, Porodin, Elešnica, Rakitovo, Nea Nikomedeia.***

ideological restructuring of forager and hunter-gatherer communities. We hypothesised already that the boundaries in the Balkans had formed not on the base of farming and/or herding adoption but the dynamics of social networks. The incoming near eastern lineages and the difference of the values for the Balkans (~20%) and Mediterranean coastal area, including the Adriatic (~10%) as the mitochondrial DNA analysis and the maternal lines showed (*Richards and Macaulay 2000.139–151*; see also *Richards in this volume*) can be linked not to an incipient farming, but to a continuous and long-term networks of the circulation of goods and people over long distances.

∴

REFERENCES

BARBER E. J. W. 1991. *Prehistoric Textiles. The Development of Cloth in the Neolithic and Bronze Age*. Princeton University Press. Princeton.

BOGDANOVIĆ M. 1988 Architecture and structural features at Divostin. In A. McPherron and D. Srejović (eds.), *Divostin and the Neolithic of Central Serbia Ethnology Monographs 10: 35–142*.

BOYADZIEV Y. D. 1995. Chronology of prehistoric Cultures in Bulgaria. In D. W. Bailey and Panayatov I. (eds), *Prehistoric Bulgaria. Monographs in World Archaeology 22: 149–192*.

BÖKÖNYI S. 1988. The Neolithic fauna of Divostin In A. McPherron and D. Srejović (eds.), *Divostin and the Neolithic of Central Serbia. Ethnology Monographs 10: 419–447*.

BUDJA M. 1998. Budja M. Clay tokens – accounting before writing in Eurasia. In M. Budja (ed.), *5th Neolithic Studies. Documenta Praehistorica 25: 219–235*.

1999 Budja M. The transition to farming in Mediterranean Europe – an indigenous response. In M. Budja (ed.), *6th Neolithic Studies. Documenta Praehistorica 26: 119–141*.

2001 Budja M. The transition to farming in Southeastern Europe: perspectives from pottery. In M. Budja (ed.), *8th Neolithic Studies. Documenta Praehistorica 28: 27–47*.

2003 Symbolic systems in the context of transition to farming in Southeast Europe. Pottery and boundaries. In L. Nikolova (ed.), *Early Symbolic*

Systems for Communication in Southeast Europe. BAR IS 1139: 347–360.

CHERRY J. F. 1990. The first colonisation of the Mediterranean islands: a review of recent research. *Journal of Mediterranean Archaeology 3: 145—221.*

CORNAGGIA CASTIGLIONE O. 1956. Origini e distribuzione delle pintaderas preistoriche "euro – asiatiche". *Rivista di Scienze Preistoriche 11: 123–153.*

DZHANFEZOVA T. 2003. Neolithic Pintaderas in Bulgaria (Typology and Commenst on their Ornamentation). In L. Nikolova (ed.), *Early Symbolic Systems for Communication in Southeast Europe. BAR IS 1139: 97–108.*

GARAŠANIN M. 1979. Centralnobalkanska zona. In A. Benac (ed.), *Praistorija jugoslovenskih zemalja II. Neolitsko doba: 79–212.* Sarajevo.

GIMBUTAS M. 1982. *The Goddesses and Gods of Old Europe 6500–3500 BC. Myths and Cult Images.* Thames and Hudson. London

HALSTEAD P. 1995. From sharing to hoarding: the Neolithic foundations of Aegean Bronze Age society? In R. Laffineur, W. D. Niemeier (eds.), *Politei. Society and State in the Aegean Bronze Age. Proceedings of th 5th Aegean Conference. Eegaeum 12: 11–21.*

KALICZ N. 2000. Unterscheidungsmerkmale zwischen der Körös- und der Starčevo- Kultur in Ungarn. In S. Hiller and V. Nikolov (eds.) *Karanovo III. Beitrage zum Neolithikum in Südosteuropa: 295–310.*

KARMANSKI S.1975. *Rani neolit. Donja Branjevina.* Katalog izložbe. Odžaci.

KARMANSKI S. 1987. Nalazi labreta na lokalitetu Donja Branjevina u svetlu novih arheoloških i etnoloških činjenica. *Glasnik SAD 4: 101–106.*

1987a. Donja Branjevina. Privately circulated.

1996. *Boginja je pronađena.* Odžaci.

KORKUTI M. 1995. *Neolithikum und Chalkolithikum in Albanien.* Heidelberger Akademie der Wissenschaften. Monographien B. IV. Mainz am Rhein.

KUTZIAN I. 1947. *The Körös Culture.* Dissertationes Pannonicae Ser. II. No. 23. Budapest.

LETICA Z. 1988. Anthropomorphic and zoomorphic figurines from Diovostin. In A. McPherron and D. Srejović (eds.), *Divostin and the Neolithic of Central Serbia. Ethnology Monographs 10: 173–201.*

MAKKAY J. 1984. *Early Stamp Seals in South-East Europe.* Akademiai Kiado, Budapest.

MACANOVA V. 2000. Neolitische Siedlung bei Rakitovo. Stratigraphie und Chronologie. In S. Hiller and V. Nikolov (eds.), *Karanovo III. Beitrage zum Neolithikum in Südosteuropa: 59–74.*

MATSANOVA V. 1996. Cult objects from the Early Neolithic site at the town of Rakitovo. *Poročilo o raziskovanju paleolitika, neolitika in eneolitika v Sloveniji XXIII: 105–128.*

MATSANOVA V. 2003. Cult Practices in the Early Neolithic Village of Rakitovo. In L. Nikolova (ed.), *Early Symbolic Systems for Communication in Southeast Europe. BAR IS 1139: 65–70.*

McPHERRON A., SREJOVIĆ D. (eds.) 1988. *Divostin and the Neolithic of Central Serbia.* Ethnology Monographs 10. Pittsburgh.

McPHERRON A., RASSON J., GALDIKAS B. 1988. Other artefact categories. In A. McPherron and D. Srejović (eds.), *Divostin and the Neolithic of Central Serbia. Ethnology Monographs 10: 325–336.*

McPHERRON A., AITKEN M. J., BUCHA V. 1988. Absolute dating of Divostin, Grivac-Barice and Banja. In A. McPherron and D. Srejović (eds.), *Divostin and the Neolithic of Central Serbia. Ethnology Monographs 10: 379–388.*

MELLAART J. 1970. *Excavation at Hacilar 1 and 2.* Edinburgh University Press. Edinburgh.

MIKOV V., GEORGIEV V. I. 1969. Nadpisut vurhu kruglia pechat ot Karanovo – naydrevnata pismenost v Evropa. *Arheologia 1: 4–13.*

MILOJČIĆ V. 1959(1960). Ergebnise der Deutschen Ausgrabungen in Thessalien (1953–1958). *Jahrbuch des Römisch-Germanische Zentralmuseums Mainz 6: 1–56.*

1960. Präkeramisches Neolithikum auf der Balkanhalbinsel. *Germania 38/3–4: 320–335.*

ONASSOGLOU A. 1996. Seals. In G. A. Papthanassopoulos (ed.), *Neolithic culture in Greece: 163–164*.

ÖZDOĞAN M. 1997. The Beginning of Neolithic economies in Southeastern Europe: An Anatolian Perspective. *Journal of European Archaeology 5/2: 1–33*.

1999. Northwestern Turkey: Neolithic Cultures in Between the Balkans and Anatolia. In M. Özdoğan and N. Başgelen (eds.), *Neolithic in Turkey. The cradle of civilization. Text and Plates: 218–219*.

PYKE G. and YIOUNI P. 1996. The excavation and the ceramic assemblage. In K. A. Wardle (ed), *Nea Nikomedeia I. The excavation of an Early Neolithic village in Northern Greece 1961–1964 directed by R. J. Rodden*. The British School at Athens. Athens.

PERIĆ S. 1998(1999). Višeslojna neolitska naselja I problem kulturne stratigrafije neolita na teritoriji Srbije. *Starinar XLIX: 11–39*.

PERLÈS C. 2001. *The early Neolithic in Greece. The first farming communities in Europe*. Cambridge World Archaeology. Cambridge University Press. Cambridge.

2003. An alternate (and old-fashioned) view on the Neolithisation in Greece. In M. Budja (ed.), *10th Neolithic Studies. Documenta Praehistorica XXX: 99–113*.

RADUNČEVA A., MATSANOVA V., GATSOV I., KOVACHEV G., GEORGIEV G., CHAKALOVA E., BOZHILOVA E. 2002. *Neolitno selishte do gr. Rakitovo. Razkopki i prouchvaniya 19*. Gal-Iko, Sofija.

RENFREW C. 1987. *Archaeology and Language. The Puzzle of Indo-European Origins*. Penguin Books. London.

RICHARDS M., MACAULAY V. 2000. Genetic Data and the Colonization of Europe: Genealogies and Founders. In C. Renfrew and K. Boyle (eds.), *Archaeogenetics: DNA and the Population prehistory of Europe. McDonald Institute Monographs, Cambridge: 139–151*.

RICHARDS M. 2003. The Neolithic transition in Europe: archaeological models and genetic evidence. In M. Budja (ed.), *10th Neolithic Studies. Documenta Praehistorica XXX: 159–167*.

RODDEN R. J. 1962. Excavations at the Early Neolithic Site at Nea Nikomedeia, Greek Macedonia (1961 season). *Proceedings of the Prehistoric Society XXVIII: 209–288*.

SCHMANDT-BESSERAT D. 1992. *Before Writing. From Counting to Cuneiform*. University of Texas Press. Austin.

STANKOVIĆ S. 1989/1990(1991). Predstava bika u starijem neolitu. Bull representations in the Early Neolithic. *Starinar XL/XLI: 35–42*.

TALALAY E. T. 1987. Rethinking the function of clay figurine legs from Neolithic Greece: an argument by analogy. *American Journal of archaeology 91: 161–169*.

TALALAY E. T. 1993. *Deities, Dolls, and Devices. Neolithic Figurines from Franchthi Cave, Geece*. In T. W. Jacobsen (ed.), Excavation at Franchthi Cave, Greece Fasc. 9. Indiana University Press. Indianapolis.

TASIĆ N. 2003. The White Painted Ornament of the Early and Middle Neolithic of the Central Balkans. In L. Nikolova (ed.), *Early Symbolic Systems for Communication in Southeast Europe. BAR IS 1139: 181–192*.

THEOCHARIS R. D. 1973. *Neolithic Greece*. National Bank of Greece. Athens.

THISSEN L. 2000. *Early Village Communities in Anatolia and the Balkans: Studies in Chronology and Culture Contact*. Unpublished Ph.D. dissertation. Leiden.

THISSEN et al. on-line http://www.chez.com/canew/cadata.htm

THISSEN et al. on-line http://www.chez.com/canew/swdata.htm

TODOROVA H. 1998. Der balkano-anatolische Kulturbereich vom Neolithikum bis zur Frühbronzezeit. In M. Stefanovich, H. Todorova and H. Hauptmann (eds.), *James Harvey Gaul. In memoriam. In The Steps of James Harvey Gaul 1: 27–54*.

TODOROVA H., VAJSOV I. 1993. *Novokamennata epoha v Bulgaria*. Izdatelstvo nauka I iskustvo. Sofia.

TRBUHOVIĆ B., KARMANSKI S. 1993. *Donja Brajevina 1989–1993*. Odžaci.

TÜRKCAN A. 1997. Stamp Seals. In Çatalhöyük Archive Reports. Çatalhöyük 1997 Archive Report. Online: http://catal.arch.cam.ac.uk/catal/Archive_rep97/turkan97.html

VALOVIĆ S. 1987. Ritualna neolitska zoomorfna zvečka iz Ratine. Baša prošlost. *Zbornik radova Narodnog muzeja i Istorijskog arhiva Kraljevo 2: 219–226*.

VAN ANDEL H. T., RUNNELS N. C. 1995. The earliest farmers in Europe. *Antiquity 69/264: 481–500*.

VASIĆ M. M. 1936. *Preistoriska Vinča II*. Beograd.

WHITTLE A., BARTOSIEWICZ L., BORIĆ D., PETTITT P., RICHARDS M. 2002. In the beginning: new radiocarbon dates for the Early Neolithic in northern Serbia and south-east Hungary. In E. Banffy (ed.), *Prehistoric Studies In Memoriam Ida Bognar-Kutzian Antaeus 25: 15–62*.

YOUNGER J. G. 1992. Seals? From Middle Helladic Greece. *Hydra 8: 35–54* and, on-line http://www.people.ku.edu/~jyounger/articles/

UDK 903'12/'15(495)"634"
Documenta Praehistorica XXX

Who did it? Perspectives on the beginning of the Neolithic in Greece

Dimitrios Vlachos
Department of Archaeology and Prehistory, University of Sheffield, UK
prp00dv@sheffield.ac.uk & dimv@hist.auth.gr

ABSTRACT – *The beginning of the Neolithic in Greece has been the focus of study by many scholars for many years, and a strong argument about it is still active. DNA analysis has shed new light on a wide spectrum of questions related to the population history of Europe and the Middle East, the beginning of the Neolithic, and the adoption of agriculture in these areas. This paper will try to chart the various theories for the beginning of the Neolithic in Greece, and the contribution of archaeogenetics to the same discussion. Subsequently, there will be an effort to give some theoretical implications for future research.*

IZVLEČEK – *Začetek neolitika v Grčiji je že mnogo let v središču raziskovanja mnogih znanstvenikov in je še vedno predmet živahnih razprav. Analize DNA so na novo osvetlile številna vprašanja, ki se nanašajo na populacijsko zgodovino Evrope in Bližnjega vzhoda, začetek neolitika in prevzem kmetijstva na teh območjih. V članku bomo poskusili orisati različne teorije o začetkih neolitika v Grčiji in prispevek arheogenetikov k tej razpravi. Razen tega bomo nakazali nekaj teoretičnih možnosti za nadaljnje raziskovanje.*

KEY WORDS – *Mesolithic; Neolithic; Greece; DNA; agriculture*

PAST AND PRESENT TRENDS

There has been a long discussion about the beginning of the Neolithic in Greece and a lot of ideas and theories will come to light in the near and distant future in the archaeological discipline. The truth is that the beginning of the Neolithic in Greece is not very well known to many archaeologists who are engaged in the study of this period in Europe or the Middle East. But, it is true that these two areas have close, but problematic, relations with the Greek mainland. The developments or changes and new introductions which for the first time appeared in the Middle East affected them in several ways and with a particular chronological sequence. The questions are always very simple: 'who', 'when', and 'why', but the answers are anything but simple. In this paper there will be an effort towards the direction that the explanation of the establishment of Neolithic societies in Greece is a very complicated process that moves beyond a single rapid event or the mere acceptance of only one explanation, such as migration or cultural diffusion. In addition, the pre-existing social and economic background of each region, in particular Greece, must be examined separately from Europe or the Near East in order for us to understand better the process of change. In this sense, archaeogenetic analysis – meaning mostly DNA analysis in archaeology – even if it is still at the beginning of its development, makes a very strong contribution towards this direction.

A close look at the evidence shows that around 7000 BC many changes happened to the Mesolithic terrain of Greece; permanent or at least semi-permanent villages, domesticated plants and animals, are things that point to the beginning of agriculture and the introduction of new habits, such as the use of pottery.

In the case not only of Greece, but also for a great part of Europe, the theoretical constructions used for the explanation of these processes and shifts moved between three major trends: firstly, an indigenous approach that excluded any kind of human migration or direct and decisive external influence, at least in the field of physical, meaning human, migration or significant population movements (*Higgs and Jarman 1969; 1972*). In the case of Greece, it was proposed that the introduction of some domesticated plants and animals or some exchanges supported by local processes could have happened (*Theocharis 1981*). Secondly, the 'wave of advance' model, which proposed migration as the major mean for the introduction of these new habits to Greece and the rest of Europe (*Ammerman and Cavalli-Sforza 1984*). And finally, a process that engaged local hunter-gatherers and 'newcomers' from the Middle East (*Dennell 1992*), where the model introduced by Perlès (*2001; this volume*) can be placed.

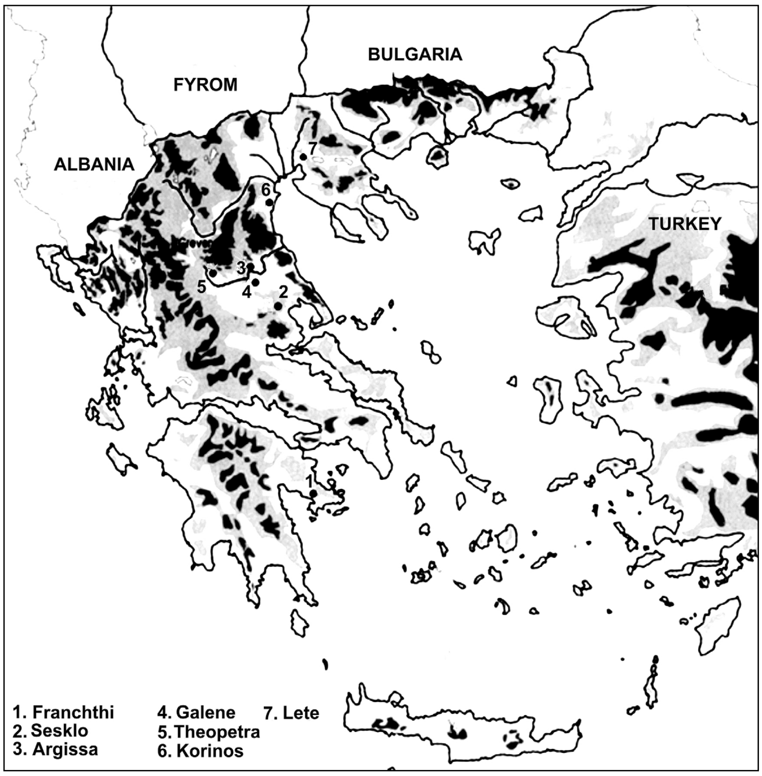


Fig. 1. Map of Greece showing sites mentioned in the text (after* Kotsakis 2001*).

the wild progenitors of certain plants and animals in these areas can be explained.

If we want to discuss the 'indigenist' or autochthonous model for the beginning of Neolithic in Greece and Europe, an approach developed from Higgs and his colleagues in the late 60's and early 70's and strongly supported by Dimitrios Theocharis in Greece, we have to bear in mind that human migrations, meaning the populations of Middle and Near East, had little or no affect on the start of Neolithic. The main theoretical acceptance of this view was that the beginning of Neolithic was an independent development, where acknowledging the exogenous origin of some domestic plants and animals is more a sign of exchange or natural spread than proof of migration. In particular, Higgs and Jarman (*1969; 1972*) supported the view that the domestication of plants and animals in the Near East was uncertain or even non-existent for some of them. In general, except for those positions, cultural diffusion and frontier contacts (*Zvelebil 2000*) are the key points of the indigenous model, where small-scale movements of population through kinship lines and marriages or acquisition of knowledge through trade and exchange networks between foragers and early farmers served as channels of communication. In this sense, the absence of archaeological evidence for

The 'wave of advance' model introduced by Ammerman and Cavalli-Sforza, where migration is the principal factor of social and economic change, was the first attempt at reconstructing past population and human evolution assisted from 'classical' genetic data from living populations. Principal components analysis was used, where each of the seven principal components represents a unique historical episode. The main idea of this 'wave of advance' model, described at the first principal component, is the 'demic fusion' of culture through sequential migrations of populations to the whole of Europe, including of course Greece, from the Middle East, (the Levantine area), which was responsible for the introduction of Indo-European languages to the continent (*Renfrew 1987*). According to this view, the displacement of old populations is not rapid, but happens over many generations. The population growth that occurred in the Neolithic was considered as one proof of this view. This approach, even if its aim is to interpret a cultural and economical phenomenon as the beginning of the Neolithic economy in Europe, takes no account of the various factors that led to this result. Instead, it underestimates the whole process to an abstract and schematic type of cultural process in which the biological counterpart has the main and important role for change.

Finally, the third, and more moderate, perspective on the introduction of the Neolithic way of life in Greece attempts to interpret the phenomenon on the basis of admixture and finally absorption, on the one hand of the pre-existing Mesolithic populations, and on the other, of adventurous colonists from the Near East. This approach presupposes that the Mesolithic population in Greece were very small and that this was the decisive factor for the replacement, or to be more accurate, the displacement of these populations by newcomers from the east, who came full of potential and the experience of the Neolithic way of doing things, socially and economically, and they managed to change dramatically the pre-existing, Mesolithic way of life.

DNA ANALYSIS IN ARCHAEOLOGY

A series of questions are posed. Are these theoretical structures adequate to interpret the beginning of the Neolithic in Europe, and Greece in particular? And what's new with DNA analysis? Has something changed with the introduction and development of archaeogenetics in archaeology and the way we see, understand and interpret the archaeological evidence concerning the beginning of the Neolithic in Greece?

