A Game of Clans

collectores venatoresque, agricolae pastoresque

A Game of Clans

collectores venatoresque,

agricolae pastoresque

Carlos Quiles

A Game of Clans

collectores venatoresque,

agricolae pastoresque

Carlos Quiles

A Song of Sheep and Horses

Book 1

ACADEMIA PRĪSCA

2019

A SONG OF SHEEP AND HORSES:

EURAFRASIA NOSTRATICA, EURASIA INDOURALICA

Book One: A Game of Clans: *collectores venatoresque, agricolae pastoresque.*

Book Two: A Clash of Chiefs: *rex militaris, rex sacrorum.*

Book Three: A Storm of Words: *vetera verba, priscae linguae.*

Book Four: A Feat of Crowds: *hic sunt leones, hic sunt dracones.*

Version: 1.2 (first printed edition), June 1st, 2019

ISBN-13: 978-1-072-00322-9 paperback

ACADEMIA PRISCA

Avda. Sta. María de la Cabeza, 3, E-LL, Badajoz 06001, Spain.

European Union

Work based on Quiles, Carlos (2017). Indo-European demic diffusion model (3rd ed.). Badajoz, Spain: Universidad de Extremadura. DOI: 10.13140/RG.2.2.35620.58241

Official site: <https://indo-european.eu/asosah/>

Publisher's site: <https://academiaprisca.org/>

Full text and latest revisions: <https://indo-european.info>

Blog for images, discussion, and new findings: <https://indo-european.eu/>

Cover image *Die Glockenbecherleute* by Gerhard Beuthner, appeared in Erdal-Bilderreihe Jugensteinzeit Nr. 117 Bild 5 (1930).

Table of Contents

Guide to the reader

Abbreviations

AASI: Ancient Ancestral South Indian

AEA: Ancient East Asians

AHG: Anatolian Hunter-Gatherer

AME: Ancient Middle Easterner

ANA: Ancient North African

ANE: Ancient North Eurasian

ANI: Ancestral North Indian

ANS: Ancient North Siberian

ASI: Ancestral South Indian

AP: Ancient Palaeosiberian

BA: Bronze Age

BBC: Bell Beaker culture

BMAC: Bactria and Margiana Archaeological Complex

BE: Basal Eurasians

CA: Copper Age

CHG: Caucasus Hunter-Gatherer

CWC: Corded Ware culture

ENA: Eastern non-Africans

EWE: Early West Eurasians

EN: Early Neolithic

FBA: Final Bronze Age

IA: Iron Age

IE: Indo-European

IN: Iranian Neolithic

LBA: Late Bronze Age

LBK: Linearbandkeramik

LCA: Late Chalcolithic

LN: Late Neolithic

MBA: Middle Bronze Age

MCW: Multi-Cordoned Ware

MLBA: Middle–Late Bronze Age

MN: Middle Neolithic

NWAN: North-West Anatolian Neolithic

PCA: Principal Component Analysis

CWE: Common West Eurasian

CEU: Central European

GAC: Globular Amphora(e) culture

EBA: Early Bronze Age

EEA: Early East Asian

EEBA: Early European Bronze Age

EEF: Early European Farmer

EH: Early Helladic

EHG: Eastern Hunter-Gatherer

EIA: Early Iron Age

PIE: Proto-Indo-European

PU: Proto-Uralic

SNP: Single Nucleotide Polymorphism

SRBW: Simple-Relief-Band Ware

TMRCA: Time to Most Recent Common Ancestor

TRB: Funnel Beaker culture

WHG: Western Hunter-Gatherer

WSHG: Western Siberian Hunter-Gatherer

Symbols

(x[SNP])	denotes “negative for [SNP]”
[SNP]$^{+}$	marks an unofficial or probabilistic [SNP] call
[SNP]*	implies that the sample is of a “basal” [SNP] subclade
[N%]$^{+}$	denotes an unofficial result of “N% ancestry”
[SNP]+	denotes “positive for [SNP]”
*[word]	denotes a reconstructed form

Conventions used in this book

This text is not a simple essay anymore. Even though I conceived it initially as a mere fourth revision at the end of 2017, it grew rapidly out of hand, as I intended to include as much relevant information as possible on published (and reported) population movements supported by genetic investigation. The association of genetic data with potential prehistoric ethnolinguistic communities required in turn the addition of all potentially relevant archaeological data.