We will first examine developments in the field of DNA analysis. During the last twenty years a great number of DNA studies have been engaged with the problem of the agricultural transition in Europe and the origins of the Neolithic, and have tried to offer valuable explanations concerning these subjects. A lot of researchers, from the famous Ammerman and Cavalli-Sforza, and Renfrew in the 1980's, to the most recent in the 1990's, such as Richards, Barbujani, Pinhasi, Sokal, Torroni, Allaby, Bradley and many others, all these attempts associated with DNA analysis included human, animal, or plant DNA analysis, involving mostly modern, but also ancient samples, and with sometimes contrasting or, at least, different results.

From all these studies it is clearly understood that until now most of the genetic information based on living populations is used to strengthen or weaken the various explanations about the introduction of agriculture and the domestication of plants and animals through migration, 'demic' fusion, or indigenous explanations. But, there are some limitations to this approach, like the fact that the sampled living populations relate to survivors, and that all the extinct lineages are no longer present in our sample (*Sykes and Renfrew 2000*). Furthermore, most of the studies based on ancient human DNA, besides all the inherent technical problems such as degradation through time or the contamination of the samples from modern DNA, including the DNA of those working in the laboratory, have been more of a genetic interest than of archaeological interest. It is now obvious that a more archaeologically driven approach is needed to extract possible explanations concerning genetic evidence, and not the other way around. It is necessary to examine the past and present trends in DNA analysis for the transition to agriculture and the beginning of the Neolithic in Europe, and Greece in particular, in order to understand better the contribution of DNA studies to this end.

The study by Ammerman and Cavalli-Sforza in 1984, based on classic genetic markers and many other assumptions, has seven principal components. The first principal component, and the most interesting to us, describes a quarter of the genetic variation of Europe as a gradual distribution of populations from the Middle East to the north-western Europe through migration, the already well-known 'wave of advance' model. A number of mitochondrial DNA analyses seem to strengthen this theory (*Barbujani and Chikhi 2000*), but for Richards et al. (*1996*) this is not true, because this explanation takes into account only 9–14 per cent of mitochondrial sequences. Richards et al. (*1996*) argue for a more diversified and complex view of the population history of Europe during this period and in their study they did not identify geographical patterns in their sample, and suggested a largely Palaeolithic or Mesolithic origin for the European gene pool.

In Y-chromosomal analysis things are more or less the same. This recent (but debatable, for many biologists) method of analysis sometimes confirms the mitochondrial evidence of the migrationist or 'demic' fusion model and, in contrast, some other studies weaken it. For Semino et al. (*1996*), the frequency of the Y-chromosome haplotypes originating in the Near East average fifteen (15) per cent, and simultaneously, the same is true for twenty-five per cent in the Balkans and less than ten per cent for Western Europe. For Malaspina et al. (*2000*) the image of 'demic' fusion expanding within the entire European continent from the Levant, which is associated with the spread of agriculture, must be confronted with a sharp genetic discontinuity in Central Europe, as is evident in their sample of 1801 Caucasian males. In their view what is most likely to have happened is that a primary phase of a major spread of farmers to Eastern Europe from the Near East preceded an episode of a further cultural spread of farming towards Western Europe, with little or no population movements.

However, the most interesting evidence arises from the genetic analysis of plants and animals. Until recently, the domestication of plants and animals was seen as a single event, unique for each crop and animal species, and the genetic information appeared to support this assumption. Nowadays, new genetic evidence shows that a more diffuse, less revolutionary perspective should not be ignored, and parallel origins, or a motif of dual, or multiple domestication must be counted for an effective interpretation of the Neolithic phenomenon (*Allaby 2000; Bradley 2000*). The focus is moving away from the innovative Neolithic centres of the Fertile Crescent and new possible domestication events have to be examined.

So, we can see that DNA analysis, like any other scientific analysis in archaeology, has offered more arguments and more disagreements in relation to discussions about the beginning of the Neolithic in Greece. But simultaneously, DNA analysis in archaeology has opened new paths to expand our way of thinking concerning old, present, and possible future explanations. DNA analysis in archaeology is new, and as Renfrew (*2000.9*) has stated: "These are early days in the archaeogenetics of Europe". And if we consider the very few archaeogenetics studie done in Greece, based on a very small sample, which is not representative of the whole of Greece, such as the sample used for the study of Richards et al., a lot of work needs to be done in order to use DNA analysis as a useful tool for the interpretation and explanation of the beginning of the Neolithic in Greece.

WHAT IS THE RIGHT ANSWER: *A*, *B*, OR *C*? IS THERE A *D*?

In this light we will try to re-think and re-negotiate the theoretical structures for the beginning of the Neolithic in Greece. First of all, we have to make things clear about each of these theoretical structures. Beginning from the indigenist model, there are some inherent limitations to this approach. Nowadays, there can be little doubt about the chronological sequence of the Neolithic economy, meaning that the domestication of plants and animals happened sometime around 8000 BC, and originated in the Near East or Levant or, thinking of the data from Allaby and Bradley, somewhere else. So, the theoretical position of Higgs and his scholars who favoured the total rejection of the domestication process in the Near East is no longer valid, at least in terms of the chronological sequence of the phenomenon. Until recently, archaeological evidence from Franchthi Cave and the other Early Neolithic settlements of Greece, where domesticated plants and animals appear all together in the form of a 'package', supported this argument. The wild seeds found in the cave do not match genetically with the domesticated species (*Hansen 1991; 1992*). In addition, there is also negative evidence, like the presence at Mesolithic Franchthi of wild oats, a plant not present in the Near East. This plant was no longer cultivated during the Neolithic as might be expected if there was continuity from the same population at the cave. But this exclusion is not a confirmation of an exogenous explanation, like Ammerman and Cavalli-Sforza has favoured, because it underestimates various other factors which could be involved in the process and accepts only one: the migration of populations from distant areas.

Unlike this approach, the cultural diffusion model presupposes that the domesticated plants and animals, as well as all other goods introduced to the region, have nothing to do with gene replacement and that genetic continuity prevails. Instead of this, it was suggested that through exchange networks local hunter-gatherers acquired, adopted and, ultimately, used this new way of living. But this approach treats the Mesolithic inhabitant in Greece as a passive receiver and user of economic developments happening elsewhere. The same is true of frontier contacts, where a limited number of 'strangers' coming from the east through trading partnerships, kinship, or marriage alliances, managed to change completely the habits of a pre-existing and functional way of life. Beside this, the indigenous senario seems weak, because too many traits of the material and symbolical culture are introduced in the region of Greece and Europe as a whole.

Equally, the 'demic' fusion or migration hypothesis does not find a lot of support in either the archaeological, ecological or demographic evidence (*Zvelebil 2000*). No archaeological data confirms the view of population pressure which would have led the first farmers to migrate far to the west, or an extent of woodland clearance that would be expected if extensive agriculture was the norm for this period.

But the main negative aspect of this approach was cited above: the total absence of the social aspect of the phenomenon and the overestimation of the biological factor.

The third theoretical structure was based on two arguments: the first related to the material culture, lithic analysis in particular (*Perlès 1990; 2001*), and the second related to the absence of any formative stage, and the Mesolithic 'gap' in Greece reflected in the absence of a considerable number of Mesolithic sites. According to Perlès, the different technological or operational sequences observed between the Mesolithic Francthi Cave and Early Neolithic Thessalian open sites, such as Argissa and Sesklo, show a completely new lithic technology, not completely similar to the Near East, but a sign of retaining a part of the symbolism and technical knowledge from the colonists. Kotsakis (*2001.65*) argues that we are talking about two distinct habitational environments, something that could explain the differences in technological choices.

Moreover, evidence from the cave of Theopetra in Eastern Thessaly changed the way we think about Mesolithic/Neolithic discontinuity in Greece. Being a small cave, the limited potential in supporting a large number of individuals leads to the assumption of a 'station' point where the semi-mountainous plateau of the adjacent region of Grevena is the most likely candidate for foraging activities. In addition, the archaeobotanical and faunal record from the cave of Theopetra with the identification of wild einkorn (*triticum boeticum*), wild barley (*hoerdeum vulgare*), wild goat and possibly bovids (*Kyparissi-Apostolika 1999*) further supports the argument about a re-thinking of a local pre-adaptation of domesticated cereals in Greece (*Halstead 1996.299*).

At this point we have to make some observations on the argument concerning the number and nature of known – or unknown – Mesolithic sites, because the limited number of Mesolithic sites in Greece, which are less than a dozen, has been used to explain the rejection of an indigenous model and favours an exogenous one. It has been suggested that, with the exception of Francthi, Sidari and Theopetra, Early Neolithic sites are all founded on virgin soils in large alluvial basins devoid of Mesolithic occupation, in contrast with Mesolithic sites that were restricted to specific environments, presumably coastal or near-coastal locations (*Perlès 2001*). So, according to this approach, the Mesolithic background could not support or explain the population growth of the Neolithic. This admission could be more or less misleading and seems circular. The absence of Mesolithic sites is used to explain a phenomenon, and the phenomenon is being explained by the absence of Mesolithic sites.

But is this absence real or merely the result of the history of research, as many researchers have suspected? Many examples and recent discoveries in the Macedonia region, in northern Greece, and Thessaly are signs that the latter could be true. The excavation at an Early Neolithic site in Korinos has changed the view we had of this period in Macedonia (*Besios et al. 2001*). No Early Neolithic sites were known from this area, which was considered 'empty' space during this time period, but the discovery of a settlement that was buried 8 metres under the present surface has opened a whole new chapter to our thinking about the Early Neolithic in Greece. Furthermore, at Galene, in Thessaly, a Late Neolithic site was found under a sedimentation layer, 0.80 metres thick (*Kotsakis 2001.66*), while at Lete, near Thessaloniki in central Macedonia, a Middle Neolithic site was also found under a sedimentation layer (*Tzanavari and Filis 2003*).

Thus it is now evident that other factors, like alluvial deposits could be responsible for the limited number of discovered Mesolithic sites in Greece, and that more attention should be paid to surveys covering the gaps in our knowledge of the Mesolithic and Early Neolithic. These examples confirm the previous suspicion of van Andel and his colleagues about the extent of sedimentation of the surface of the Thessalian Plain and, possibly, other parts of Greece (*van Andel, Zangger and Demitrack 1990; van Andel, Gallis and Toufexis 1995.131*). This means that the smallest or short-term settlements, where one could detect intermediate changes in the material and symbolic culture, meaning the replacement of various elements for social and economic production and reproduction, could be still unnoticed, unlike the prominent long-lived tells that represent successful settlements and received all the attention during the 50's and 60's (*Kotsakis 2001.67*).

CONCLUSIONS

Through all this evidence there has been an effort to negotiate the view that we do not need to think primarily about migrations or indigenous approaches where we, willingly, limit ourselves to a form of automatic explanation. Moreover, we could not describe the transition solely as an economic process. Of course, by this proposition we do not have to deny the possibility of minor population movements or interactions, frontier or direct contacts, or any other form of contact, but we need to emphasise the role of the Mesolithic individual to accept, understand and ultimately change the way he or she produced and organised his/her life, and this is different from the traditional indigenous model, where the Mesolithic populations were considered as passive recipients of developments happening somewhere else.

In addition, the present archeological data should be treated carefully, as it is very well known that research is ongoing and new evidence is coming to light every day. What is needed is a theoretical framework to cover possible future explanations and interpretations. The discussion is moving beyond a mere description of an event or a simple comparison of data between Greece and Near East, to a whole process of interaction between people, Mesolithic inhabitants in particular, and possible 'newcomers' – from where, if something like that is true, we do not yet know – in which each of them has something to offer. A notion of a pure replacement action by a possibly foreign population in the form of 'command and conquer' should be considered as misleading. It is to the historical and social context that archaeological observation should draw attention, and not to generalisations, norms, and necessities.

ACKNOWLEDGEMENTS

I warmly thank Professor Mihael Budja for inviting me to the seminar. Professor K. Kotsakis and my supervisor P. Halstead strongly encouraged me to participate and offered valuable suggestions and corrections to the text. I am grateful to Sofia Agatzioti for her valuable help on corrections to the text.

∴

REFERENCES

ALLABY R. 2000. Wheat domestication. In C. Renfrew and K. Boyle (eds.), *Archaeogenetics: DNA and the population prehistory of Europe: 321–324*.

AMMERMAN A. J. and CAVALLI-SFORZA L. L. 1984. *The neolithic transition and the genetics of population in Europe*. Princeton: Princeton University Press.

BARBUJANI G. and CHIKHI L. 2000. Genetic population structure of Europeans inferred from nuclear and mitochondrial DNA polymorphisms. In C. Renfrew and K. Boyle (eds.), *Archaeogenetics: DNA and the population prehistory of Europe: 119–129*.

BESIOS M., ATHANASIADOU A., GOURTZIOUMI I., KARANIKOU Z., NOULAS E. and HRISTAKOU-TOLIA M. 2001. Anaskafes Voreias Pierias. *To Archaeologiko Ergo sti Makedonia kai Thraki 15: 379–384*.

BRADLEY D. G. 2000. Mitochondrial DNA diversity and origins of domestic livestock. In C. Renfrew and K. Boyle (eds.), *Archaeogenetics: DNA and the population prehistory of Europe: 315–320*.

DENNELL R. 1992. The origins of crop agriculture in Europe. In C. Wesley Cowan and P. J. Watson (eds.), *The origins of agriculture. An international perspective: 71–100*.

HALSTEAD P. 1996. The development of agriculture and pastoralism in Greece: When, how, who, and what? In D. R. Harris (ed.), *The origins and spread of agriculture and pastoralism in Eurasia: 296–309*.

HANSEN J. M. 1991. *The palaeothnobotany of Franchthi Cave. Excavations at Franchthi Cave, Greece, fasc. 7*. Indiana University Press.

1992. Franchthi cave and the beginnings of agriculture in Greece and the Aegean. In P. C. Anderson-Gerfaud (ed.), *Préhistoire de l'agriculture. Nouvelles approches expérimentales et ethographiques: 231–247*.

HIGGS E. S. and JARMAN M. R. 1969. The origins of agriculture: a reconsideration. *Antiquity 43 (169): 31–41*.

1972. The origin of animal and plant husbandry. In E. S. Higgs and M. R. Jarman (eds.), *Paper in economic prehistory: 3–13*.

KOTSAKIS K. 2001. Mesolithic to Neolithic in Greece. Continuity, discontinuity or change of course? In M. Budja (ed.), *Documenta Prehistorica 28: 63–73*.

KYPARISSI-APOSTOLIKA N. 1999. The Palaeolithic deposits of Theopetra Cave in Thessaly (Greece). In G. Bailey, E. Adam, E. Panagopoulou and K. Zachos (eds.), *The Palaeolithic Archaeology of Greece and adjacent areas: 232–239*.

MALASPINA P., CRUCIANI F., TORRONI A., TERRENATO L., NOVELLETTO A. and SCOZZARI R. 2000. Human Y-chromosomal networks and patterns of gene flow in Europe, West Asia and North Africa. In C. Renfrew and K. Boyle (eds.), *Archaeogenetics: DNA and the population prehistory of Europe: 163–166*.

PERLÈS C. 1990. *Les industries lithiques taillées de Franchthi (Argolide, Grèce), vol. II. Les industries du Mésolithique et du Néolithique initial. Excavations at Franchthi Cave, Greece, fasc. 5*. Indiana University Press.

2001. *The Early Neolithic in Greece*. Cambridge: Cambridge University Press.

RENFREW C. 1987. *Archaeology and language: the puzzle of Indo-European origins*. London: Jonathan Cape.

2000. Archaeogenetics: towards a population prehistory of Europe. In C. Renfrew and K. Boyle (eds.), *Archaeogenetics: DNA and the population prehistory of Europe: 3–11*.

RICHARDS M. R., CÔRTE-REAL H., FORSTER P., MACAULAY V., WILKINSON-HERBOTS H., DEMAINE A., PAPIHA S., HEDGES R., BANDELT H-J. and SYKES B. 1996. Palaeolithic and Neolithic lineages in the European mitochondrial gene pool. *American Journal of Human Genetics 59: 185–203*.

SEMINO O., PASSARINO G., BREGA A., FELLOS M. and SANTACHIARA-BENERECETTI A. S. 1996. A view of the Neolithic demic diffusion in Europe through two Y chromosome-specific markers. *American Journal of Human Genetics 59: 964–968*.

SYKES B. and RENFREW C. 2000. Concepts in molecular genetics. In C. Renfrew and K. Boyle (eds.), *Archaeogenetics: DNA and the population prehistory of Europe: 13–22*.

THEOCHARIS D. R. 1981. *Neolithikos Politismos. Athina: Morfotiko Idryma Ethnikis Trapezis*.

TZANAVARI K. and FILIS K. 2003. Lete I: o prosdiorismos tis pithanis thesis tou neolithikou oikismou. To Archaeologiko Ergo sti Makedonia kai Thraki 17 (in press).

VAN ANDEL T. H., GALLIS C. and TOUFEXIS G. 1995. Early Neolithic farming in a Thessalian river landscape, Greece. In J. Lewin, M. G. Macklin and J. C. Woodward (eds.), *Mediterranean Quaternary River Environments: 131–143*.

VAN ANDEL T. H., ZANGGER E. and DEMITRACK A. 1990. Land use and soil erosion in prehistoric and historical Greece. *Journal of Field Archaeology 17: 379–396*.

ZVELEBIL M. 2000. The social context of the agricultural transition in Europe. In C. Renfrew and K. Boyle (eds.), *Archaeogenetics: DNA and the population prehistory of Europe: 57–80*.

UDK 903(450.36+497.4)"634"

Documenta Praehistorica XXX

Early herders of the Eastern Adriatic

Dimitrij Mlekuž
Department of Archaeology, University of Ljubljana, SI
dimitrij.mlekuz@uni-lj.si

ABSTRACT – *The paper discusses the evidence for the presence of sheep and goats on east Adriatic coast during the Mesolithic and Neolithic, and possible routes of transformation from hunter-gathering to pastoral societies.*

IZVLEČEK – *Članek kritično ovrednoti dokaze za prisotnost ovc in koz na vzhodnojadranski obali v mezolitiku in neolitiku in predstavi možne transformacije lovsko-nabiralniških skupnosti v pastirske.*

KEY WORDS – *Mesolithic; Neolithic; hunting-gathering; herding; East Adriatic*

INTRODUCTION

Sheep and goat flocks were ubiquitous on the east Adriatic coast only a few decades ago. They formed the subsistence base and way of life for countless villages and families.

The image of herds grazing on the stony Mediterranean landscape seems somehow timeless, but was it always like that? I am going to discuss the process of transformation of Mesolithic and Neolithic societies on the east Adriatic coast, where sheep and goats were the medium and agents of this change. I argue that the transformation of these societies was structural and involved much more than just the adoption of sheep and goats.

HUNTING-GATHERING AND HERDING

The main difference between hunting (and gathering) and herding is social (*cf. Bender 1987; Hayden 1990*). It lies in the contradicting rationalities of sharing[1] and accumulation, based on the principles of collective and divided access to the means of subsistence (*Ingold 1980.2–3*). This observation has a series of corrollaries, which define pastoralist societies.

While in a hunting economy animals belong to no one and therefore everyone has a right to their meat, hunters derive a *collective* security in the face of fluctuating resources through regulations of sharing. In a pastoral economy, animals constitute property over which the owner has an exclusive right of disposal, thus pastoralist must insure themselves *individually* against future catastrophes of unknown magnitude by maximizing their reserves in the number of animals (*Ingold 1980.89*). Herding societies' production units are therefore fragmented, often equivalent to households (*Sahlins 1972; Hesse 1984*). Accumulation involves the appropriation of the natural increase, therefore production of meat, which entails the elimination of animals from reproduction, and is limited to the satisfaction of immediate domestic needs (i.e. underproduction; *Sahlins 1972*), which in consequence limits population growth.

1 As emphasised by Tim Ingold (*1986*), there are two forms of sharing, *sharing out*, as a form of distribution and *sharing in*, as a principle of collective access, which inheres in hunter-gatherer social relations and practices. This latter meaning of the word sharing is used throughout this paper.

AGENTS AND MEDIA OF CHANGE: SHEEP AND GOATS

The domestic goat (*Capra hircus*) is often dismissed as the "poor man's cow" for its ability to thrive on meagre fodder and cope with harsh environments. Archaeological and genetic evidence clearly demonstrate that goats were, in the form of its wild progenitor – the bezoar (*Capra aegagrus*) – one of the first domesticated animals (*MacHugh and Bradley 2001*). Luikart et al. (*2001*) demonstrated that structure and distribution of mtDNA variation in domestic goats are qualitatively different from the patterns observed in other large Eurasian domesticated herbivores. Goats seem to have three and not two matrilineal roots, which raises the possibility of additional domestications. Moreover, the global distribution of goat mtDNA variation shows a remarkably low level of phylogeographic structure (particularly when compared with domestic cattle). This basically means that geographical location has little relevance to the mtDNA type a particular animal possesses. Based on the antiquity of goat domestication and the presence of goats in almost every corner of Eurasia stretching deep into prehistory, we might expect that goats should display a high level of geographical structuring. Luikart et al. (*2001*) therefore suggest that goats have been a highly mobile species, which has expanded along human exchange networks.

The wild ancestors of modern domestic sheep still remain uncertain. There are three presumptive candidates (the urial, *mouflon* and argali; *Ryder 1983*).

As demonstrated by Hiendleder et al. (*1998; 1998a*), domestic sheep mtDNA haplotypes can be divided into two divergent lineages. One can be found only in European domestic sheep, while the other type is uncommon in Europe, but common elsewhere. The European mitochondrial lineage is similar to the *mouflon* type, while for the other lineage they found no similar connection to any of the three wild species. This strongly supports the hypothesis that modern domestic sheep and the European *mouflon* derive from a common ancestor and provides evidence of an additional wild ancestor, other than the urial and argali groups, which has yet to be identified, but may be sought among Anatolian *mouflon*.

SPATIAL CONTEXT: DINARIDES

The Dinarides mountain range extends along the Adriatic coast from the eastern Alps in the north to the Albania massifs in the south (Fig. 1). It rises abruptly from sea except for narrow coastal plains in Istria and between Zadar and Šibenik. With peaks as high as 2538 m, it creates a climatic divide between the Mediterranean and continental climate immediately to the east. The Massif is broken only by rare river valleys, such as the Neretva, and is a serious barrier to communication; even today it is traversed at only a few passes. To the west, a series of long, narrow islands parallel the coast.

The whole area is characterised by limestone geology and is a landscape of classic karst topography. Although the region experiences extremely heavy rainfall, there is a general lack of surface water. The porous limestone quickly absorbs water via cracks and fissures, draining the surface. Subsurface water is conducted to vast, seasonally flooded depressions (*poljes*) in the Dinarides, or underwater springs along the Adriatic coast. Soils – except in depressions – are thin and leached (*terra rosa*), and as a result of millennia of overuse some parts of the landscape are virtually barren.

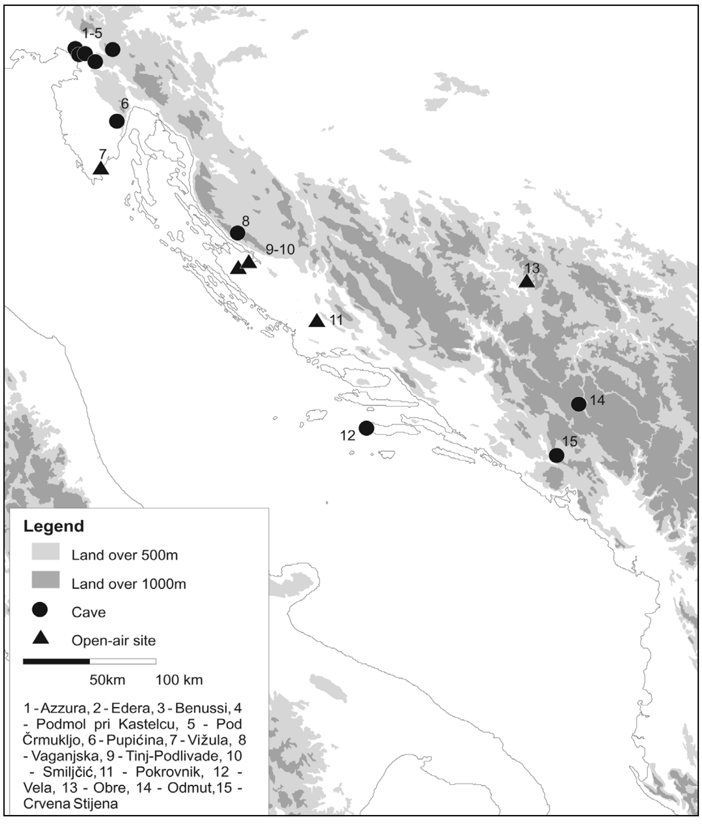


Fig. 1. The Dinarides and east Adriatic, with important sites mentioned in the text.

TRADITIONAL PRACTICES

There is a long history of the practice of transhumant pastoralism in the Dinaric region. We have inscriptions from Roman times (*Šašel 1979*) which suggest that the practice can be dated deep in prehistory.

Ethnographic data from the Dinarides (*Cvijić 1966; Vriščak 1989; Marković 1971*) offer rich evidence of various traditional ways of keeping of sheep and goats by various semi-nomad, transhumant and semi-transhumant strategies, which were specific for each group involved and are very difficult to generalize (Fig. 2).

The most frequent pattern recorded is of "normal transhumance" where groups, living on the Adriatic coast take their flocks to the mountain pastures every summer, where they have established cabins (*katuni*). In a number of cases they have established more permanent settlements, where they live with their herds and families during the summer. This phenomenon of double villages is attested for Velebit.

Some groups move to the uplands and back down in a series of stages, with temporary stops at each stage. There are even cases of semi-nomadic herders spending the warmer part of the year wandering around with all of their possessions, and spending the colder part of the year in low-lying villages, often in very simple buildings.

Another pattern is of "inverse transhumance" – often associated with Vlachs – where groups descend from the mountains in winter to pasture their sheep on the coastal pastures, returning to the mountain pastures in the spring.

There is also evidence of combined transhumance, typical of the herders of the Lika polje, but also documented elsewhere. The Lika herders moved their flocks into the mountains in spring and descended to the coast in the winter.

This rich range of flock movement strategies is no doubt a product of the very complex economic, demographic, political and environmental history of the region. A complex web of strategies was invented to adjust to population movements (especially Vlachs) connected with the expansion of Ottoman Empire, conflicts on the Ottoman-Venetian-Habsburg border, and the demands of Venetian coastal towns, Venice itself, and later, Austrian ports, physiocratic attempts to rationale agriculture, changing patterns of land ownership, raiding by hinterland brigands (*hajduks*), or the depletion of pastures... Complex pattern of transhumance strategies, observed in a historical and ethnographical records, is a result of an on-going process of interaction between people and landscape and a dynamic response to political, economical and environmental rhythms. Thus, ethnographically documented transhumant practices in the Dinarides should not be seen as fossil strategies remnants from the deep past, but as a dynamic response to changing conditions and practices always in a process of negotiation and becoming.

THE USE AND ABUSE OF ETHNOGRAPHIC EVIDENCE

The rich ethnographic evidence has lured many researchers to use it as a direct analogy to explain (early) Neolithic settlement patterns and patterns of material culture distribution.

Sterud (*1978*) used direct ethnographic evidence for long-distance transhumance from Adriatic coast on the one hand and the Sava Plain on the other to the mountain pastures in central Bosna in a very straight-

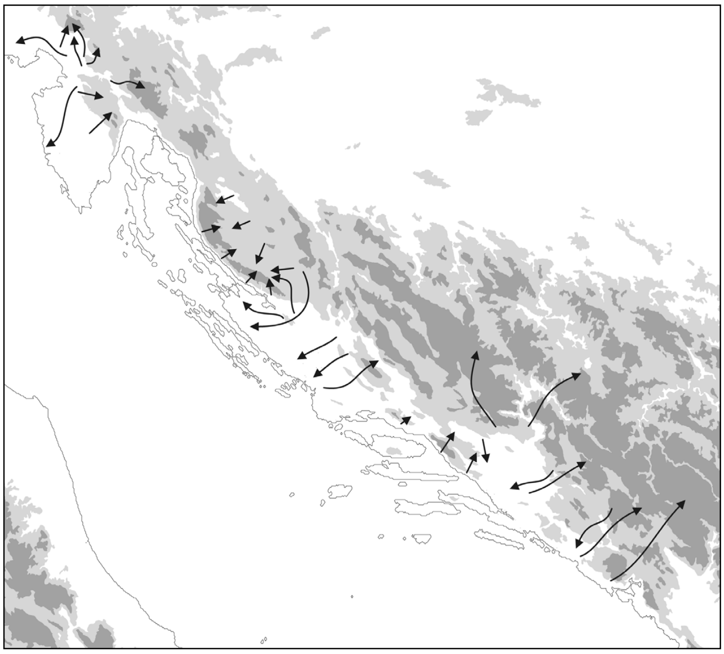


Fig. 2. Traditional transhumant routes in the Dinarides (compiled from* Cvijić 1966; Vriščak 1989; Marković 1980*).

forward way to explain Mediterranean (Impresso) and continental (Starčevo) aspects of material culture found at the Obre I site. He sees long-range transhumance as a prime medium for cultural contacts and exchange in the early Neolithic.

Although refreshingly imaginative, his approach can be criticized on two grounds.

The main criticism can be directed to his use of ethnographic data. Traditional transhumance routes, which he uses to demonstrate long-range transhumance, are the result of extremely complex historical and economic factors, which evolved over millennia of herding (see above). It is very improbable that routes recorded at the beginning of the 20th century are the same as those in the very early Neolithic. The ecological niche occupied by modern transhumant pastoralists simply did not exist in prehistory (*Halstead 1987; Lewthwaite 1981*; see below).

Questionable is also his idea of the very early establishment of long-range transhumance routes. Radiocarbon dates for the Obre I site are surprisingly early (sequence begins at ca. 6100 BC)[2] and are among earliest Neolithic dates in the Dinarides; it is, in fact, earlier than dates for open air sites on the Adriatic coast. One can hardly imagine the establishment of long-range transhumance routes from the coast to the high Karst mountains at very beginning of the Neolithic on the Adriatic coast.

Joannes Müller (*1994*) compared the early Neolithic settlement pattern in Ravni kotari, where open-air sites in the costal plain (Smiljčić, Tinj-Podlivade...) and cave sites in the Velebit mountain (Vaganjska pećina) are documented, with modern settlement patterns, with permanent villages in the lowlands and seasonal settlements (*katuni*) in the mountains.

Although the exploitation of the vertical gradient is possible, the long occupation history of Vaganjska cave – which extends deep in Palaeolithic – is in strong contrast with open air sites which were established after 6000 BC. Possible finds of capriovid bones in the Mesolithic layers of Vaganjska (*Forenbaher and Vranjican 1985*) possibly demonstrate an older and different presence of capriovid in Mesolithic societies (see below) than those documented in Neolithic lowland villages.

"MESOLITHIC SHEEP"?

There are several collections of capriovid bones found in Mesolithic contexts along the Adriatic coast, which opens up the possibility for the very early adoption of capriovids in hunter-gathering societies. However, these collections are not without problems.

I will present two possible chronologies for the introduction of the capriovids to the east Adriatic, *long* and *short* one, each based on different sets of evidence.

The *long chronology* of capriovid presence in the east Adriatic extends before 7000 BC and is based on few and problematic data, whereas the *short chronology* starts at around 6000 BC and is widely documented by large faunal collections (*capriovid* bones often predominate in the faunal record) in contexts often associated with pottery, whether Impresso or monochrome.

Collections of capriovids were found in west Mediterranean Mesolithic contexts, where in the '80s and early '90s there was an active discussion on the status of these finds (*cf. Geddes 1983; 1985; Zilhão 1993; Binder 2000*).

The local domestication of goats was suggested for Cova Fosca dated to ca. 6400 BC (*Olaria 1988*). A large collection of sheep bones was identified in the Castelnoven layers at Châteauneuf, and the late Mesolithic acquisition of exotic domestic sheep through a long distance exchange mechanism was suggested for Abri Dourgne and Grotte Gazel, among others (*Geddes 1983; 1985*).

These finds have been lately largely discounted as being the result of various "taphonomic filters" (*Zilhão 1993; 2001*), the weather being intrusive from overlying Neolithic layers, the result of bad excavation practices, and/or analytical biases due to the mistaken misidentification of ibex as capriovid bones (*Binder 2000.130–131*).

Similar collections were found on the east Adriatic coast (Tab. 1). Layer 5 in Grotta Benussi (Pejca na Sedlu) in the Trieste Karst contained 5 capriovid bones in a late Sauvettarien context dated ca. 7400 BC. Subsequent layers (layer 4, dated to ca. 6400 BC and layer 3, dated to ca. 6000 BC) contained similar number of capriovid bones (*Riedel 1975*). Grotta

2 All data in the paper are in calendar years BC.

Site	Layer	Date	Capriovid NISP	Reference
Grotta Azzura	4	Mesolithic	12	Wilkens 1992; Cremonesi et al. 1984
Grotta Benussi	5	8380±70 (R-1045)	5	Riedel 1975
Grotta Benussi	4	7620±150 (R-1044)	8	Riedel 1975
Grotta Benussi	3	7050±60 (R-1043)	9	Riedel 1975
Podmol pri Kastelcu	13	Mesolithic	5	Turk et al. 1993
Pod Črmukljo		Mesolithic	1	Pohar 1986
Vaganjska Pećina	1	Mesolithic	??	Forenbaher and Vranjican 1985
Crvena Stjena	IV	Mesolithic	??	Malez 1975; Basler 1983

Tab. 1. Evidence for the "long chronology" of capriovid presence on the east Adriatic coast.

Benussi is especially important because no Neolithic layers were found, thus intrusion seems less probable.

Similar finds of caprovids in a Mesolithic context were found in Podmol pri Kastelcu, where 5 sheep bones were found in layer 13, dated to the Mesolithic (*Turk et al. 1993.71–73*).

Wilkens (*1992; Cremonesi et al. 1984*) identified 8 sheep and 4 sheep or goat bones in Castelnovien layers at Grotta Azzura (Pečina na Leskovcu) in the Trieste Karst.

A rock shelter at Pod Črmukljo contained one sheep incisor (*Pohar 1986*) in a Mesolithic context.

A similar situation can be observed in Dalmatia, Herzegovina and Montenegro. Layer IV in Crvene stjene in Montenegro contained goat (*Malez 1975*) and sheep bones (*Basler 1983*) in a Castelovien layer IV underlying layer III with Impresso pottery.

Forenbacher and Vranjican (*1985*) mention the possible presence of capriovid bones in Mesolithic layers of Vaganjska pećina in Velebit Mountain.

Surprisingly, these collections were mostly ignored by archaeologist (except *Budja 1993*, which discusses them in the context of "transition to farming"; see also *Veluščček 1995; Budja 1996*). Not fitting into rigid periodic schemes, they were usually dismissed as being intrusive from overlying Neolithic layers and attributed to taphonomic processes and bad excavation practices.

A discussion about the local domestication of wild sheep and goats by Castelnovien groups was raised by some zoo-archaeologists, but it never entered into archaeological discourse. Riedel (*1975*) discusses the probability of local domestication in the case of Grotta Benussi and Malez (*1975*) interprets finds from Crvene stijene as evidence for the existence of a wild goat ("Balkan goat") population in the Balkans in the early Holocene, which was husbanded by Mesolithic groups.

In my opinion, there is far too much evidence of the early presence of capriovids in Mesolithic contexts to be dismissed as being simply the result of various taphonomic filters (*cf. Zilhao 1998, 2001; Veluščček 1995; Wilkens 1992*). However, this question will not be resolved until direct dates of bones become available.

If we accept that those collections are not the result of taphonomic agency, then how did they come to be in Mesolithic contexts?

The local domestication of sheep and goat by Mesolithic groups seems highly improbable in the light of new analyses of sheep and goat mtDNA (see above). If we accept the early presence of sheep and goats in the east Adriatic, they must have been somehow transported from their centre of domestication, somewhere in south-eastern Anatolia. What, then, were the actual mechanics of transporting capriovids to the east Adriatic coast?

"Commensal politics", negotiations of power through competitive feasting, may have started to become important during the Mesolithic in Europe. Exotic animals may have been important prestige items in competitive feast systems operating on the Adriatic coast (*Miracle 2001*), where seasonal aggregations may have been used as arenas for competition among power- and status-aspiring individuals. Social events such as competitive feasting were actively manipulated to undermine the principles of sharing and set in motion the process of the emergence of social inequality (*Hayden 1995*).

Miracle's (*2001*) interpretation of a midden in Pupićina Cave in Istria suggests increased social tensions, which were negotiated through commensal feast. Exotic items and food such as capriovids may have been actively used for display and consumption in a context of power negotiations between individuals and between groups.

The small sizes of bone collections suggest that sheep and goats were not herded, but were used only for display and feasts.

Alternatively, sheep and goats might also have been used as a risk buffer which allowed individuals to avoid obligations of sharing that were valid for hunted animals (*Ingold 1980*). In this way they probably played an important role in "relaxing" the ideology of sharing and offered a means for the introduction of an ideology of accumulation.

Another question is how they were actually brought several thousand kilometres from Near East.

There were a series of potentials that were opened up by the sea for individuals (*cf. Warren 1997*). The sea was not a barrier. Travelling by water was not only a viable alternative to overland journeys, but offered individuals increased mobility by avoiding power relations defined by existing social structures of mating and exchange networks. Sea travel offered opportunities for establishing long-range contacts and thus enabled them to act as middlemen (or middle-women) for prestige items. Seascapes became landscapes of social opportunities through the establishment of long-range contacts and links for the exchange of partners, information, and prestige items.

Alternatively, the emergence of endogamous (closed) mating networks especially in a linear (coastal) environments would lead to local inequalities for groups located on the periphery of a mating network (*Chapman 1990*). Marginal communities would therefore benefit from long-range sea transport, as it lowers transport costs, places them in contact with more distant communities, and enables them to acquire a less peripheral position in a network.

Evidence for open-sea navigation in the Mediterranean after 7000 BC is abundant (*cf. Cherry 1990*) and may demonstrate a wider pattern of exploiting the social opportunities offered by the sea.

Similar evidence can be found for the Adriatic. Frequent finds of large fish bones from Vela špilja on Korčula Island (such as tunny and swordfish) indicate deep-sea fishing. This implies proficient open sea navigation, aimed perhaps at the exploitation of rich sources of flint that are located on the opposite shore of the Adriatic. An igneous rock cobble associated with burial, which must have been brought from distant islets of Brusnik or Palagruža, is direct evidence of open sea navigation before the mid-seventh millennium BC (*Forenbaher 2001*).

I believe that the possibilities offered by sea navigation created an extensive social network covering a large part of the Mediterranean, which demonstrates the properties of "small-world" social networks.

It has long been recognized that the structure of social networks plays an important role in the dynamics of information propagation. Experiments in social network structures suggest that there are only about six intermediate acquaintances separating any two people on the planet. This is the so-called "small world" phenomena of social networks.

Any social network needs very weak requirements to exhibit a "small world" property: an underlying network structure of short links connecting neighbours and random, longer, short-cuts (*Watts and Stogatz 1989*).

In the case of the "Mesolithic Mediterranean small world" (Fig. 3), long-range shortcuts were established by sea travel connections in an underlying structure of mating networks along the coasts, where every community was connected to neighbouring communities (*sensu Wobst 1974*).

The small-world property of social networks in the Mediterranean and the increased individual mobility offered by the sea, provided channels for the fast dissemination of prestige items in the context of increased social tensions.

Low level of phylogeographic structure in goat mtDNA (see above) may also be result of mobility of stock across long-range exchange networks.

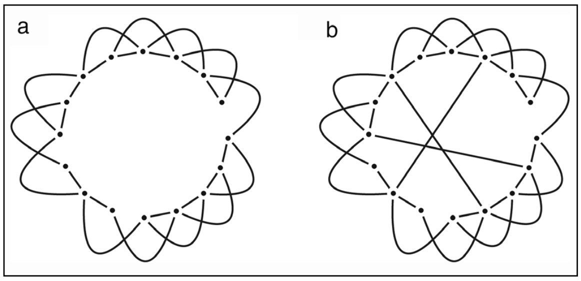


Fig. 3. The emergence of "small world" property in a social network. When some random short-cuts are added to the network (a), "small-world" social network emerge (b).

Even in the most distant communities, sheep and goats – whether they were on the Mediterranean coast of the Levant, Anatolia, Greece or north Africa – were only a few marriages or boat trips away.

Although these animals were domesticated, communities, which acquired and incorporated them were not pastoralist (or Neolithic) societies. The mere adoption of domestic animals did not disrupt established ways of doing things. The transition to herding took place later, when adoption of an ideology of accumulation opened the door for larger herds, which were relied on for food.

"NEOLITHIC SHEEP"!