The first two volumes of this series must be understood as a *detailed supplement* of the main work, which is the third volume concerning linguistic data. This order of relevance is not only related to this series' emphasis on languages over prehistoric cultures or genetics, but to the actual nature of the matter at hand: this a comprehensive work on reconstructed languages and the peoples who might have spoken them.

The work follows simple rules in its aim to achieve clarity and coherence.

It is an encyclopaedia-like text, free and organised in more or less isolated linguistic, archaeological, and genetic sections organised to facilitate future revisions by anyone, incorporating the latest research.

Unlike armchair work in linguistics or bioinformatics, where results and interpretations can be reviewed with knowledge and proper access to data, it is impossible to be an *armchair archaeologist* without ample experience in the specific field investigated. Therefore, secondary archaeological sources, giving proper interpretation and synthesis of primary research and fieldwork, are preferred over primary sources in the archaeological section, with little or no personal additions in this part, although primary sources and proper connections of the data have also been added whenever necessary. All archaeological summaries included are properly referenced, with the main author or authors behind the content of each paragraph properly cited—at least the author of the secondary source, often more relevant than primary sources—to allow for proper identification of the original text and for further reading.

A chronologically and regionally organised structure has been given to the full text, to allow for an easy searching of the content, and for the reading of the text in either a linear or non-linear manner.

Names of samples, their cultures or groupings, ancestries, or clusters do not necessarily follow the nomenclature systems used by the different authors, papers, research labs, or archaeological teams, but are made to fit into the coherent picture of this book (Eisenmann et al. 2018).

Haplogroup (hg.) will be frequently used to refer to Y-chromosome haplogroups, unless otherwise expressly stated. Y-DNA haplogroups and subclades will also be referred to as *line* or *lineage*, whereas common admixture components defined in recent papers will be referred to as *ancestry*. The preferred nomenclature system of haplogroups is *X-Y*, where *X* is the standard name by ISOGG (2018), and *Y* is one or more SNP mutations defining the haplogroup, using whenever possible the one preferred by YFull. An asterisk *X-Y** is used to represent a *basal lineage*, commonly understood as a subclade with different mutations from the most common, 'successful' ones.

Additional positive *Y+* reported online in non-peer reviewed publications are represented in this text as *X-Y*$^{+}$. The originally published haplogroup for the samples, other reported positive and negative SNPs, as well as the author or authors of the additional information, can be found in online supplementary materials of this book.

For the sake of consistency, only YFull estimates for year formed and time to most recent common ancestor (TMRCA) of Y-chromosome haplogroups have been used[1], unless other sources are expressly stated. Years before present (ybp) have been approximated to BC assuming 2,000 years of difference, to round out estimates. Estimates were obtained by Vladimir Tagankin by applying the method published in Adamov et al. (2015) to the data received

[1] Dates were retrieved from the website <https://www.yfull.com/> during October-December 2018.

from voluntary users[2]. Also for the sake of consistency, dates expressed as years before present (YBP) have been simplistically approximated to BC.

TMRCA dates are used as gross approximations to expansions of Y-DNA lineages (see Figure 1). They can offer an inaccurate idea of the lineage evolution because a) the actual rate of mutation is unknown, and b) TMRCA estimates are based on the lineages that survived, which may obviate other previous expansions in the same trunk.