The short chronology of sheep and goat presence in the east Adriatic is far less problematic, although there are still open questions. In collections which define the short chronology of capriovid presence on the east Adriatic coast, two large patterns can be observed.

Pattern one can be observed in deeply stratified cave sites with a long history of occupation. Capriovid bones appear there in contexts which can be described as Mesolithic on the basis of continuity in the lithic industry, and as Neolithic on the basis of the presence of domesticated animals and – in most cases – small quantities of pottery.

In the Edera Cave (Stenašca) in the Trieste Karst, some uncharacteristic potsherds and a Castelnovian lithic toolkit were found (*Biagi et al. 1993*) in layer 3a, dated to ca. 5600 BC, together with a large number of capriovid bones (*Boschin and Riedel 2000*).

In Pupićina Cave in Istria, a full-blown pastoral economy can be observed in a layer dated to ca. 5600 BC (*Miracle 1997*). No pottery was found. Unfortunately, late Mesolithic and early Neolithic layers that would document a transition to herding are absent from this site.

Similar patterns can be observed in deeply stratified caves in Herzegovina and Montenegro. Thus in Crvena Stjena layer III, Impreso pottery and a large collection of capriovid bones were found (*Malez 1975*), while the lithic industry displays continuity from Mesolithic layer IV.

Pattern two includes open-air sites located on coastal plains with arable land (Vižula, Tinj-Podlivade, Smiljčić, Pokrovnik...). They are usually flat and contain large quantities of Impresso pottery (*Müller 1994*) and complete package of domesticates.

Both patterns are spatially exclusive (Fig. 4). Pattern one can be found in peripheral, mountainous areas (Trieste Karst, Čičarija, Herzegovina, Montenegro) while pattern two sites are located in flat coastal plains with arable land (Ravni Kotari, Red Istria and Zagora region).

Both patterns display a different rate of adoption of domesticates and pottery. While the establishment of pattern two sites is roughly contemporary and falls within a very short time frame (contra *Chapman and Müller 1990*), pattern one sites seem to appear after the establishment of pattern two sites in same region.

The formation of patterns can be explained by two alternative scenarios. In the first scenario, early Neo-

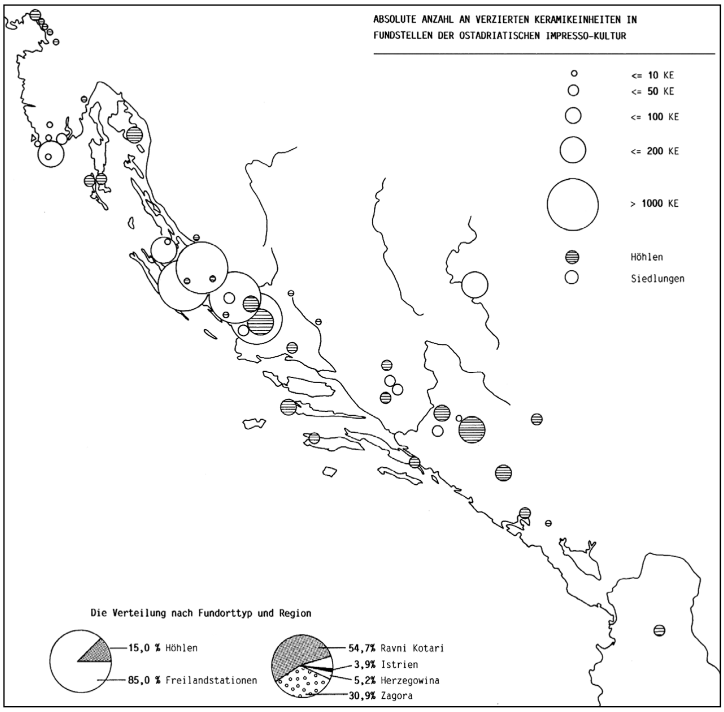


Fig. 4. The distribution and quantity of pottery in open air and cave sites in the east Adriatic (after* Müller 1994.Abb. 1*)

3 Pokrovnik in Zagora ca. 5870 BC, Tinj-Podlivade in Ravni kotari ca. 5830 BC, while Vižula in ca. 5720 BC (*Müller 1994.345–355*).

lithic communities are established in niches suitable for mixed farming by maritime pioneer colonisation (*cf. Zilhão 1998; 2001*) around 6000 BC. A system of short-range mobility of sheep is soon devised, where herds are (seasonally) moved to caves located in more peripheral areas from lowland open-air settlements (see below). This may explain the sudden appearance of cave sites with Impresso pottery (Gospodska pećina...) in regions where pattern two sites are established.

Mesolithic communities then selectively adopt some aspects of the Neolithic package – mostly pottery and capriovids – and integrate into the wider regional division of labour as pastoralists. This process may be quite long, and may take several hundred years in some regions (Trieste Karst, Učka...).

In the second scenario, Mesolithic groups in coastal lowlands (with maritime contacts with Apulian Neolithic groups) adopt the complete package and begin to practice mixed farming. Groups in peripheral regions not suitable for farming begin to practice capriovid herding. Thus there gradually emerged two complementary economic systems which were integrated into a wider regional economic framework of divided labour (see below).

FROM HUNTERS TO HERDERS

Both scenarios sketched above assume the adoption of herding by Mesolithic groups. Yet the establishment of herding society was probably neither rapid nor smooth. There were many obstacles which slowed down the transition from hunting to herding societies. In fact, the process of the deep structural transformation of Mesolithic groups to full-blown herding societies was probably not over before the middle Neolithic.

An important source of information on the adoption of pastoralism, especially concerning its introduction to hunter-gatherers and their transformation, are the accounts of the American Southwest during Spanish colonisation in the 1700's (*Bailey 1980*).

Sheep were brought to the southwest of North America by the Spaniards in the late 16th century. Within approximately 200 years pastoralism had changed the economy and social structure of the Navajo. When the Navajo were confronted with sheep in early 1700s they were hunter-gatherers and horticulturalists. But then, within only a matter of decades, herding became a main subsistence strategy which profoundly changed their society, and they become a full-blown herding society. Bailey's (*1980.77*) conservative calculation of 7.5 years doubling rate for flocks in the 18th century, gives the Navajo 8000 sheep by 1721, 32 000 sheep by 1735 and 64 000 by 1742, reaching a half-million by mid 19th century – a figure reported by a number of Anglo-American observes. The pressure on pastures was enormous, so herders were forced to seek for new grazing. Because of the growing flocks and limited grazing land patterns of vertical mobility – transhumance – were soon devised. One family often had up to three residences over an annual cycle. For this reason Bailey (*1980.67–77*) claims that it was not the horse that increased Navajo mobility, but sheep.

The main problems faced by early aspiring herders were probably social. There was probably strong tension between sets of conflicting values of sharing and accumulation. Lee (*1979.412–413*) observed tense relations between those families of the !Kung who had begun to farm and herd and their relatives who continued the foraging life. Yellen (in *Hesse 1984.245*) reports an interesting story of a !Kung San named Rakudu, who become a successful herder. However, he faced a serious problem when he was attempting to arrange a marriage for his eldest son. The trouble was that discussions with the father of most suitable bride had led nowhere because of objections raised on the narrow application of a usually ignored kinship rule by the potential inlaw. Legalistic objections were, of course, merely a cover for real objections. Rakudu and his sons had the reputation of being stingy, as they resisted suggestions to slaughter some animals for feasts. Thus the normal social obligations could not be met. Faced with the paradox of wealth and social alienation, Rakudu soon dropped herding.

Another set of problems early herders faced with was environmental. The main motivation for accumulation in pastoral societies is the immanence of catastrophe. Not only in the course of a seasonal cycle, but also in the longer term, flocks of small stocks are given to large and sudden fluctuations in size and change in age-sex structure. Compared with larger stock, they contain a higher risk factor, balanced by a capacity for rapid recovery due to their high fertility rates. If a herd is left unmanaged, its explosive growth potential leads quickly to the imposition of Malthusian population control. The tendency toward herd expansion is a fundamental feature of the pastoral mode of production (*Cribb 1991.30*). Thus the main limiting factor on herd expansion was lack of pastures.

As the sparse palinological data suggests, during the early Holocene the east Adriatic was covered with open woodland. Deciduous trees, mainly oak, predominated in these forests. Although evergreen species were present in the coastal regions, they remained of minor importance until about 6400–6000 BC, with the transition to a Mediterranean type of climate (*Beug 1961; Brande 1989; summary in Chapman et al. 1996*). There was a vegetational gradient from the Mediterranean type along the coast to a sub-Mediterranean in the uplands and a continental one further inland (*Brande 1989*). In the northern Adriatic (Istria and Karst) the woodland included thermophiluous trees as well as more cold-tolerant species; evergreen species were never as important as in southern Dalmatia (*Beug 1977; Culiberg 1995, Andrič 2001*).

The avaibillity of fodder (pastures) is the main limiting factor on herd growth. But on the other hand, sheep and goats change landscapes by browsing and grazing on young shoots, and therefore – in the long term – create new pastures. Since sheep and goat reproduce much faster than they open up new pastures, they are soon faced with Malthusian control. Thus in the long term we have a very complex ecological relationship between animals and pastures which is further complicated by catastrophic events which drastically reduce herds. The growth of herds thus follows a series of expansions and reductions, where every expansion pushes carrying capacity higher. This cycle frequency is somehow related to sheep reproduction rates, and is far too short to be detected archaeologically. However, the cumulative effect of grazing on the landscape can be observed in the palinological record.

There is sparse evidence for the impact of grazing on a regional scale. Changes in woodland composition, documented in the pollen core from Škocjanski zatok in north Istria (*Culiberg 1995*) can be explained by the impact of grazing. There is also strong evidence of extremely heavy localised impact at specific locales. At Podmol pri Kastelcu (*Turk et al. 1993*) "open vegetation" is documented in layers where capriovid bones predominate, and the low number of NAP may indicate that most of the grass was grazed before flowering.

Environmental data thus suggest that forest grazing was practised, and heavily grazed pastures existed around caves where animals were kept. This raises the question of mobility patterns and landscape use.

Hunter-gatherer movements across landscapes follow a complex spatial pattern covering the greater part of a well-defined territory or range and scheduling their movements with regard to consumption (*cf. Binford 1980*).

Pastoralists' utilisation of landscape is much simpler. They move according to the schedule of pastoral production, which is dependent upon the consumption patterns of flocks (*Cribb 1993.20–22*). They exploit the same basic resource – pasture – in different seasons. The main motivation behind pastoral movement is to maintain access to a single environmental niche by following its seasonal relocation (usually across a vertical gradient). Migration is motivated by a desire to optimize conditions for pastoral production and minimize risks to the herd. Short-range transhumance systems have usually been suggested for the Neolithic (*cf. Rowley-Conwy 1992*).

Soil morphological evidence from the Trieste Karst suggests that caves were used as sheep pens, probably on a seasonal basis, as demonstrated by data from Pupićina Cave (*Miracle 1997*). The minimum number of individual capriovids in caves is usually very low (especially if we consider that it took at least a few hundred years for each layer to form), as is the quantity of pottery compared to open-air sites (*Müller 1994*). But thick deposits of animal dung (*Boschian and Montagnari-Kokelj 2000*) and environmental evidence of grazing around caves (*Turk et al. 1993*; see above) testify to an intensive seasonal presence of sheep. Caves, therefore, appear to be specialised sites, used mainly as (night?) shelters for animals. This may be compared to the practice of the New Mexico Navajo, who bedded their flocks close to their residences – hogans or rock shelters. They were allowed to graze nearby during the day, but in the evenings they were returned to the corrals (*Bailey 1980.77*).

In a lowland region, where we have evidence for open-air sites, perhaps a logistic (*Binford 1980*) pattern formed with caves "tethered" to central villages and visited by task specific groups with flocks on a seasonal schedule.

In marginal regions, where no open air-sites were found, caves may have been used as shelters for animals and shepherds in a system of residential mobility ("nomadism"), where families moved around the

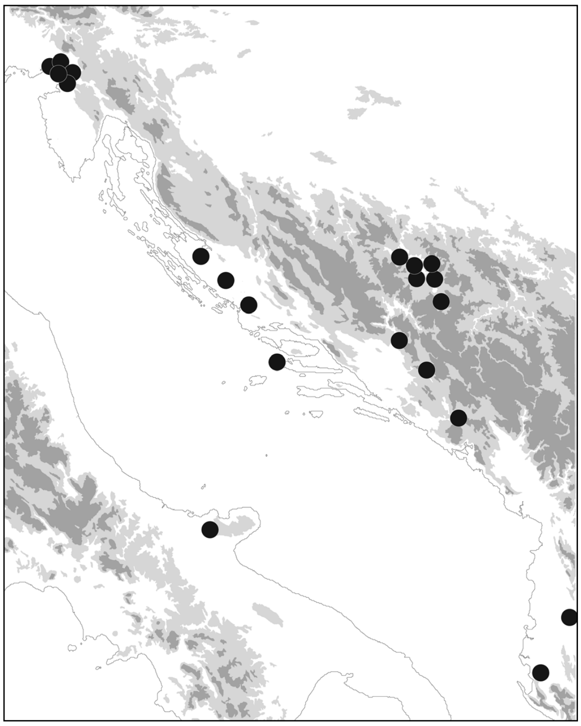


Fig. 5. Distribution of rhytons (after **Perić 1996*).***

landscape with their flock in the course of yearly round. Both mobility startegies are documented among contemporary Navajo (*Bloomberg 1983*).

With a few exceptions, pastoralism is either combined with agriculture, or depends for its persistence on its integration with agriculture within a larger regional division of labour (*cf. Khazanov 1984*). Thus herding emerged in regions where agriculture was established from the beginning; elsewhere, especially in more marginal regions, it was probably practiced alongside hunting or horticulture. Specialised pastoralist groups emerged probably not before the middle Neolithic, when we have widespread evidence of established pastoralism and when an inter-regional system of divided agro-pastoral labour and exchange emerged. The emergence of this wider economic system can be observed in the distribution of a special type of artefact the middle Neolithic rhyton ("vasi a quattro gambe"), which become widespread in the middle Neolithic, when pastoralsim become the main economic strategy. Although rhytons were interpreted as salt pots (*Chapman 1988*), its resemblance to a stylised (sheep?) udder or womb (*Perić 1996*) and its distribution in regions where sheep and goat were the main herding animals (Fig. 5) suggest that they were connected with a common set of values which were shared by east Adriatic herders. This interpretation may not contradict its possible role in the context of the salt trade, as salt became increasingly important for animal nutrition.

CONCLUSION

The transformation from hunter-gathering to herding societies which took place during the late Mesolithic and Neolithic on the east Adriatic coast was a deep structural transformation and not just an intensification of old strategies with new resources. Although it was basically a revolutionary change of values, the path to full-blown pastoralism was long and full of obstacles. Contradictions with old values, contrasts in the organisation of production, and problems in the scheduling of everyday activities attended the adoption of the herding way of life. It was much more than the mere incorporation of domestic animals into human society (*Hesse 1984.245*).

∴

REFERENCES

ANDRIČ M. 2001. Holocene vegetation dynamics and the formation of the Neolithic and present-day Slovenian landscape. In M. Budja (ed.), *Documenta praehistorica 28: 133–176*.

BAILEY L. R. 1980. *If you take my sheep. The evolution and conflicts of Navajo Pastoralism: 1630–1868*.

BEUG H.-J. 1961. Beiträge zür postglazialen Florenund Vegetationsgeschichte in Süddalmatien: der See "Malo Jezero" auf Mljet. *Flora 150: 600–631*.

1977. Vegetationsgeschichte Untersuchungen im Küstenbereich von Istrien (Jugoslawien). *Flora 166: 357–381*.

BASLER D 1983. *Paleolitske kulture u jadranskoj regiji Jugoslavije*. Glasnik Zemaljskoga muzeja u Sarajevu 38.

BENDER B. 1978. Gatherer-hunter to farmer: a social perspective. *World Archaeology 10(2): 204–222*.

BIAGI P., STARNINI E. and VOYTEK B. 1993. The late Mesolithic and early Neolithic settlement of northern

Italy: recent consideration. *Poročilo o raziskovanju paleolitika, neolitika in eneolitika v Sloveniji 21: 45–68*.

BINDER D. 2000. Mesolithic and Neolithic interaction in southern France and northern Italy: new data and current hypotheses. In T. D. Price (ed.), *Europe's first farmers: 117–143*.

BINFORD L. R. 1980. Willow smoke and dogs' tails: hunter-gatherer settlement systems and archaeological site formation. *American Antiquity 45: 4–20*.

BLOOMBERG B. 1983. *Mobility and sedentism: the Navajo of Black Mesa, Arizona*. Center for Archaeological Investigation Research, Paper No. 23. Carbondale, Southern Illinois University at Carbondale.

BOSCHIN F. and RIEDL A. 2000. The late Mesolithic and Neolithic fauna of the Edera Cave (Aurisina, Trieste Karst): a preliminary report. *Atti della Societá per la preistoria e protoistoria della regione Friuli-Venezia Giulia 8: 73–90*.

BOSCHIAN G. and MONTAGNARI KOKELJ E. 2000. Prehistoric shepherds and caves in the Trieste Karst (Nort-eastern Italy). *Geoarchaeology 15(4): 331–371*.

BRANDE A. 1989. Patterns of Holocene vegetation and landscape changes in south Dalmatia. *Ecologia Mediterranea 15(1–2): 45–53*.

BUDJA M. 1993. The Neolithisation of Europe. Slovenian aspect. *Poročilo raziskovanju paleolitika, neolitika in eneolitika v Sloveniji 21: 163–193*.

1996. Neolithization of Europe. The Slovene Aspect. Contribution to the Discussion. *Arheološki vestnik 47: 323–329*.

CHAPMAN J. 1988. Ceramic production and social differentation: the Dalmatian Neolithic and the west Mediterranean. *Journal of Mediterranean Archaeology 1(2): 3–25*.

1990. Demographic trends in Neothermal South-East Europe. In C. Bonsall (ed.), *The Mesolithic in Europe: papers presented at the third international symposium in Edinburgh 1985: 500–515*.

CHAPMAN J. and MÜLER J. 1990. Early farmers in the Mediterranean basin: the Dalmatian evidence. *Antiquity 64(242): 127–134*.

CHAPMAN J., SHIEL R. and BATOVIĆ Š. 1996. *The changing face of Dalmatia. Archaeological and ecological studies in a Mediterranean landscape*. London, Leicester University Press.

CHERRY J. F. 1990. The first colonisation of the Mediterranean islands: a review of recent research. *Journal of Mediterranean Archaeology 3: 145–221*.

CREMONESI G., MELUZZI C., PITTI C. and WILKENS B. 1984. Grota Azzura: Scavi 1982 (Nota preliminare). *Il Mesolithico sul Carso triestino, Società per la preistoria e protoistoria della regione Friuli-Venezia Giulia, Quaderno 5: 21–64*.

CRIBB R. 1991. *Nomads in archaeology*. Cambridge, Cambridge University Press. (New studies in archaeology).

CULIBERG M. 1994 (1995). Desertification and reforestation of the Karst in Slovenia (Dezertifikacija in reforestacija slovenskega Krasa). *Poročilo o raziskovanju paleolitika, neolitika in eneolitika v Sloveniji 22: 201–217*.

CVIJIĆ J. 1966. *Balkansko poluostrvo i južnoslovenske zemlje*. Beograd, Zavod za izradu učbenika SFRJ.

FORENBAHER S. and VRANJICAN P. 1985. Vaganačka pećina. *Opuscula archaeologica 10: 1–21*.

FORENBAHER S. 2001. *Vela špilja. A stratified praehistoric site*. http://www.vela-spila.hr/eng/

GEDDES D. S. 1983. Neolithic transhumance in the Mediterranean Pyrenees. *World archaeology 15: 51–66*.

1985. Mesolithic domestic sheep in west Mediterranean Europe. *Journal of Archaeological Science 12: 25–48*.

HALSTEAD P. 1987. Traditional and ancient rural economy in Mediterranean Europe: plus ça change? *Journal of Hellenistic Studies, CVII: 77–87*.

HAYDEN B. 1990. Nimrods, piscators, pluckers, and planters: the emergence of food production. *Journal of Anthropological Archaeology 9: 31–69*.

1995. Pathways to power: principles for creating socioeconomic inequalities. In T. D. Price and G. M. Feinman (eds.), *Foundations of social Inequality: 15–86*.

HESSE B. 1984. These are our goats: the origins of herding in west central Iran. In Clutton-Brock J. and Grigson C. (eds.), *Animals and Archaeology: 3. Early Herders and their Flocks, vol. 202*: *243–264*.