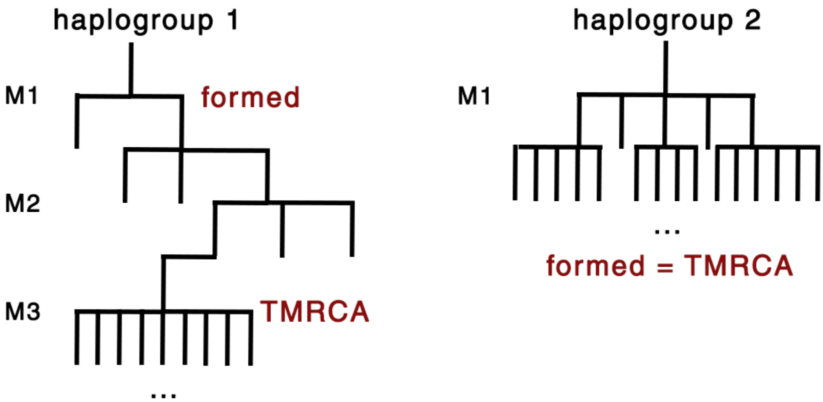

Figure 1. Simplistic example of SNP mutations in a haplogroup. Lines represent diverging male lineages. Haplogroup 1 is only successful after the third mutation, and is thus defined by mutations M1, M2, and M3, with M1 representing its formation date, and M3 its TMRCA. Haplogroup 2 is successful during its formation, and thus M1 defines it, as well as its formation and TMRCA date.

Modern physical maps are used to illustrate potential expansion routes of ancient cultures, peoples, and languages, even though they pose a significant danger to the development of a sound model, since they almost invariably involve "a concatenation of weakly supported links that corporately form an 'arrow' of dispersion" (Mallory 2014). Map routes are only depicted as a visual help to add movement to the otherwise stationary maps of ancient cultures,

---

[2] For details on the specific methodology used, see <https://www.yfull.com/faq/what-yfulls-age-estimation-methodology/>.

peoples, languages, and ancient DNA obtained from scattered burials. Eurasian biomes (Figure 2) and Suppl. Fig. 19) are commonly referenced to in this book to delimit cultural groups and migration routes.

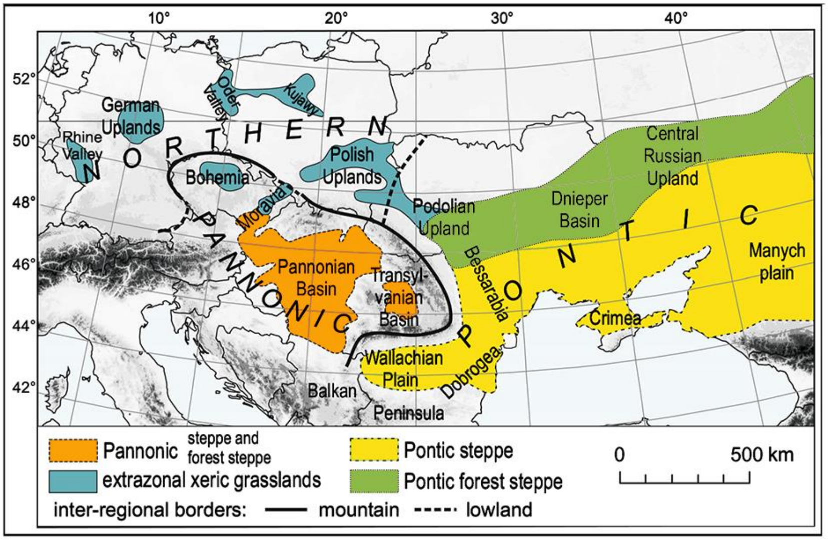

Figure 2. Simplified map of the distribution of steppes and forest-steppes (Pontic and Pannonian) and xeric grasslands in Eastern Central Europe (with adjoining East European ranges). Modified from Kajtoch et al. (2016).

List of Supplementary Figures

The following is an ordered list of supplementary graphics with their description and links to online sites for download. All supplementary data is also contained in the fourth volume of this series, *A Feat of Crowds*.

Maps

A list of available maps can be found at <https://indo-european.eu/maps/>.

Graphics

A list of available graphics may be found at <https://indo-european.eu/pca/>.