HIENDLEDER S., LEWALSKI H., WASSMUTH R. and JANKE A. 1998. The Complete Mitochondrial DNA Sequence of the Domestic Sheep (Ovis aries) and Comparision with the Other Major Ovine Haplotype. *Journal of Molecular Evolution, 47: 441–448*.

HIENDLEDER S., MAINZ K., PLANTE Y., and LEVANSKI H. 1989a. Analyisis of mitochondrial DNA indicates that domestic sheep are derived from two different ancestral maternal sources. No evidence for contribution from Urial and Argali sheep. *Journal of Heredity, 89: 113–120*.

INGOLD T. 1980. *Hunters, pastoralists and ranchers*. Cambridge, Cambridge University Press.

1986. *The appropriation of nature: Essays on human ecology and social relations*. Manchester, Manchester University Press.

KHAZANOV A. M. 1984. *Nomads and the outside world*. Cambridge, Cambridge University Press.

LEE R. B. 1979. *The !Kung San. Men, women and work in foraging society*. Cambridge, Cambridge University Press.

LEWTHWAITE J. 1981. Plains tails from the hills: transhumance in Mediterranean Archaeology. In J. A. Sheridan and G. N. Bailey (eds.), *Economic Archaeology. BAR int. series 96. Oxford, Archaeopress: 57–66*.

LUIKART G., GIELLY L., EXCOFFIER L., VIGNE J., BOUVET J., and TABERLET P. 2001. Multiple maternal origins and weak phylogeographic structure in domestic goats. *Proceedings of the National Academy of Sciences, 98(10): 5927–5932*.

MACHUGH D. E. and BRADLEY D. G. 2001. Livestock genetic origins: Goats buck the trend. *Proceedings of the National Academy of Sciences, 98(10): 5382–5384*.

MALEZ M. 1975. *Kvartarna fauna Crvene Stijene*. Crvena Stjena – Zbornik radova. Nikšić.

MARKOVIĆ M. 1980 *Stočarska kretanja na Dinarskim planinama*. ZbNŽO, knjiga 45. Zagreb.

MIRACLE P. 1997. Early Holocene foragers in the karst of northern Istria. *Poročilo raziskovanju paleolitika, neolitika in eneolitika v Sloveniji 24: 43– 61*.

2001. Feast or famine? Epipaleolithic subsistence in the northern Adriatic Basin. In M. Budja (ed.), *Documenta Praehistorica 28: 177–197*.

MÜLLER J. 1994. *Das ostadriatische Frühneolitikums. Die Impresso-Kultur und die Neolithisierung des Adriaraumes*. Prähistorische Archäologie Südosteuropas 9.

OLARIA C. 1988. *Cova Fosca: un asentamiento meso-neolíthico de cazadores y pastores en la serranía del Alto Maestrazgo*. Monografies de Prehistoria i Arquelogia Castellonenques 3. Castelon: Disputación de Castelón.

PERIĆ S. 1996. Kult-Rythone der neolitischen Vierhzüchter der Balkanhalbinsel. *Starinar 47: 21–66*.

POHAR V. 1986. Kostni ostanki iz mezolitskega najdišča Pod Črmukljo pri Šembijah (Ilirska Bistrica). *Poročilo o raziskovanju paleolitika, neolitika in eneolitika v Sloveniji 14: 11–20*.

RIEDEL A. 1975. La fauna epipaleolitica della grotta Benussi (Trieste). *Atti e memorie della commissione grotte "E. Boegan" 15: 123–144*.

ROWLEY-CONWY P. B. 1992. Arene Candide: a small part of a larger pastoral system. In R. Maggi, R. Nisbet and G. Barker (eds.), *Archeologia della pastorizia nell'Europa meridionale. Rivista di studi Liguri A. 61, 1–4: 95–116*.

RYDER M. L. 1984. *Sheep and man*. London. Duckworth.

SAHLINS M. 1972. *Stone age economics*. Chichago, Aldine.

STERUD E. 1978. Prehistoric populations of the Dinaric Alps: an investigation of Interregional interaction. In C. L. Redman, M. J. Berman, E. V. Curtin, W. T. Versaggi and J. C. Wanser (eds.), *Social archaeology: beyond subistence and dating: 381–408*.

ŠAŠEL J. 1979. Aditus ad aquam. *Traditiones 5–6: 353–361*.

TURK I., MODRIJAN Z., PRUS T., CULIBERG M., ŠERCELJ A., PERKO V., DIRJEC J. and PAVLIN P. 1993.

Podmol pri Kastelcu – novo večplastno arheološko najdišče na Krasu, Slovenija. *Arheološki vestnik 44: 45–96*.

ZILHÃO J. 1993. The spread of agro-pastoral economies across Mediterranean Europe: a view from the far west. *Journal of Mediterranean Archaeology 6: 5–63*.

1998. Maritime pioneer colonisation in the early Neolithic of the west Mediterranean. *Poročilo o raziskovanju paleolitika, neolitike in eneolitika v Sloveniji 24: 19–24*.

2001. Radiocarbon evidence for maritime pioneer colonization at the orogins of farming in west Mediterranean Europe. *Proceedings of the National Academy of Sciences, 98(24): 14180–14185*.

VELUŠČEK A. 1995. Proces neolitizacije kot prehod h kmetovanju, prepoznan v mezolitskih kontekstih kraške Dinarske Slovenije? *Arheološki vestnik 46: 327–337*.

VRIŠČAK T. 1989. Kuda idu "horvatski nomadi"? *Studia Ethnologica 1: 79–98*.

WARREN G. 1997. Seascapes: Navigating the coastal Mesolithic of Western Scotland. *Assemblage 2*. http:// http://www.shef.ac.uk/assem/2/2war1.html

WATTS D. J and STROGATZ S. H. 1998. Collective dynamics of 'small world' networks. *Nature 393(4): 440–442*.

WILKENS B. 1992. Il ruolo della pastorizia nelle economie preistoriche dell'Italia centro-meridionale. In R. Maggi, R. Nisbet and G. Barker (eds.), *Archeologia della pastorizia nell'Europa meridionale. Rivista di studi Liguri A. 61, 1–4: 81–94*.

WOBST M. 1974. Boundary conditions for Palaeolithic social systems: a simulation approach. *American Antiquity 39: 147–178*.

UDK 903(560)"634":621.968-032.5
Documenta Praehistorica XXX

The latest results from the technological and typological analysis of chipped stone assemblages from Ilipinar, Pendik, Fikir tepe and Menteşe, NW Turkey

Ivan Gatsov
New Bulgarian University, Archaeological Institute and Museum, BAS, Sofia, BG
igatsov@yahoo.com

ABSTRACT – *The papers presents the latest results from the technological and typological analysis of chipped stone assemblages from Ilipinar, Pendik, Fikir tepe, and Menteşe in NW Turkey. The stone industry of Ilipinar shows parallels with the chipped stone material from Fikir tepe. At Ilipinar the period of technological and raw material changes in Bulgarian Thrace correspond to the end of phase V–A and to the whole V–B, but the technological and typological features are completely different.*

IZVLEČEK – *V članku predstavimo najnovejše rezultate tehnoloških in tipoloških analiz kamenega orodja iz najdišč Ilipinar, Pendik, Fikir tepe in Menteşe na severozahodu Turčije. Kamena industrija iz Ilipinarja kaže podobnosti s kamenim materialom z najdišča Fikir tepe. Na najdišču Ilipinar obdobje tehnoloških sprememb in sprememb surovine v bolgarski Trakiji odgovarja koncu faze V–A in celotna faza V–B, toda tehnološke in tipološke značilnosti so popolnoma drugačne.*

KEY WORDS – *core; flake and blade manufacturing; tool; retouch*

The main information concerning the sites mentioned below can be found in the work of J. Roodenberg (*Roodenberg 1995; Roodenberg, Thissen 2001*), and M. Özdoğan (*Özdoğan M. 1989; 1995; 1998; Gatsov 2000*).

Ilipinar

The Ilipinar chipped stone industry is characterized by flake manufacturing and flake transformation into retouched tools. The other main feature is blade production, mostly used for manufacturing, the use of unmodified blades. The frequency of blade tools is low, and the blade perforators as its best diagnostic features may be considered.

In the earliest phases, X and IX obsidian artefacts are recorded in greater quantities, while in the remaining phases their frequency is considerably lower. The obsidian blade manufacturing was directed towards bladelet and blade production. At this stage of research in Ilipinar any downturn changes in the stone technology are observed. Although there is less material from these phases, the proportion between the categories as well as the main technological and typological characteristic in all phases of Ilipinar are similar (Figs. 1–4). The methods of obtaining raw materials and the organization of production were connected with flake core knapping off the area investigated. The predominance of butts prepared by a blow butts suggests that flake core preparation was concentrated mainly on the core platform. As a main feature of these activities, ad hoc flake manufacturing and transformation can be considered. An alternative method of organizing flint and obsidian blade manufacturing was made on spot in the area under study. It should be stressed that very a small part of this type of blank was later modified into blade retouched specimens.

Here some problems arise with the occurrence of prismatic "bullet" cores. The question is whether they can be seen as a technological indicator of an earlier technological tradition, or as a feature of

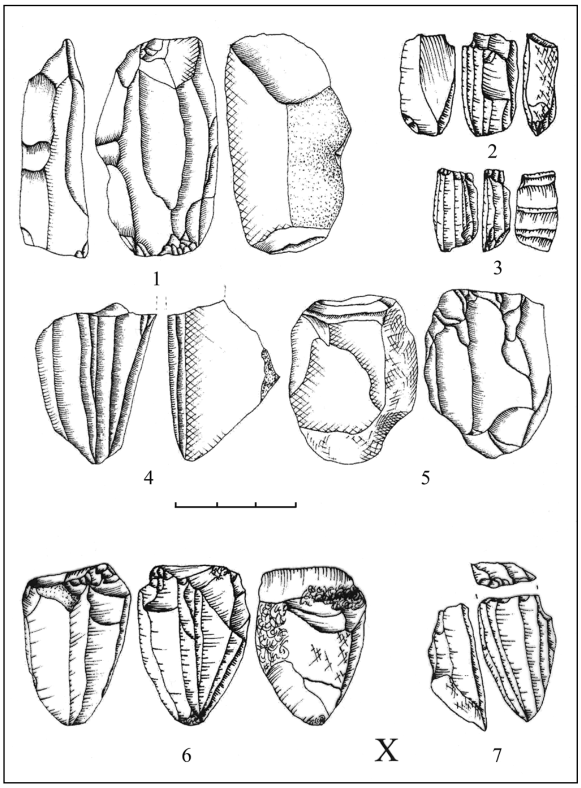


Fig. 1. Ilipinar, Phase X, 1–7 – cores.

some technological influence from other areas. The other question that arises concerns the site of this industry. Up to now the parallels with Fikir tepe are more or less established (*Gatsov 2001*). But how does one explain the roots of the Ilipinar industry? Where are the balance and the limits between technological traditions and functional determination?

Fikir tepe

About Fikir tepe some characteristic features can be detected. At this site two production chains are revealed. The first is linked with the exploitation of cores for flakes. The former were used for tool manufacturing and especially for flat cortical end scrapers, as well as massive ones. The other production chain is connected with blade acquisition. For this purpose, blade single platforms, as well as prismatic ones, were used. These types of cores do not fit with the more or less large flake tools. Blade tools are characterized by blade perforators with steep or semi steep retouching on the edges, partial or continuous (Fig. 5). As far the chipped stone assemblages analyzed are concerned, they probably resulted from similar methods of flake and blade production. In both cases similar to the Ilipinar the cores had been used. They reflected the above mention two types of production chains similar to the Ilipinar ones. These chains, as well as their intended products in the shape of flake end scrapers and blade perforators, show definite parallels between the Fikir tepe and Ilipinar chipped stone assemblages.

Pendik

The chipped stone material was collected from two trenches. Both collections show clear typological monotony, which is seen mainly in flake end scrapers, perforators, and retouched blades (Fig. 6). Unfortunately, the quantity of the material (debitage and retouched specimens) is not enough for more detailed comparisons, or to establish more certain parallels. At this stage of research it seems that there are certain similarities between the Pendik and Ilipinar assemblages. These parallels can be found in the similar morphological parameters of the flake end scrapers and blade perforators. The occurrence of the same type of flake end scrapers and blade perforators with steep partial retouch in Pendik and Ilipinar can be drawn. Here, the basis for searching for similarities or not can come more from ceramic and others type of finds and less from stone artefacts (*Gatsov in print*).

Menteşe

Further below the preliminary results from the technological and typological analysis of the chipped stone artifacts from Menteşe are presented. This ma-

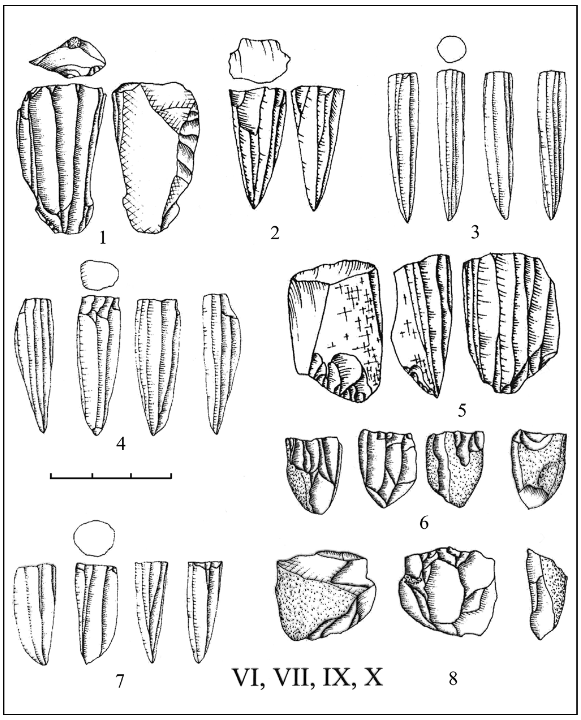


Fig. 2. Ilipinar, phases VI, VII, IX, X – cores.

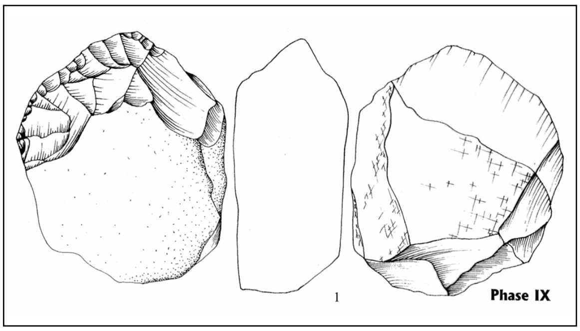


Fig. 3. Ilipinar, phase IX–macro end scraper.

terial belongs to the earlier sequence of the site, and was connected with a trench covering approximately 28 m^2.

The collection contains a small quantity of flint and obsidian cores, mostly blades, fewer flakes, and very few fragments and chips. To some degree the latter may be due to the material not having been sieved. The flint and obsidian cores are presented by single platform items, mainly for blades and bladelets, and in the final stage of exploitation. Some examples are close to the prismatic ones. The core processing was carried out from one platform. Most of the cores have a flat or semi rounded striking surface. Only few items of cores with changed orientation were recorded. These were usually primary single platform cores which were transmitted in multi directional ones. In this way, all surfaces were used. As a rule, core length was 5–7 cm. It is characteristic that most of the predominant blades in this collection had very low thickness values. The presence of punctiform butts suggests that for blade detaching a punch was used. As was mentioned above, fragments and chips were almost entirely absent. The frequency of retouched tools is relatively small. This category is represented mostly by flake end scrapers and retouched blades (Fig. 7, Fig. 8). It is worth noticing the presence of obsidian trimming blades, as well as a massive core fragment. It is perhaps likely that core processing was done on the spot.

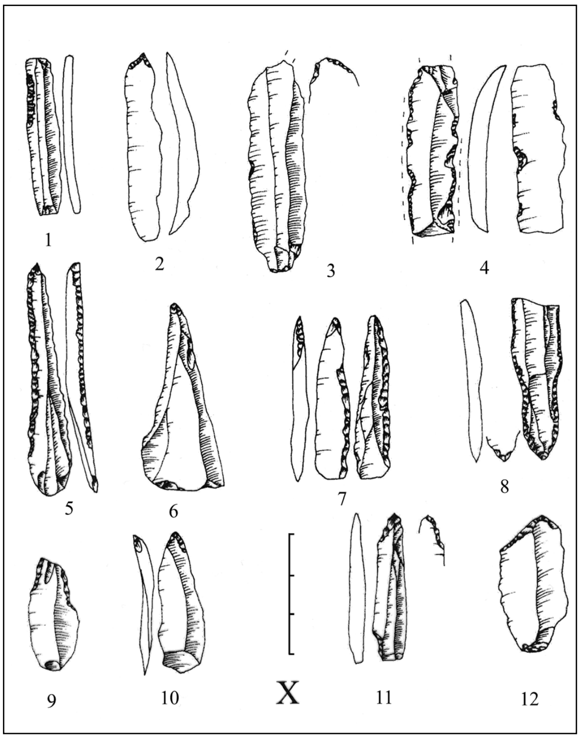


Fig. 4. Ilipinar, phase X–1–12 – perfotarors.

At the present stage of research I would like to suggest that the material from Menteşe could be a little earlier than earliest phase X at Ilipinar.

Here it is worth adding the opinion of Dr. A. van As and Dr. M.-H. Wijnen about the Menteşe pottery: "The pottery from Menteş coe Höyük, excavated in 2000, was manufactured by a combination of modelling and coiling techniques and fired in an open fire in reducing to neutral conditions. As a result the pottery has mostly a light grey-brown to dark grey brown colour, although clear reds occur. In the upper levels deep black becomes more common. A large amount of the pottery had a high glossy burnished outer surface. In the upper levels vessels with a S-shaped profile were very common; preliminary results indicate that in the lower levels the S-shape was far less pronounced, whereas the simple plain-rimmed, hole-mouth vessel became more common. Vessels had, in general, a flat base; the whole sample yielded only one ring-base. Decoration is relatively sparse – maximal 2% of the total sample. It always consists of shallow incised groves arranged in simple geometric patterns. The higher levels yielded

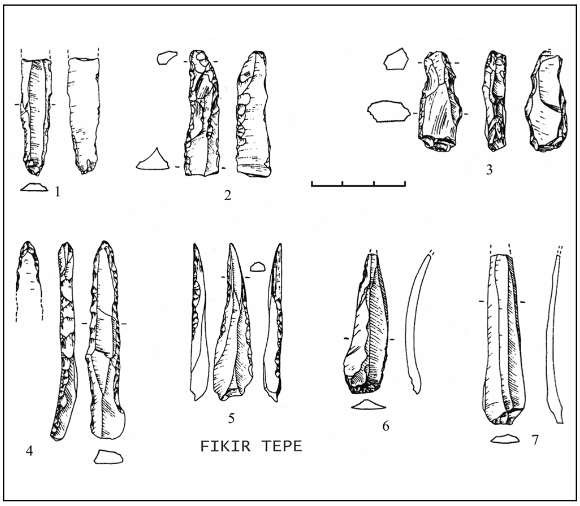


Fig. 5. Fikir tepe 1–7 perforators.

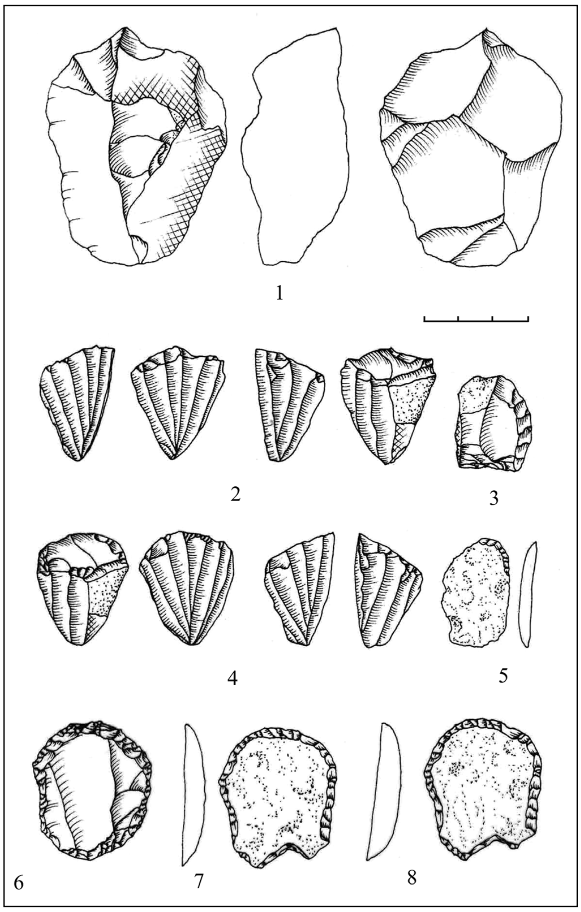


Fig. 6. Pendik 1–8 cores and end-scrapers.

also the remains of at least two rectangular boxes on feet, decorated with incised geometric patterns. Concluding, it can be said that the pottery from Menteşe fits perfectly in the Fikirtepe-sequence." (This information was included in my report concerning the Menteşe Höyük chipped stone collection presented at Thessaloniki 8th EAA Annual Meeting, 2002. Here I would like to thank to Dr. M.-H. Wijnen and Dr. A. van As for their help.)

CONCLUSION

In my opinion, the stone industry of Ilipinar shows undoubted parallels with the chipped stone material from Fikir tepe, but the problem is not only in looking for a synchronic connection. The main problem that arises is to what degree some of the features of the Ilipinar industry can be considered as a link between the assemblages, which are earlier or later than Ilipinar.

The main obstacle to answering this question is the weak comparative base. In West Anatolia the database is still insifficient. In Turkish Thrace few assemblages are studied only. The lack of stratified sites from the presumably earlier Epipalaeolithic periods poses additional obstacles.

As for Epipalaeolithic sites, only the collections from the Turkish Black Sea cost can be taken into account (*Gatsov and Özdoğan 1994*). These materials were found on the surface. They are characterized by small sized single platform cores for blades and bladelets. The core shape is defined by blank detachment executed from all striking surfaces. In my opinion, it is hard to say that definite connections exist between the Black Sea and Ilipinar collections. It is also impossible to make a comparison with the Bulgarian Early Neolithic chipped stone assemblages from Thrace. The stone material from this part of Thrace is marked by macro blade technology. As a matter of fact, flakes and flake tools are missing. There is a marked typological monotony, which consists of blades with high semi-steep or steep retouching, as well as with similar specimens with rounded ends – type Karanovo I and II. The retouched implements are represented by different modifications to the type of blanks – retouch blades, blade perforators, blade end scrapers, blade truncations. The occurrence of macro technology falls between 6000 BC and 5500 BC, and covers the Early Neolithic period in this area. The raw material is of a very high quality yellow flint, with or without inclusions. Probably the sour-

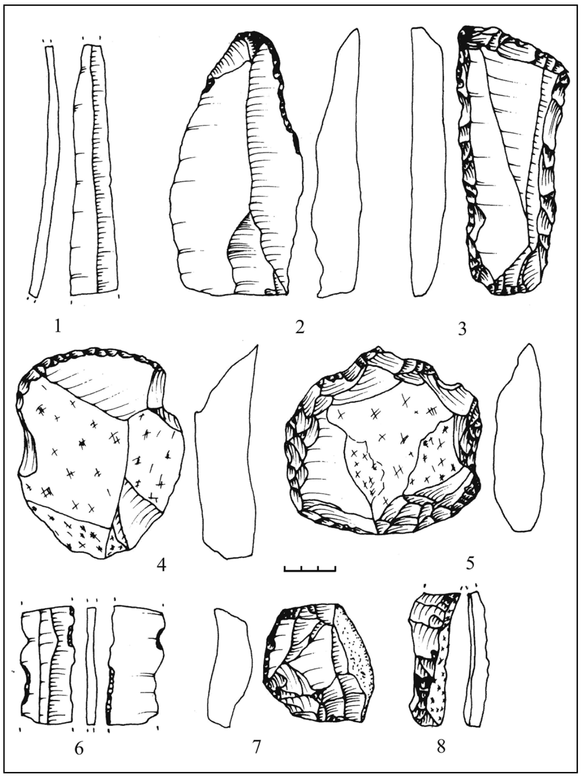


Fig. 7. Menteşe 1–8 blades and retouched tools.

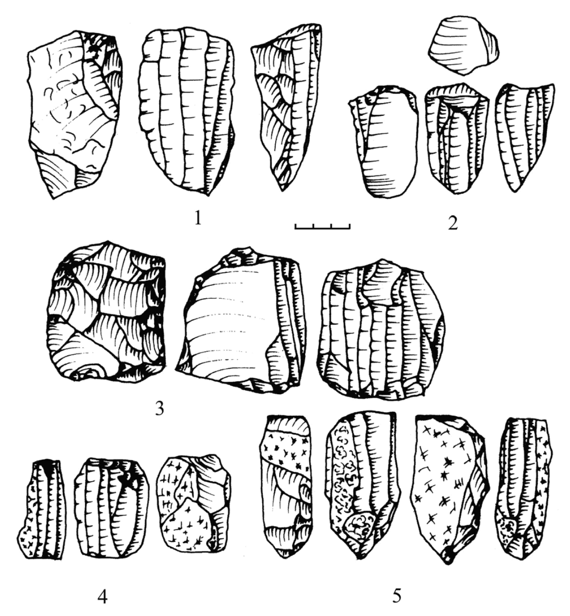


Fig. 8. Menteşe 1–5 cores.

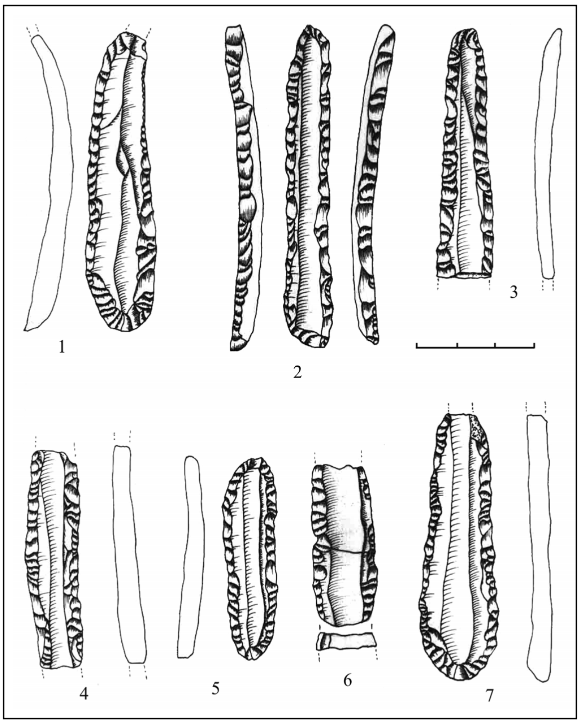


Fig. 9. Hoca Çeşme 1–7 blade with high retouch.

ces of this raw material lie in the region of Bulgarian Thrace – not far from the settlements of Karanovo and Azmak. Unfortunately, studies of the spatial distribution of raw materials have not been conducted (*Gatsov and Kurchatov 1997*).

In the region of Turkish Thrace, only a few blade macro blades have been found in phase II of Hoca Çeşme (Fig. 9). Thus far the area of Karanovo and Azmak can be considered as a centre of this "macro blade area". The last is limited to the Stranga/Sakar region and the upper part of the Maritza (Meric) River in present-day Bulgaria.

Another interesting feature is linked with the decline of macro technology in the region considered. After 5500 BC technological changes occurred in Bulgarian Thrace. The changes can be seen in a technological and typological degradation, and it has to be pointed out that the high quality yellow flint was replaced by less quality raw material. The Early Neolithic structure of raw material supply strategies, the organization of production, and the high degree of specialization disappeared for no obvious reasons (*Gatsov and Gurova 2001*).

At Ilipinar the period of technological and raw material changes in Bulgarian Thrace correspond to the end of phase V–A and to the whole of V–B, but the technological and typological features are completely different (*Gatsov 2001*).

The present analysis may serve in future for analytical purposes when more material becomes available, which is why this work is confined to the limits of technological and typological attributes and raw materials.

ACKNOWLEDGEMENTS

I would like to thank to Prof. Dr. M. Özdoğan and Dr. J. Roodenberg, who kindly offered the chipped stone collections from NW Turkey to me for research.

REFERENCES

GATSOV I. 2000. Chipped stone assemblages from South Bulgaria and North – West Turkey. Epipapaeolithic/Mesolithic and Neolithic. *BAR, International Series, 854: 1–28*.

2001. Epipalaeolithic/Mesolithic and Neolithic Periods Chipped Stone Assemblages from Southern Bulgaria and Northwest Turkey: Similarities and Differences. *TUBA – AR 4: 101–112*.

(in press.) Chipped stone assemblage from Pendik, NW Turkey. In Festschrift for Prof. U. Esin. Istanbul University.

GATSOV I. and GUROVA M. 2001. Some remarks on chipped stone industries of the earliest Neolithic cultures in Bulgaria. In B. Ginter (ed.), *Problems of the Stone Age in the Old World: 249–264*.

GATSOV I. and KURCHATOV V. 1997. Neolithische Feursteinartefakte Osterreichisch – Bulgarische. In S. Hiller and V. Nikolov (eds.), *Ausgrabungen in Karanovo. Bd. I: 213–234*.

ÖZDOĞAN M. 1989. Neolithic cultures of Northwestern Turkey. In S. Bokoni (ed.), *Neolithic of Southeastern Europe and its Near Eastern Connections. Varia Archaeologica Hungarica II: 201–215*.

1995. Neolithic in Turkey. In Reading in Prehistory. *Studies presented to Halet Cambel: 53–55*.

1998. Recent excavations in Eastern Thrace and Contact between the Prehistoric Cultures of Anatolia and Balkans (abstract in English). *TUBA – AR, 1: 63–92*.

ÖZDOĞAN M. and GATSOV I. 1994. Some Epi-Palaeolithic Sites in NW Turkey. *Anatolica: 97–120*.

ROODENBERG J. J. 1995. *The Ilipinar excavation I. Five seasons in Fieldwork in NW Anatolia 1987–1991*. Istanbul.

ROODENBERG J. J. and THISSEN L. C. (eds.) 2001. *The Ilipinar Excavations II Nederlands Instituut Voor Het Nabije Oosten, Leiden*.

UDK 903'12/'15(4)"634":575.113
Documenta Praehistorica XXX

The Neolithic transition in Europe: archaeological models and genetic evidence

Martin Richards
Department of Chemical and Biological Sciences, University of Huddersfield, UK
m.b.richards@hud.ac.uk

ABSTRACT – *The major pattern in the European gene pool is a southeast-northwest frequency gradient of classic genetic markers such as blood groups, which population geneticists initially attributed to the demographic impact of Neolithic farmers dispersing from the Near East. Molecular genetics has enriched this picture, with analyses of mitochondrial DNA and the Y chromosome allowing a more detailed exploration of alternative models for the spread of the Neolithic into Europe. This paper considers a range of possible models in the light of the detailed information now emerging from genetic studies.*

IZVLEČEK – *Glavni vzorec evropskega genskega bazena je gradient klasičnih genskih markerjev v smeri jugovzhod-severozahod. Tak marker je na primer krvna skupina. Njen gradient so populacijski genetiki prvotno pripisovali demografskemu vplivu neolitskih kmetovalcev, ki so se razširili iz Bližnjega vzhoda. Molekularni genetiki so to sliko obogatili z analizami mitohondrijske DNA in Y kromosoma, kar je omogočilo podrobnejši razvoj alternativnih modelov razširjanja neolitika v Evropo. V članku pretehtamo več možnih modelov v luči podrobnih informacij, ki jih danes dajejo genske raziskave.*

KEY WORDS – Neolithic farmers; Mesolithic foragers; mitochondrial DNA; Y chromosome; phylogeography

MODELS OF NEOLITHIC DISPERSAL

How did the Neolithic spread from the Near East into Europe? In the past, this issue has often been polarised as an either/or between 'demic diffusion', usually taken to mean a large-scale movement into Europe of Near Eastern farming people, versus 'cultural diffusion', in which it is rather the idea of farming that spread. However, in recent years the range of possible models has become rather more nuanced. Zvelebil (*2000*) has listed seven possible mechanisms:

❶ Folk migration. This is the traditional migrationist explanation: the directional movement of a whole population from one region to another, leading to genetic replacement.
❷ Demic diffusion, by means of a wave of advance.
❸ Élite dominance, in which a social élite penetrates an area and imposes a new culture on the local population.
❹ Infiltration of a community, for example by small numbers of specialists fulfilling a particular need, such as livestock farmers.
❺ Leapfrog colonization by small groups targeting optimal areas, to form an enclave surrounded by indigenous inhabitants.
❻ Frontier mobility, or exchange between farmers and foragers at agricultural frontier zones;
❼ Regional contact, involving trade and exchange of ideas.

In this article, we will ask whether it is possible to use the existing genetic evidence to begin to distinguish these possibilities.

What would be the genetic predictions for each of these models? If we assume, for the sake of argument, that the Near East and Europe can be cleanly partitioned and were genetically distinct prior to the onset of the Neolithic, then different models may be taken to predict different genetic patterns.

The first model is classic "migrationism" and would involve genetic replacement, so that the sink region (Europe) should be genetically indistinguishable from the source (the Near East), except for any differentiation that had taken place within the last 8000 years. Model (7) would involve no movement of genes whatsoever – Ammerman's "indigenism" (*Ammerman 1989*). This would include both cultural diffusion (*Dennell 1983; Barker 1985; Whittle 1996*) and separate development, in which the social and ideological, rather than economic, aspects of the Neolithic take centre stage (*Hodder 1990; Thomas 1996; 1998*). In this case, the source and sink regions should remain genetically distinct, except for the effects of any post-Neolithic gene flow between them.

Models (2) to (6) are all "integrationist" (*Zvelebil 2000*) in character, involving both the arrival of new genetic lineages in an area, and the eventual acculturation of the indigenous communities. Élite dominance might show minor evidence of newcomers, although it might not be relevant to the question of the early Neolithic (*Renfrew 1987*). The wave of advance model predicts continent-wide genetic clines (*Ammerman and Cavalli-Sforza 1984*). Infiltration and leapfrog colonization would be likely to leave traces of Near Eastern lineages in the regions where they had occurred, but in patches rather than in the form of clear clines. Frontier mobility would allow for genetic exchange between colonised, newly Neolithic areas such as central Europe, and forager strongholds to the north and west. In each of these, however, any genetic discontinuities might tend to be eroded over time as the effects of subsequent gene flow acted to blur the picture.

CLASSICAL MARKERS

It has long been assumed (by population geneticists, at least), that classical markers support the Ammerman and Cavalli-Sforza (*1984*) model of demic diffusion by means of a wave of advance. This model depended on a view of the early Neolithic that emphasized sedentism, local population growth, and expansion into more marginal environments. Ammerman and Cavalli-Sforza (*1984*) modelled the expansion using Fisher's "wave of advance", and compared the results with radiocarbon maps of the spread of the "Neolithic package" across Europe. The "package" included emmer wheat, einkorn wheat and barley – whose wild progenitors occurred only in the Fertile Crescent region of the Near East – domestic animals, pottery, ground and polished stone tools, and houses. However, they often relied upon one or two "marker" items, rather than the whole package.

This smoothing led to their estimation of a uniform rate of spread across Europe of about one kilometre per year, or 25 kilometres per generation – from Greece to the British Isles in about 2500 years. This led them to the idea of a single all-embracing mechanism, which they called "demic diffusion". This was intended to be distinct not only from cultural diffusion, or the spread of ideas, but also from good old-fashioned directed colonization. The mechanism they proposed was the wave of advance: logistic population growth (resulting from agricultural surpluses and storage) plus random local migratory diffusion or range expansion. They referred to it as "colonization without colonists".

The so-called classical markers, or non-DNA markers, comprise allele frequencies for blood groups, the tissue antigen HLA system, and some enzymes. The signal from these markers was not strong, and moreover, different markers gave different signals. Furthermore, it was clear that Europe and the Near East were not as genetically differentiated as Ammerman and Cavalli-Sforza would have liked. So they took a multivariate approach, choosing principal-component (PC) analysis (*Menozzi et al. 1978*), and presented the results, component by component, as synthetic contour maps, showing the changes in frequency with geography.

The first PC, accounting for about 27% of the total variation in classical marker frequencies across Europe and the Near East, famously showed a gradient from the southeast to the northwest, with the Near East at one pole and Europe at the other. This pattern was clearly reminiscent of the radiocarbon map for the spread of the Neolithic. This was, Cavalli-Sforza and his colleagues believed, strong evidence for a mixed demic diffusion hypothesis, in which there was both a demic expansion and intermarriage with local hunter-gatherers on the way. The second and third components (explaining about 22% and 11% of the variation respectively) showed gradients that were oriented roughly southwest-northeast and east-west. Because of their lower impact on the genetic variation, they were assumed to have been the result of processes that had taken place since than the Neolithic.

The conclusions of Ammerman and Cavalli-Sforza and their colleagues were supported by Sokal and colleagues (*Sokal et al. 1989; 1991*), using spatial autocorrelation analysis. This approach also indicated that about a third of classical markers were arranged in a southeast-northwest cline. With this backing, the assumed model of surplus-driven population growth and expansion gained ground and began to be taken for granted amongst population geneticists. Despite the inability of these methods to quantify the demographic impact of the Neolithic newcomers, the role of the putative pioneers came to be emphasized at the expense of the indigenous Mesolithic peoples of Europe. Furthermore, the idea that the PC maps could be interpreted chronologically, like archaeological stratigraphy, also took hold (*Cavalli-Sforza 1996*).

However, gradually some criticisms were expressed. Why interpret the first PC solely in terms of Neolithic expansion? Europe is a small peninsula of the Eurasian landmass, and as such is likely to have been the sink for many dispersals throughout prehistory. The PC maps were much more likely to represent a palimpsest of dispersals, each one overwriting the last (*Zvelebil 1989; 1998*). The idea of "one PC–one migration", suggested quite specifically by Cavalli-Sforza, was highly implausible; and this disposed equally of the idea that principal components provided a genetic stratigraphy. Indeed, the problematic second PC, running southwest–northeast, was increasingly looking as if it might be explained at least in part by Lateglacial hunter-gatherer expansions, preceding the Neolithic by more than 5000 years (*Torroni et al. 1998*).

The archaeological aspects of Ammerman and Cavalli-Sforza's work also sustained criticism. Items in the "Neolithic package", it was pointed out, rarely moved together, except in southeast and central Europe, and they were often exchanged into Mesolithic communities (*Thomas 1996; Zvelebil 1986; Price 2000*). This could have led Ammerman and Cavalli-Sforza to over-estimate the impact of the Neolithic and the uniformity of its spread. More recent studies have tended to emphasize that the spread of the Neolithic was a heterogeneous process, with no evidence in the archaeological record for large-scale continent-wide immigration (*Pluciennik 1998; Zvelebil 2000*). Furthermore, the link between Neolithic populations and high population density, and Mesolithic ones and low density, has not survived more detailed study. The archaeological and palynological records suggested that the high growth potential of Neolithic communities was very unlikely ever to have been achieved during the early millennia of farming (*Willis and Bennett 1994; van Andel and Runnels 1995; Roberts 1998.154–8*). At the same time, riverine and coastal Mesolithic communities may well have allowed the growth of affluent, complex foraging communities, with higher population densities, and a much higher degree of sedentism, than once assumed (*Zvelebil 1986*).

MOLECULAR MARKERS AND PHYLOGEOGRAPHY

In the 1980s, it became possible to analyse not merely the products of certain genes, as had been done in the "classical" analyses, but the DNA sequences of the genes themselves. For studies of evolution and migration, attention has focused on the two non-recombining genetic loci in humans. The mitochondrial DNA (mtDNA) is present in both sexes, but inherited only down the maternal line, whereas the Y chromosome is present only in males and is inherited only from father to son. Although future studies will focus on the remaining, recombining parts of the genome – the X chromosome and the autosomes – there are two particular advantages to the non-recombining systems, in which variation is not reshuffled between different lineages with every passing generation, but is inherited down a single line of descent.

❶ Phylogenies, or genealogical trees, can be estimated. Both mtDNA and the Y chromosome can be seen as genetic systems in which mutations fall onto an independently-formed genealogy: the maternal and paternal lines of descent, respectively. Any sample of individual subjects will have a defined set of genealogical relations on both the maternal and paternal side, so that in principle a tree of ancestry could be reconstructed for each. The mtDNA and the Y chromosome both allow us to estimate those trees, because both systems have recorded a trace of the pattern of descent, as mutations have inscribed variants into their DNA sequences during the course of history. This implies a dramatic increase in the resolution of processes involving individuals, such as prehistoric dispersals (*Richards and Macaulay 2000*).

❷ Lineages can be dated, using the molecular clock. Although not as reliable as radiocarbon dating, this represents a great improvement on the analysis of frequencies of classical markers where, as we have seen, dating is a problem even if it could be assumed that a particular genetic pattern has been produced by a single process.