Introduction

This project began as a short essay called "Indo-European Demic Diffusion Model", published in April 2017 in the Department of Anatomy, Cell Biology, and Zoology of the University of Extremadura, in which I contended that recent genetic investigation suggested that the expansion of Indo-European languages from the steppe was linked to the expansion of R1b1a1b-M269 lineages in Eurasia. In particular, genetic data recovered from ancient individuals seemed to support that the expansion of R1b1a1b1-L23 lineages in Europe was associated with Yamna migrants, and thus also subsequently with the expansion of East Bell Beakers as North-West Indo-European-speakers in Europe, whereas the spread of the Corded Ware culture likely represented the expansion of Uralic speakers.

Some researchers had already expressed doubts on the traditional association of Corded Ware with the Indo-European expansion, although none of them had given an alternative model consistent with the current data, explaining the role of R1a1a1-M417 lineages spreading with Uralic speakers (Horváth 2014), or the recently described "Yamnaya ancestry" peaking among Uralic individuals (Heggarty 2015; Klejn et al. 2017) as the result of mixed Indo-European–Uralic communities.

The theory laid in this text takes dialectal evolution as its stable framework, as the core which should underlie any Indo-European expansion model, and uses genetic investigation (of ancient and modern DNA samples) and its potential relationship with archaeological cultures to establish an expansion model step by step. It also takes into account that there are complex problems found in correlations of languages with archaeological cultures (Meier-Brügger 2003) and human genetics (Campbell 2015).

Even though phylogenetic methods became popular in the early 2000s, and have been used intermittently since then, especially by non-linguists (Ringe, Warnow, and Taylor 2002; Anthony and Ringe 2015), it seems more reasonable to avoid such methods in scientific publications, due to their controversial pseudoscientific nature and questionable results (Pereltsvaig and Lewis 2015)[3]. Historical linguistics can only provide a relative historical framework for individual proto-languages and their relationships, though.

Archaeology works with the concept of culture, and as such it is able to determine timelines. When these timelines complement relative chronologies and wide guesstimates of proto-languages beautifully, both are able to provide a contextualised historical explanation of linguistic frameworks (Vander Linden 2015; Hänsel and Zimmer 1994). The model of Indo-European migrations set forth by Marija Gimbutas (Gimbutas 1963, 1977) has been impressively corrected and expanded recently by Volker Heyd (Heyd 2004; Harrison and Heyd 2007; Heyd 2007; Heyd 2011), Valentin A. Dergachev (2007), David W. Anthony (Anthony 2007; Anthony and Brown 2011; Anthony 2013), James P. Mallory (2013), or Christopher Prescott (Prescott and Walderhaug 1995; Prescott 2012), among others. Similarly, the models of early

[3] Kallio (2015): "Rather than the standard comparative method the most popular tool has recently been the probabilistic approach (…). To put it crudely, all this means that instead of comparing two reconstructed protolanguages one only compares two 50-item or 100-item wordlists. Call me a grumpy old man, but I fail to see how such laziness would be progress, although it is of course faster and easier, requiring hardly any knowledge of the languages themselves. It is therefore no wonder that limited wordlists are particularly popular among nonlinguists applying phylogenetic methods to languages (see now Pereltsvaig & Lewis 2015 for an excellent review)."

Uralic–Indo-European contacts (Koivulehto 1991; Koivulehto 2003) and Uralic migrations from eastern Europe recently advocated by Kallio (Kallio 2002, 2014) or (Parpola 2013) have paved the way for a clearer understanding of the cultures and peoples involved in steppe-related migrations, and constitute the basic starting point of this book.

Language and culture expansion have been usually explained by two main alternative models: the demic diffusion model, which involves mass movement of people; and the cultural diffusion model, which refers to cultural impact between populations, and involves limited genetic exchange between them. Language transfer since ancient times seems to be associated with an expansion of people (Mikhailova 2015).

Ancestry of any selected population is likely to be a mixture of several ancient groups, which is reflected on the genetic structure (Haak et al. 2010; Skoglund et al. 2012; Malmström et al. 2009; Lazaridis et al. 2014). However, the genetic landscape for ancient populations is limited by the number of ancient DNA samples and ancient populations studied (Hellenthal et al. 2014). Population expansions are often accompanied by a significant replacement of patrilineal lineages (see Figure 3), due to the formation of expanding kin groups and to the intergroup competition among them (Zeng, Aw, and Feldman 2018). This reduction in variability and Y-chromosome haplogroups is exacerbated by migration and exogamy practices, and also by violent conflicts involving mainly males.