These developments have led to the development of what has been termed the "phylogeographic" approach (*Richards et al. 1997; Bandelt et al. 2002*). Phylogeography is a heuristic tool for interpreting complex population-genetic data that tries to make maximum use of reconstructed trees of descent, along with the geographic distribution and diversity of genealogical lineages; it is effectively the mapping of gene genealogies in time and space (*Avise 2000.3*). The process of testing phylogeographic hypotheses always entails making assumptions, and inevitably has to be carried out within a model or framework based on external information (such as from archaeology). Even so, the assumptions themselves can often be susceptible to empirical investigation, and may often be less unrealistic than those of more traditional population-genetics approaches (*Richards et al. 2000*).

MITOCHONDRIAL DNA

The first major application of phylogeographic procedures to the question of European genetic variation was an analysis of mitochondrial DNA (mtDNA) (*Richards et al. 1996*). This work made use of a new phylogenetic-network approach to tree reconstruction, developing new phylogeographic approaches, such as founder analysis, to the study of migration and colonization.

Founder analysis works by comparing the genetic variation in a region that has been settled (the sink population) with that in likely source populations, in order to identify founder sequence types and use them to date individual migration events (*Richards and Macaulay 2000*). This is done explicitly to avoid the charge that "the age of a population is not the age of the common molecular ancestor of its set of DNA sequences", although curiously this criticism continues to be made (*Barbujani et al. 1998; Chikhi et al. 1998; Barbujani and Chikhi 2000*). When there is an individual migration event from the source to the sink region, so that a founder event occurs, the molecular clock is effectively reset, so that the descendants of that individual can be regarded as members of a new line of descent tracing to the time of arrival. The molecular age of the founder type in the source population will of course be older – perhaps much older. Founder analysis proceeds by subtracting from the mutational variation in the sink population that fraction of the variation that arose in the source population and has been carried into the sink region by the founders during the colonization process. This is done so that only the new mutations that have arisen since the colonization are used when estimating dates.

The initial, rather tentative, results from European mtDNA suggested that the majority of lineages appeared to descend from founders of Middle or Late Upper Palaeolithic origin, implying re-expansions in the Lateglacial or post-glacial period. Only a fifth or less dated to the Neolithic (*Richards et al. 1996; 1998*).

Further work by Torroni and colleagues (*1998; 2001*) strikingly confirmed the existence of major Lateglacial expansions from southwest Europe, suggesting a plausible explanation for the second PC of classical markers. Meanwhile, Richards et al. (*2000*) carried out a much more thorough founder analysis of a greatly enlarged Near Eastern and European mtDNA data set. Although it is very difficult to extrapolate to the scale of the immigration at the time, it is possible at least to estimate the proportion of lineages in the modern population that descend from one or other immigration event. They found that about three-quarters of modern mtDNA lineages could be traced to just eleven ancestors (the remaining quarter comprising a larger set of minor founders). Under a range of assumptions, the putative Neolithic component in modern Europe (i.e., those lineages that appeared from the Near East about 9000 years ago) occurs at between 12%–23%, the best estimate being ~13%. Lateglacial expansions were conflated with preceding Middle Upper Palaeolithic immigration, but between them accounted for almost 70% of modern lineages. It appeared that, on the maternal line of descent, only a small fraction of modern Europeans were descended from Near Eastern farmers; in the main, they were descended from indigenous European foragers, who adopted farming later on.

A number of critiques of this work have appeared, guided by classical population-genetics approaches rather than phylogeography, in particular the dating of "population splits" (*Chikhi et al. 1998; Barbujani and Bertorelle 2001*). This approach, however, fails to provide dates that are genuinely meaningful in terms of demographic history (*Bandelt et al. 2002*). Critiques of the statistical validity of the founder analysis may have more force, since it relies on the sample size in the source population being adequate to identify all of the most important founder types. However, some limited resampling tests have given very similar results, particularly for the Neolithic contribution (*Richards et al. 2000*). This reanalysis used only the "core" Fertile Crescent data, omitting

Anatolia, Egypt, and the southern Caucasus. It may also help, therefore, to address the Eurocentric bias of the main analyses, which draw rather a sharp division between "Europe" and the "Near East" at the Bosporus and Caucasus mountains (*M. Özdoğan, personal communication*).

Richards et al. (*2000*) also repeated the analysis at the regional level. It must be pointed out that this approach has serious limitations. In the first place, the results for any one region are based on fewer data and are therefore naturally associated with greater uncertainty. Moreover, the regional data are of variable quality, and may poorly represent the deep ancestry of lineages within each region in some cases (such as eastern Europe and Greece). Finally, the results are, at best, estimating the proportion of lineages in the present-day population that can be attributed to each founder event from the Near East (or to bottlenecks within Europe), rather than from the immediate source region. Given these caveats, the results may nevertheless bear some discussion.

The analysis suggested that the highest Neolithic impact was on southeast Europe, central Europe, northwest and northeast Europe, which showed values of 15–22% Neolithic lineages each. The Neolithic lineages are mainly from haplogroup J, and include a specific subset of J lineages, called J1a, that are largely restricted to this region and seem to be a marker for the Linienbandkeramische Kultur (LBK) and post-LBK dispersals (*Richards et al. 1996*). For southeast and central Europe, a relatively high Neolithic component seems congruent with the usual interpretation of the archaeological record. There is some consensus that the Balkan Neolithic and the central European LBK were the result of direct colonization, although there is debate about the extent of acculturation along the way (*cf. Gronenborn 1999, 2003; Tringham 2000; Budja 2001*). Acculturation may indeed have taken place in between the two processes, where there was a substantial break in the expansion (*Bogucki 2000; Zvelebil 2000*). The mtDNA results suggest that colonization from (ultimately) the Near East did indeed take place, and that the descendants of Near Eastern colonists are represented in the central European populations of the present day. Nevertheless, more than three-quarters of the surviving lineages are the result of acculturation of indigenous foraging peoples. This appears to broadly support "integrationist" models (*Zvelebil 2000; 2001*), such as pioneer "leapfrog" colonization (directed towards suitable land) and acculturation and genetic exchange across the agricultural frontier during the phase in which aspects of farming become available to the surrounding foraging populations. Strontium isotope analysis has recently suggested immigrations of non-local people into LBK settlements from very early times (*Bentley et al. 2002*). It is possible that some of these were brought in from the surrounding foraging communities (*Gronenborn 1999*).

The presence of Near Eastern lineages at similar frequencies in the northwest seems less consistent with Zvelebil's model, which suggests that a long-term frontier was established on the north European plain, and that the transition to farming to the north, northwest, northeast and southwest took place largely by acculturation. However, it also conflicts with the patterns of the classical markers and the Y chromosome (see below), in which the putative "Neolithic" lineages or alleles tend to zero towards the north-west periphery of the continent. If we take the mtDNA patterns seriously, perhaps there were female-only exchanges between the post-LBK peoples of the North European plain and the northwest across the agricultural frontier (*Wilson et al. 2001*). Alternatively, there may have been acculturation at the LBK frontier, after which predominantly Near Eastern mtDNAs, but predominantly acculturated Y chromosomes (by chance in both instances) moved northwest (*Renfrew 2001*). It is also, of course, possible that the mtDNA lineages were dispersed into the northwest by later dispersals.

There are fewer Neolithic-derived mtDNA lineages along the Mediterranean and the Atlantic west (about 10%). The sample from the eastern Mediterranean is small and not well provenanced, but the results nevertheless appear compatible with the maritime colonization of Greece by Near Eastern pioneer groups (*Perlès 2001*). As in central Europe, some of the putative Neolithic lineages further west are again regionally specific: for example haplogroup J1b, which appears to have leap-frogged from the Near East straight across to the Atlantic façade. This certainly seems consistent with the archaeological view of maritime colonization in the west alongside acculturation of quite dense, sedentary Mesolithic communities (*Barnett 2000; Zilhão 2000; 2001*).

THE Y CHROMOSOME

Unlike the mtDNA work on the Neolithic transition, the first major publication on the Y chromosome (*Semino et al. 2000*) had been prefigured by earlier studies that had already identified a demic component (*Semino et al. 1996*). However, Semino et al. (*2000*) teased out some of the more detailed patterns for the first time, providing some interesting parallels with the mtDNA work. They identified several potentially Neolithic markers that implied a Near Eastern Neolithic contribution to Europe as a whole of less than 25%. There have been recent criticisms of their interpretation by Chikhi et al. (*2002*), on the grounds that an admixture approach suggests a much higher putative Neolithic contribution than the crude estimates. However, their arguments are unconvincing, since an admixture approach seems quite inappropriate in the context of the questions under consideration, and suffers from some of the weaknesses of the classical approach (such as lack of dating).

It is noticeable, though, that the putative Neolithic lineages are markedly more common along the Mediterranean than in central Europe, which contrasts somewhat with the mtDNA picture described above. Without a founder analysis, such as has been done for mtDNA, it is certainly likely that earlier and later processes may be conflated: the palimpsest problem again. The question is to what extent. King and Underhill (*2002*) have argued that the high correlation between the distribution of painted pottery and anthropomorphic clay figurines and some of the putatively Neolithic Y chromosomes indicates that indeed at least some of the latter do represent early Neolithic settlement. This implies that, on the male side, intrusive lineages from the Near East only spread through the first burst of Neolithic settlement in Europe around the eastern Mediterranean basin, but were not carried to an appreciable extent into central Europe with the LBK. This in turn supports the view that high levels of acculturation took place in the Balkans prior to the LBK expansion (*Gronenborn 1999; 2003*). The Near Eastern lineages that spread through the eastern and central Mediterranean in the early Neolithic would have been subsequently overlaid by later Near Eastern dispersals. It is also possible that Neolithic colonization of the Mediterranean from the Near East involved maritime pioneers who were predominantly male, and that this goes some way to explaining the much higher male contribution of Neolithic lineages in the east and central Mediterranean (*Perlès 2001*).

CONCLUSIONS

Nothing intrinsically associates any particular mtDNA, or Y chromosome, with the spread of the Neolithic. These reconstructions are made on the basis of the estimated time of arrival of particular lineages and their geographical distribution. Alternative explanations of the same patterns are inevitably possible, depending on the breadth of possible frameworks made available by the archaeological evidence (*Bandelt et al. 2002*). But given these caveats, what can be suggested about the process of the Neolithisation of Europe from the study of the genetics of modern European populations?

All of these marker systems suggest that there was indeed a process of colonization during the spread of the early Neolithic into central and western Europe. This rules out, as decisively as is likely to be possible with genetic evidence, models based solely on cultural diffusion and acculturation, or separate development (model 7). This pattern would also seem to rule out élite dominance (model 3).

At the other extreme, the mtDNA and Y-chromosome evidence both imply a minor overall contribution to modern lineages of less than a quarter, suggesting that large-scale demic diffusion (model 2) or even replacement (model 1) can also be ruled out. However, discriminating smaller-scale demic diffusion, which could have a large cumulative impact in terms of, for example, language replacement (*Renfrew 2001*), is more difficult. Small-scale demic diffusion by means of a wave of advance would be expected to generate clines, which are indeed seen in some classical and some molecular markers, including the Y chromosome. In the case of classical markers, whether the clines to any extent reflect a Neolithic expansion is hard to determine; in the Y chromosome, however, it does seem that they may be partly the result of a Neolithic dispersal. However, comparison of founder and PC analyses of mtDNA imply that many components of the clines may be the result of both more ancient and more recent expansion events (*Richards et al. 2002*).

We are left with a number of mixed migrationist/diffusionist models that are not mutually exclusive (*Gronenborn 1999; 2003; Zvelebil 2000; 2001*). The evidence of mtDNA and the Y chromosome seems to be consistent with pioneer leapfrog colonization and infiltration of southeast and central Europe, and the subsequent infilling acculturation of much larger numbers of indigenous foragers. There may have been a wave of advance (Zvelebil's "starburst demic diffusion") during the rapid expansion in the LBK area, but if so, it must have largely involved mtDNA and Y-chromosome lineages from assimilated Balkan foraging populations, rather than from the Near

East (*Gronenborn 1999*). Archaeological evidence is now emerging from both ceramics and lithics for the assimilation of Mesolithic groups into LBK settlements (*cf. Gronenborn 2003*).

There is some evidence for further colonization from the LBK zone into the northwest, including the British Isles, whereas the pattern in Scandinavia might be explained by frontier exchange. The Atlantic west seems also to have experienced distinct, presumably maritime leapfrog colonization events from the direction of the west Mediterranean coastline. The movements into the northwest seem either not to have involved men, or to have involved male lineages that had undergone acculturation, and were therefore indigenous to central Europe. In all or most regions of Europe, even in the LBK zone, there seems to have been substantial local adoption of agriculture.

ACKNOWLEDGEMENTS

I would like to thank Detlef Gronenborn for critical advice on an earlier version of this manuscript, and Mehmet Özdoğan and Catherine Perlès for valuable comments during the conference at which this work was presented.

∴

REFERENCES

AMMERMAN A. J. 1989. On the Neolithic transition in Europe: a comment on Zvelebil and Zvelebil (1988). *Antiquity 63:162–165*.

AMMERMAN A. J, CAVALLI-SFORZA L. L. 1984. *The Neolithic Transition and the Genetics of Populations in Europe*. Princeton, New Jersey: Princeton University Press.

AVISE J. C. 2000. *Phylogeography*. Cambridge, Massachussetts: Harvard University Press.

BANDELT H.-J., MACAULAY V. A., RICHARDS M. B. 2002. What molecules can't tell us about the spead of languages and the Neolithic. In Renfrew C., Bellwood P. (eds.), *Origins and dispersals of agricultural societies and language families: 99–112*.

BARBUJANI G., BERTORELLE G. 2001. Genetics and the population history of Europe. *Proceedings of the National Academy of Sciences of the USA 98: 22–25*.

BARBUJANI G., BERTORELLE G., CHIKHI L. 1998. Evidence for Paleolithic and Neolithic gene flow in Europe. *The American Journal of Human Genetics 62: 488–491*.

BARBUJANI G., CHIKHI L. 2000. Genetic population structure of Europeans inferred from nuclear and mitochondrial DNA polymorphisms. In Renfrew C., Boyle K. (eds.), *Archaeogenetics: DNA and the population prehistory of Europe: 119–129*.

BARKER G. 1985. *Prehistoric farming in Europe*. Cambridge: Cambridge University Press.

BARNETT W. K. 2000. Cardial pottery and the agricultural transition in Mediterranean Europe. In Price T. D. (ed.), *Europe's first farmers: 93–116*.

BENTLEY R. A, PRICE T. D., LUNING J., GRONENBORN D., WAHL J., FULLAGAR P. D. 2002. Prehistoric migration in Europe: strontium isotope analysis of early Neolithic skeletons. *Current Anthropology 43: 799–804*.

BOGUCKI P. 2000. How agriculture came to north-central Europe. In Price T. D. (ed.), *Europe's first farmers: 197–218*.

BUDJA M. 2001. The transition to farming in Southeast Europe: perspectives from pottery. In Budja M. (ed.), *Documenta Praehistorica XXVIII: 8th Neolithic Studies: 27–47*.

CAVALLI-SFORZA L. L. 1996. The spread of agriculture and nomadic pastoralism. In Harris D. R. (ed.), *The origins and spread of agriculture and pastoralism in Eurasia: 51–69*.

CHIKHI L., DESTRO-BISOL G., BERTORELLE G., PASCALI V., BARBUJANI G. 1998. Clines of nuclear DNA markers suggest a largely Neolithic ancestry of the European gene pool. *Proceedings of the National Academy of Sciences of the USA 95: 9053–9058*.

CHIKHI L., NICHOLS R. A, BARBUJANI G., BEAUMONT M. A. 2002. Y genetic data support the Neolithic demic diffusion model. *Proceedings of the National Academy of Sciences of the USA 99: 11008–11013*.

DENNELL R. 1983. *European economic prehistory: a new approach*. London: Academic Press.

GRONENBORN D. 1999. A variation on a basic theme: The transition to farming in southern Central Europe. *Journal of World Prehistory 2: 23–210*.

2003. Migration, acculturation and culture change in temperate Europe and Eurasia, 6500–5000 cal BC. In Budja M. (ed.), *Documenta Praehistorica XXX: 79–91*.

HODDER I. 1990. *The domestication of Europe*. Oxford: Blackwell.

KING R., UNDERHILL P. 2002. Congruent distribution of Neolithic painted pottery and ceramic figurines with Y-chromosome lineages. *Antiquity 76: 707–714*.

MENOZZI P., PIAZZA A., CAVALLI-SFORZA L. L. 1978. Synthetic maps of human gene frequencies in Europeans. *Science 201: 786–792*.

PERLÈS C. 2001. *The Early Neolithic in Greece*. Cambridge: Cambridge University Press.

PLUCIENNIK M. 1998. Deconstructing the Mesolithic-Neolithic transition. In Edmonds M., Richards C. (eds.), *Understanding the Neolithic of north-western Europe: 61–83*.

PRICE T. D. 2000. Europe's first farmers: an introduction. In Price T. D. (ed.), *Europe's first farmers: 1–18*.

RENFREW C. 1987. *Archaeology and language*. Harmondsworth, Middx: Penguin Books.

2001. From molecular genetics to archaeogenetics. *Proceedings of the National Academy of Sciences of the USA 98: 4830–4832*.

RICHARDS M., CÔRTE-REAL H., FORSTER P., MACAULAY V., WILKINSON-HERBOTS H., DEMAINE A., PAPIHA S., HEDGES R., BANDELT H.-J., SYKES B. 1996. Paleolithic and neolithic lineages in the European mitochondrial gene pool. *The American Journal of Human Genetics 59: 185–203*.

RICHARDS M., MACAULAY V., SYKES B., PETTITT P., HEDGES R., FORSTER P., BANDELT H.-J. 1997. Reply to Cavalli-Sforza and Minch. *The American Journal of Human Genetics 61: 251–254*.

RICHARDS M. B., MACAULAY V. A., BANDELT H.-J., SYKES B. C. 1998. Phylogeography of mitochondrial DNA in western Europe. *The Annals of Human Genetics 62: 241–260*.

RICHARDS M., MACAULAY V. 2000. Genetic data and the colonization of Europe: Genealogies and founders. In Renfrew C., Boyle K. (eds.), *Archaeogenetics: DNA and the population prehistory of Europe: 139–151*.

RICHARDS M., MACAULAY V., HICKEY E., VEGA E., SYKES B., GUIDA V., RENGO C., SELLITTO D., CRUCIANI F., KIVISILD T., VILLEMS R., THOMAS M., RYCHKOV S., RYCHKOV O., RYCHKOV Y., GOLGE M., DIMITROV D., HILL E., BRADLEY D., ROMANO V., CALI F., VONA G., DEMAINE A., PAPIHA S., TRIANTAPHYLLIDIS C., STEFANESCU G., HATINA J., BELLEDI M., DI RIENZO A., NOVELLETTO A., OPPENHEIM A., NØRBY S., AL-ZAHERI N., SANTACHIARA-BENERECETTI S., SCOZZARI R., TORRONI A., BANDELT H.-J. 2000. Tracing European founder lineages in the Near Eastern mitochondrial gene pool. *The American Journal of Human Genetics 67: 1251–1276*.

RICHARDS M., MACAULAY V., TORRONI A., BANDELT H.-J. 2002a. In search of geographical patterns in European mtDNA. *The American Journal of Human Genetics 71: 1168–1174*.

ROBERTS N. 1998. *The Holocene*. Oxford: Blackwell.

SEMINO O., PASSARINO G., BREGA A., FELLOUS M., SANTACHIARA-BENERECETTI S. 1996. A view of the neolithic demic diffusion in Europe through two Y chromosome-specific markers. *The American Journal of Human Genetics 59: 964–8*.

SEMINO O., PASSARINO G., OEFNER P. J., LIN A. A., ARBUZOVA S., BECKMAN L. E., DE BENEDICTIS G., FRANCALACCI P., KOUVATISU A., LIMBORSKA S., MARCIKIAE M., MIKA B., MIKA A., PRIMORAC D., SANTACHIARA-BENERECETTI S., CAVALLI-SFORZA L. L., UNDERHILL P. A. 2000. The genetic legacy of Paleolithic Homo sapiens sapiens in extant Europeans: a Y chromosome perspective. *Science 290: 1155–9*.

SOKAL R. R., HARDING R. M., ODEN N. L. 1989. Spatial patterns of human gene frequencies in Europe. *The American Journal of Physical Anthropology 80: 267–294*.

SOKAL R. R., ODEN N. L., WILSON C. 1991. Genetic evidence for the spread of agriculture in Europe by demic diffusion. *Nature 351: 143–145*.

THOMAS J. 1996. The cultural context of the first use of domesticates in continental Central and Northwest Europe. In Harris D. R. (ed.), *The Origins and Spread of Agriculture and Pastoralism in Eurasia: 310–322*.

1998. Towards a regional geography of the Neolithic. In Edmonds M., Richards C. (eds.), *Understanding the Neolithic of north-western Europe: 37–60*.

TORRONI A., BANDELT H.-J., D'URBANO L., LAHERMO P., MORAL P., SELLITTO D., RENGO C., FORSTER P., SAVANTAUS M.-L., BONNÉ-TAMIR B., SCOZZARI R. 1998. mtDNA analysis reveals a major late Paleolithic population expansion from southwestern to northeastern Europe. *The American Journal of Human Genetics 62: 1137–1152*.

TORRONI A., BANDELT H.-J., MACAULAY V., RICHARDS M., CRUCIANI F., RENGO C., MARTINEZ-CABRERA V., VILLEMS R., KIVISILD T., METSPALU E., PARIK J., TOLK H.-V., TAMBETS K., FORSTER P., KARGER B., FRANCALACCI P., RUDAN P., RICKARDS O., SAVONTAUS M.-L., HUOPONEN K., LAITINEN V., KOIVUMÄKI S., SYKES B., HICKEY E., NOVELLETTO A., MORAL P., SELLITTO D., SANTACHIARA-BENERECETTI A. S., SEMINO O., SCOZZARI R. 2001. A signal, from human mtDNA, of postglacial recolonization in Europe. *The American Journal of Human Genetics 69: 844–852*.

TRINGHAM R. 2000. Southeastern Europe in the transition to agriculture in Europe: bridge, buffer of mosaic. In Price T. D. (ed.), *Europe's first farmers: 19–56*.

VAN ANDEL T. H., RUNNELS C. N. 1995. The earliest farmers in Europe. *Antiquity 68: 481–500*.

WHITTLE A. 1996. *Europe in the Neolithic*. Cambridge: Cambridge University Press.

WILLIS K. J., BENNETT K. D. 1994. The Neolithic transition – fact or fiction? Palaeoecological evidence from the Balkans. *The Holocene 4: 326–330*.

WILSON J. F., WEISS D. A., RICHARDS M., THOMAS M. G., BRADMAN N., GOLDSTEIN D. B. 2001. Genetic evidence for different male and female roles during cultural transitions in the British Isles. *Proceedings of the National Academy of Sciences of the USA 98: 5078–5083*.

ZILHÃO J. 2000. From the Mesolithic to the Neolithic in the Iberian peninsula. In Price T. D. (ed.), *Europe's first farmers: 144–182*.

2001. Radiocarbon evidence for maritime pioneer colonisation at the origins of farming in west Mediterranean Europe. *Proceedings of the National Academy of Sciences of the USA 98: 14180–14185*.

ZVELEBIL M. 1986. Mesolithic prelude and neolithic revolution. In Zvelebil M. (ed.), *Hunters in transition: Mesolithic societies of temperate Eurasia and their transition to farming: 5–15*.

1989. On the transition to farming in Europe, or what was spreading with the Neolithic: a reply to Ammerman (1989). *Antiquity 63: 379–383*.

1998. What's in a name: the Mesolithic, the Neolithic, and social change at the Mesolithic-Neolithic transition. In Edmonds M., Richards C. (eds.), *Understanding the Neolithic of north-western Europe: 1–36*.

2000. The social context of the agricultural transition in Europe. In Renfrew C., Boyle K. (eds.), *Archaeogenetics: DNA and the population prehistory of Europe: 57–79*.

2001. The agricultural transition and the origins of Neolithic society in Europe. In Budja M. (ed.), *Documenta Praehistorica XXVIII: 8th Neolithic Studies: 1–26*.

UDK 903(510)"633/634"

Documenta Praehistorica XXX

A Study on an Early Neolithic Site in North China

Chaohong Zhao[1], Jincheng Yu[4], Tao Wang[1], Xiaohong Wu[1], Shougang Hao[2], Xueping Ma[2], Zhengkai Xia[3]

1 School of Archaeology and Museology, Peking University, zhaoch@pku.edu.cn, wuxh@pku.edu.cn

2 Department of Geology, Peking University

3 School of Environment, Peking University

4 Beijing Institute of Cultural Relics

ABSTRACT – *These are few sites about 10 000 BP in the early Neolithic period in North China; among these, the Donghulin site is the only one which included the remains of peoples' use of fire (hearth pits), stone implements, pottery objects, and human tombs. The excavation of the Donghulin site in 2001 provides very important information for research on people and culture in the early Neolithic period in North China. The finding of Donghulin Man has filled the gap in our knowledge of human development since the period of the "Upper Cave Man" (30 000a BP) in North China. It is also important for research on people-land relationships.*

IZVLEČEK – *Na severu Kitajske je nekaj zgodnjeneolitskih najdišč iz časa okoli 10 000 BP. Med njimi je najdišče Donghulin edino, kjer so našli ostanke človekove uporabe ognja (jame za ognjišča), kamnito orodje, keramiko in človeške grobove. Izkopavanja najdišča Donghulin leta 2001 so dala pomembne podatke o ljudeh in kulturi v zgodnjem neolitiku na severu Kitajske. Najdba človeka Donghulin je zapolnila našo vrzel v poznavanju razvoja človeka od časa "Upper Cave Man" (30 000a BP) na severnem Kitajskem. Najdišče je pomembno tudi za raziskovanje povezave med človekom in pokrajino.*

KEY WORDS – *Early Neolithic; Donghulin Man; Pottery; Hearth pits; Man-land relationships*

INTRODCTION

The Donghulin site is situated in a western suburb of Beijing, on the second terrace of the north bank of Qingshui River, 25 m above the riverbed. Its location is at the meeting point of Mt. Taihang and Mt. Yanshan.

Some tombs of the early Neolithic period were found at the Donghulin site in 1966 (*Zhou et al. 1972; Hao 1988*), including three human skeletons and some burial accessories. A lot of important remains were found in 2001, including stone implements, pottery objects, human bones, and animal bones. Archaeologists also found many examples of hearth pits. These are the very first human bones and evidence of the use of fire in North China about 10 000BP. It is very important for research on early people and culture in North China in an earlier period of the Holocene and it is also important for research on people-land relationships (Fig. 1).

A BRIEF HISTORY OF DISCORVEREY AND EXCAVATION

Students at the Department of Geology and Geography at Peking University found three human skeletons and snail shell necklaces, bone bracelets and stone implements in the west of Donghulin village in 1966. After that, the Institute of Vertebrate Paleontology and Paleoanthropology, Academia Sinica, investigated and excavated the site. Evidence shows that the human bones were from an early Neolithic period tomb and the skeletons belong to a young girl and two adult men. (*Zhou et al. 1972*). Teachers and

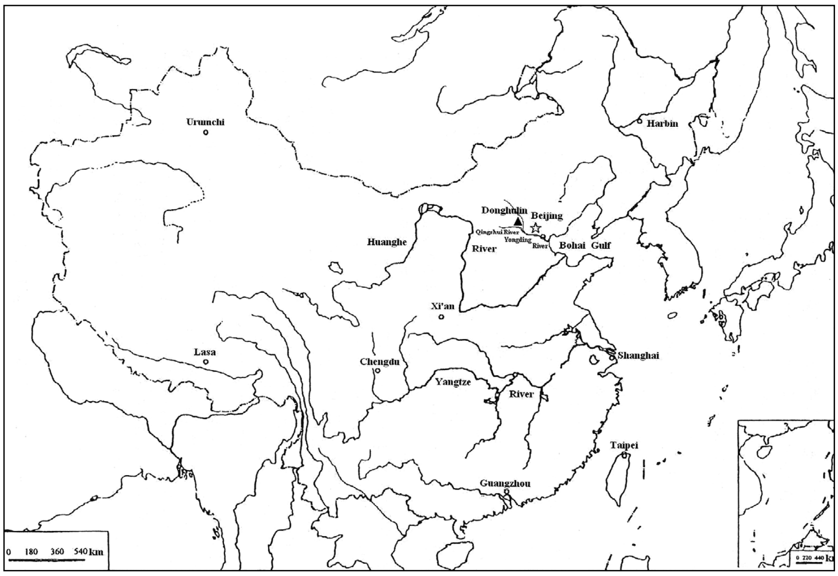


Fig. 1. Donghulin Site Location.

students from the Geology Department of Peking University found another skeleton and also collected some gastropod shell necklaces and stone implements while investigating on the site cross section again in 1998 (*Hao S. G. et al. 2001*). From July to August 2001, the School of Archaeology and Museum Studies at Peking University, and the Institute of Cultural Relics, Beijing, excavated the Donghulin site. They found hearth pits, human bones, pottery shards, stone implements, animal bones and gastropod shells (Fig. 2).

THE CULTURAL DEPOSIT OF THE SITE

Take T3 of the Excavation of Donghulin Site in 2001 as an example:

Layer 1: light grey soil, thickness: 5–20 cm, modern period;
Layer 2: grey yellow soil, thickness: 15–35 cm, modern period;
Layer 3: taupe (dust-color) soil, thickness: 0–35 cm, Ming-Qing Dynasties;
Layer 4: buff sand quality soil, thickness: 0–75 cm;
Layer 5: yellow sand quality soil, thickness: 15–50 cm;
Layer 6: yellow sandy soil in ash, thickness: 10–30 cm;
Layer 4, 5, 6 are sediment layers.
Layer 7: dust-color soil, about 95–120 cm from earth's surface, Neolithic earlier period.
Under Layer 7 is Malan loess (Fig. 3).

THE AGE OF THE SITE AND DONGHULIN MAN

^{14}C dating of human bone, shell, snail, and pottery samples was conducted at Beijing University, China and Lawrence Livermore National laboratory, USA. The results are presented in Table 1.

THE CULTURAL RELICS OF THE NEOLITHIC EARLIER PERIOD

The stone implements of the Donghulin site can be divided into chipped stone implements, pecked stone implements and polished stone implements, including the stone saddle-querns, stone rollers, stone chips, cores and some break pebble stones. Some stone chips have been used slightly and their blades have usage traces. There are usage traces on the stone saddle-querns and stone rollers. A small polished stone axe was also found inside the site, which was polished in part (Fig. 4).

The pottery wares include a small amount of potshards, most of them belonging to the abdominal and basal sections. Many are red-brown, and all are sand quality potteries. The degree of heating is not well-proportioned and the grains of quartz sand were mixed up in the pottery pastes. Most of them are baldish potteries, and several have raised stripes. Many are pottery jars. Some pottery shards have

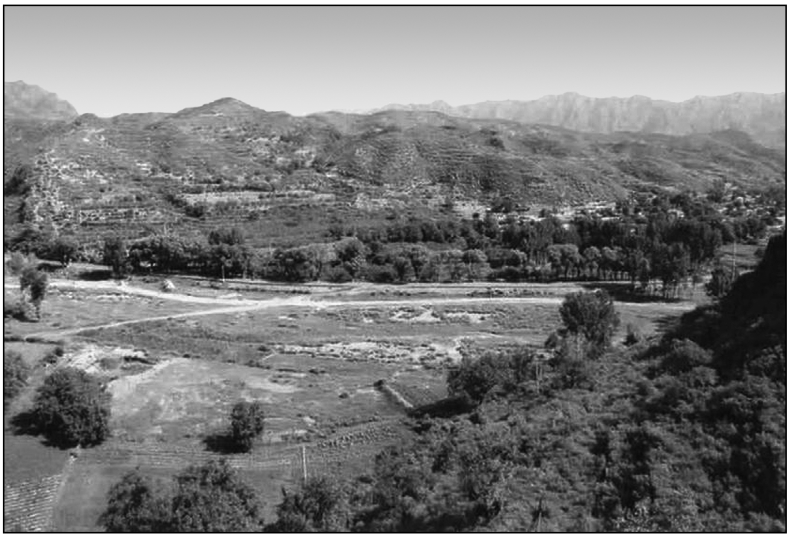


Fig. 2. A view of the Donghulin Site.

Lab Sample No.[1]	Material	δ13C (PDB)	δ14C age (Yr BP)	Calibrated Date (±1σ)(cal BC)
BA–95068	Bone	–18.44	8720±170	8160(0.05)8133
				8078(0.01)8072
				8057(0.01)8050
				7969(0.92)7586
AMS–30912	Bone	–18.44	8450±70	7580(0.68)7513
				7457(0.01)7456
				7507(0.27)7478
				7388(0.05)7382
CAMS–31482	Bone	–18.44	8450 ±80	7582(0.90)7476
				7388(0.06)7380
				7460(0.04)7454
BBA–96095	Charcoal		8960±70	8262(0.36)8198
				8187(0.12)8163
				8107(0.12)8082
				8045(0.20)8004
				7993(0.10)7971
BA–96091	Charcoal		9009±80	8289(0.60)8198
				8184(0.08)8163
				8043(0.13)8012
				7983(0.04)7972

1 Samples with a BA prefix were analyzed at Peking University, China; those with CAMS, at the Centre for AMS, Lawrence Livermore National laboratory of USA.

Tab. 1.

shed off inside and outside, so we can infer that they were made by a clay-patch pasting technique (Fig. 5).

The animal bones primarily include limbs, palatine bones, and teeth of deer. There are large quantities of gastropod shells and a small amount of mother-of-pearl.

Another important discovery of 2001 is the 5 hearth pits (ash heaps). There are many stones, ashes and animal bones in them. The basal part is Malan loess and is smooth. The stones on the upper part are in great disorder, while the stones at the base are arranged in good order, in the form of hoop. It may be for temporary cooking (Fig. 6).

RESEARCH ON THE LIVING ENVIRONMENT OF DONGHULIN MAN

The analysis of spore and pollen

According to the analysis of spore and pollen samples taken from the Donghulin site, woody plant pollen increased obviously in the earlier period of Holocene Epoch (about 10.0~8.2Ka BP), being up to 55%. They include pine (*Pinus*), fir (*Taxodium*), spruce (*Picea*), hemlock (*Tsuga*) (which now exists in the subtropics), oak (*Quercus*), and walnut (*Juglans*). Comparied to the later period of the Pleistocene, herbs are obviously decreasing. The combination indicates that the temperature rose significantly, the environment obviously changed and affected human activity. According to the change in the woody plant combination and the features of the herb combination, this period can be divided into two parts.

In the lower part (about 10.0~9.0 Ka BP), the *Artemisia genus*, which is suited to a dry environment, occupies the higher proportion, the individual sample inside can amount to 30%. Moreover, the family of goosefoot (*Chenopodiaceae*), sedge (*Cyperax*), bean family (*Leguminous*), the woody fir (*Taxodium*) and *Betula genus* are in higher amounts.

In the Upper part (9.0~8.2Ka BP), the *Artemisia genus* and sedge (*Cyperax*) in the combination appears obviously to reduce, but the grass family (*Gramineae*) had been rising, and there was a little hemlock (*Tsuga*) in the woody plants. The spore and pollen features of the early segment show that the cli-

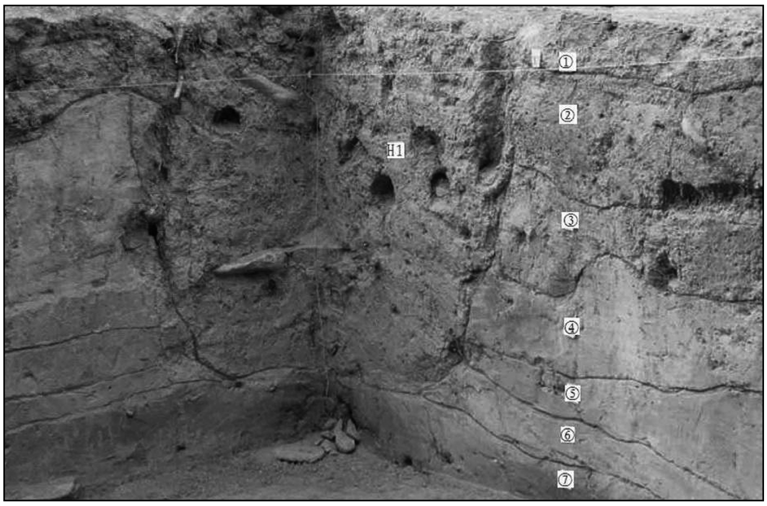


Fig. 3 A section of T3, Donghulin Site.

Fig. 4. The stone saddle-querns, stone rollers founded in Donghulin Site.

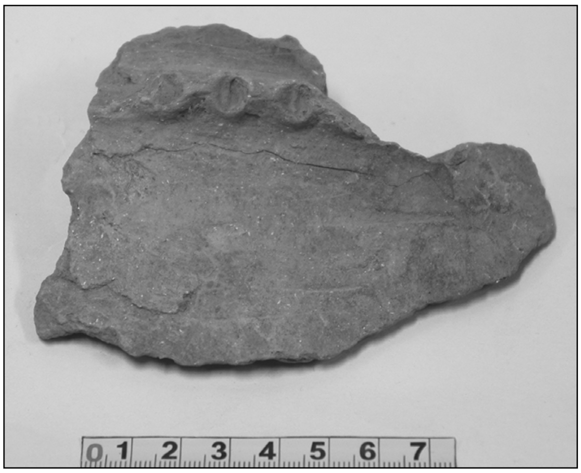


Fig. 5 Pottery from the Donghulin Site.

mate of the period was dry; the later segment was a little wet.

In general, during the occupation in the earlier period of the Holocene (10.0~8.2Ka BP), the region had mixed vegetation comprising conifers and broad-leaved trees, and hot spring species such as the walnut and hemlock. The appearance of herbs such as beans and sedges (*Cyperax*) reflects an essence of mountainous country meadow vegetation.

The Finding of Neritina violacea

Human skeletons were found both in 1966 and in 1998. There were grave goods such as necklaces, compound of gastropod shells identified. The gastropod shells belong to Neritina violacea, which only can be found in subtropical conditions now, and only can be seen along the Zhejiang in China at present (Fig. 7).

Fig. 6 The hearth pit (ash heap) at the Donghulin Site.

Snail analysis

In the period of the Donghulin people, the earlier period of the Holocene (10.0~8.2Ka BP), the snail is suddenly thriving. Abundant snails can be collected in the cultural deposit comprising 11 species: *Cochlicopa lubrica*, *Cathaica pulreraticula*, *Cathaica fassida*, *Opeas striatissimum*, *Pupilla cryptodon grandis*, *Kaliella sp*., *Vallonia costata*, *Bradybaena ravida*, *Vallonia tenuilabria*, *Discus pauper* and *Macrochlamys davidi*. The gastropod fauna in the Dong-

Fig. 7. A complete necklace restored from Donghulin gastropod shells (Neritina violacea).

hulin Holocene interval is characterized by eurytopic snails of the North China taxa. The only taxon preferring warm and wet environments is Opeas striatissimum, which gradually increased; the taxon representing cool and dry climates, perhaps, is Bradybaena ravida, whose distribution is limited. (*Hao S. G. et al. 2001*).

CONCLUSION

These are few sites about 10 000 BP from the Neolithic early period in North China; among these, the Donghulin site is the only one including relics the use of fire (hearth pits), stone implements, pottery objects and human tombs. The excavation of the Donghulin site provides very important information for research on people and culture in the early Neolithic in North China. The finding of Donghulin Man filled a gap in out knowledge of human development since the period of the "Upper Cave Man" (30 000a BP) in North China. Research on the physical anthropology, pathology and the DNA of Donghulin's inhabitants is in progress.

According to the analysis of spore, pollen and snail samples, the climate was probably much warmer than today in Beijing, with an average annual temperature about 2–3°C higher for the Donghulin people living in the earlier period of the Holocene Epoch (10.0~8.2Ka BP).The finds of Neritina violacea not only indicate that the Donghulin people had an aesthetic consciousness, but also that the sphere of Donghulin peoples' trading activity may have arrived from the Bohai Sea gulf area (150 kms away).

Donghulin Man's economic activities were still hunting and gathering, and they took deer as their principle prey. The questions of what plants were collected and whether agriculture had appeared in that period still need to be researched.

∴

REFERENCES

HAO SHOUGANG 1988. Recollections of "the Donghulin Man" discovery. *Fossils 3: 18–19* (in Chinese).

HAO SHOUGANG et al. 2001. The Donghulin Woman from western Beijing: C–14 age and an associated compound shell necklace. *Antiquity 75: 517–522.*

HAO SHOUGANG, ZHAO CHAOHONG, YU JINCHENG et al. 2002. The Early Holocene Loess Section in the Donghulin Site near Zhaitang in Beijing. *Acta Geologica Sinica, Vol. 76, No. 3: 420–430* (in Chinese).

ZHOU GUOXING, YOU YUZHU 1972. A Neolithic grave at Donghulin village, Beijing. *Archaeology 6: 12–15* (in Chinese).