Male-biased population expansions cannot explain all language expansions and replacements, though, and exceptions are frequent throughout history. Archaeological research combined with population genomics is showing how bilingualism and multilingualism was common among different prehistoric groups which interacted closely and often became symbiotically integrated with each other. This is usually associated with chiefdom-like systems and long-lasting exogamy practices, such as those found between Abashevo and Sintashta-Potapovka-Filatovka peoples, between Bell Beakers and El Argar population, or among cultures of the Baltic Sea and expanding Akozino warrior-traders. Beyond that, population bottlenecks including founder effects often obscure the original expansion of a language with male-driven migrations, as happened in Finns with N1a1a1a1a-L392 subclades, and Basques with R1b1a1b1a1a2-P312 lineages.

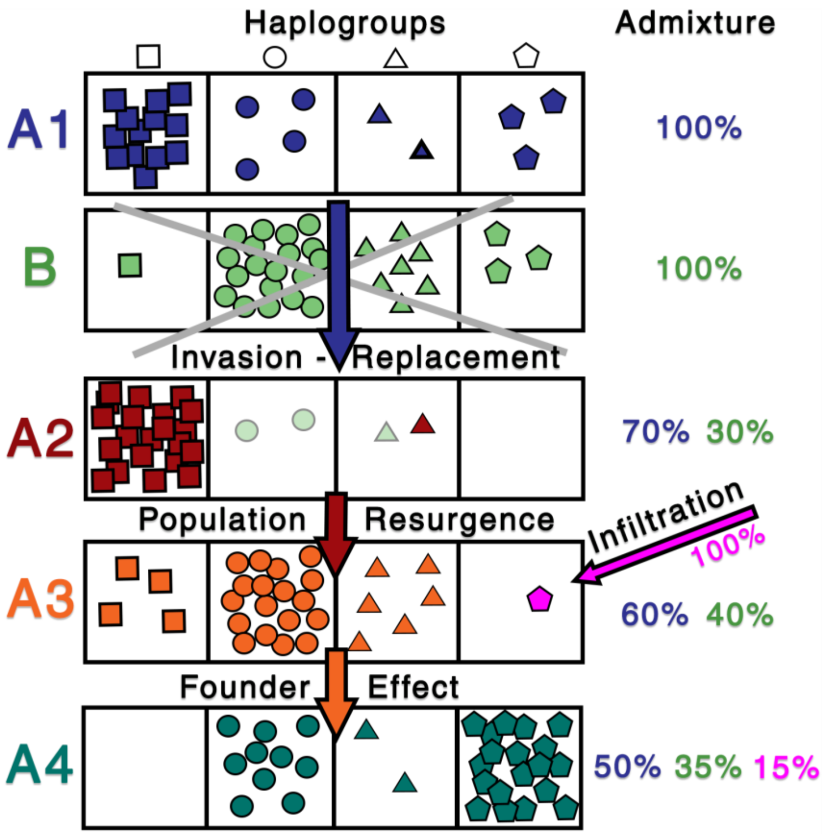

Figure 3. Simplified model of evolution of an ethnolinguistic community in terms of Y-chromosome haplogroups and admixture: Community A1 invades the territory of Community B, eventually replacing most 'indigenous' haplogroups at the same time as certain paternal lineages of A1 have more reproductive success, developing Community A2 through exogamy (evidenced by 30% of admixture from Community B). A language change is very likely to have taken place in the territory of Community B. No language change is necessary, however: (1) in the case of population resurgence (such as the change in haplogroups and admixture from Community A2 to Community A3); (2) after the incorporation of Y-DNA haplogroups and admixture from neighbouring populations; or (3) through founder effects (represented in the evolution from

Community A3 to Community A4). Graphic inspired by images in Zeng, Aw, and Feldman (2018).

Ancient DNA (aDNA) investigation allows us to disentangle complex human history (Slatkin and Racimo 2016). The most recent breakthrough in Indo-European migrations obtained thanks to population genomics, concerned with general population movements of Eurasians westwards from the steppe (Haak et al. 2015; Allentoft et al. 2015; Mathieson et al. 2015), suggested that a common so-called "Yamnaya ancestry" represented by individuals of the Yamna culture could also be found in Corded Ware, Bell Beaker, and Únětice in descending proportions, coherent with their radiocarbon dates, apparently connecting them to succeeding migrations. However, the strong reliance on ancestry to derive conclusions on potential population movements, suited for gross interpretations of Palaeolithic and Mesolithic movements over thousands of years based on few assessed samples, has proven much trickier when deriving models of ethnolinguistic change from movements of neighbouring and closely interacting populations lasting just hundreds of years. Proper assessment and interpretation of Y-DNA, which does not change with generations of admixture, has been demonstrated to be key when investigating the connection of certain groups, as is clear from the Iberian (Olalde et al. 2019) and South Asian cases (Narasimhan et al. 2018).

The massive migration of people of Yamna origin with the Bell Beaker culture some four hundred years after the expansion of Corded Ware peoples (a group probably originating close to the north Pontic area), witnesses thus the latest language shift before the start of the Early European Bronze Age. All data put in common, there is little space (if any at all) to relate the expansion of Corded Ware peoples to any Indo-European dialect surviving into historical times, because the partial genetic link of Corded Ware peoples with Yamna is probably earlier than the expansion of Proto-Anatolian, and there is a strong connection of surviving Corded Ware groups with Finno-Ugric populations. Even the 2015 papers on Indo-European migrations showed with their published data that haplogroups R1b1a1b-M269 and R1a1a1-M417 were absent from central and western Europe until after the expansion of Eurasian pastoralists. This data help thus trace most modern European languages to the Eneolithic Pontic–Caspian steppes, and therefore to a massive expansion starting at nearly the same time from eastern Europe after around 3000 BC. In these studies, R1a1a1-M417 was prevalent in Corded Ware samples and was absent from samples of the Yamna horizon, most of which belonged to haplogroup R1b-M269. Further publications on early European (Mathieson et al. 2018), Bell Beaker (Olalde et al. 2018), Turan/South Asian (Narasimhan et al. 2018), and ancient Eurasian samples (de Barros Damgaard, Marchi, et al. 2018; de Barros Damgaard, Martiniano, et al. 2018) further confirm a surprisingly long-lasting clear-cut division of patrilineal lineages among Eneolithic steppe communities, and recent studies on the prehistoric Caucasus (Lazaridis et al. 2018; Wang et al. 2019) are helping reconstruct the different fine-scale population structure of Corded Ware and Yamna peoples.

The recent genetic revolution is helping thus support the mainstream view of a natural evolution of reconstructed languages, including their dialectal stages, with concrete prehistorical communities defined in time and space (Lehmann 1992). Population genomics has therefore cleaned up the comparatist's desk, dismissing almost all models of cultural diffusion proposed to date, especially flexible frameworks such as the "constellation analogy" (Clackson 2007, 2013) of loosely interconnected prehistoric communities, sharing language and culture through unending waves of areal contact among dialect *continua*. These were probably the result of fashionable linguistic trends akin to the 'pots, not people' paradigm prevalent in archaeology since the mid–20th century, and most of them need be rejected, even though there is still an ongoing controversy over many details of the potential expansion of peoples with certain cultures (Kristiansen et al. 2017; Heyd 2017; Sørensen 2017; Furholt 2017), and there is growing concern about the need for fine-scale studies (Lazaridis 2018; Veeramah 2018).

Even more interesting than the general genetic revolution is the more specific one regarding Indo-European and Uralic migrations. Recently published data is helping reject previously popular theories concerning the dialectal and cultural evolution of Late Proto-Indo-European, such as the Anatolian homeland (Renfrew 1987), or the prevalent identification of Corded Ware with Indo-Europeans (Gimbutas 1977; Kristiansen 1989; Anthony 2007). In this sense, David Reich's words regarding the dismissal of the Anatolian homeland theory by genetic data have proven premonitory for the dismissal of their preferred model of Corded Ware as expanding Indo-European dialects:

"A great lesson of the ancient DNA revolution is that its findings almost always provide accounts of human migrations that are very different from preexisting models, showing how little we really knew about human migrations and population formation prior to the invention of this new technology" (Reich 2018).

Ancient DNA is helping locate different peoples in a very specific place, time, and route of expansion, supporting in turn the most appropriate models of dialectal splits, which closes the circle of interrelated connections between linguistics, archaeology, and genetics, and turns anthropological investigation into a shrinking helix that points more and more precisely to the true ancient ethnolinguistic picture.

While the picture is clearer today than it was just a year ago, the most recent genetic research is also correcting, not just old technology and ancient anthropological interpretations of the 1990s or 2000s, but also genetic methods and results of just months or years ago. Some data that we believed could be breakthroughs in the field have been demonstrated with time to be most likely wrong, either in the radiocarbon dating (due to mixed archaeological layers) or due to errors in technique or recent improvements in technology.

So, for example, the finding of haplogroup N1a-F1206 in the Comb Ware culture (Chekunova et al. 2014) becomes more and more unlikely with each new paper, like the finding of R1a1a-M198 around Lake Baikal during the

Early Neolithic (Mooder et al. 2005; Moussa et al. 2016). Similarly, reports based on modern populations, such as the estimated origin R1b1a1b-M269 in Neolithic Europe (Myres et al. 2011), or R1a-L146 in South Asia (Underhill et al. 2015), and many others have been proven repeatedly wrong with ancient DNA. Even today, errors in cultural attribution, radiocarbon dates, and estimated haplogroups or subclades are bound to happen—in addition to technical errors involving the processing and assessment of samples (very difficult to test without the resampling of specimens) —as we have seen most recently in samples from Hajji Firuz in Narasimhan et al. (2018), a huge investigation including scattered Asian samples and necessitating an international collaboration of many different archaeological teams.

More than *Kosinna's smile* (Heyd 2017) of equating prehistoric culture to population in a general sense, the most recent genetic investigation should probably represent the joy of Starostin's Nostratic Eurasian Epipalaeolithic, Kortlandt's Eurasiatic northern Eurasian Mesolithic, Vennemann's and Villar's Vasconic Mediterranean and western (and possibly central) European Neolithic, Wiik's Uralic northern and eastern European Chalcolithic, and Krahe's Old European Early Bronze Age. Beyond petty sociopolitical and ethnolinguistic grievances of neighbouring Eurafrasian populations, and beyond the infinite pet theories on the potential ancestral population or language *homelands*, genetics is cutting up to the chase and dismissing all theories but a few (usually related ones), or even just one, despite the obstinate defence of traditional theories by many academics.

Sadly, the field is plagued with unending setbacks: on one hand, the eternal search for academic authority, and the need to publish and to collect as much citations and publications in journals of high impact factor as possible, are provoking all kinds of reactionary views, to fit previous models with the clear-cut picture emerging in some cases from genetic investigation. On the other hand, modern political and ethnolinguistic views burden this field, ranging from modern Indian politics in favour of an "indigenous Sanskrit" opposed to the so-called “Aryan invasion theory”; through the interest of modern Russian politics in supporting “indigenous Slavs”, opposed to the known history of colonisation and Slavicisation of essentially all of their modern territory; to the interest of certain western European groups in supporting an “indigenous” Palaeolithic Vasconic-speaking population. Reactionary views and ‘nativist’ ethnolinguistic trends are slowly eroding this new anthropological subfield of population genomics, and I would not be surprised if some education systems would reject it as a useful anthropological discipline, for one or other reason.

No one is free of personal or professional bias, and mine is clear: at Academia Prisca, Fernando López-Menchero and I have invested years supporting the reconstruction of North-West Indo-European as a Late Proto-Indo-European dialect, which puts a clear red line in this series of books to any interpretation of the data that challenges this dialectal scheme. Also, I am of haplogroup R1b1a1b1a1a2a-DF27, like many in south-western Europe. On the other hand, we have been publishing texts about Proto-Indo-European since 2005, and I knew my haplogroup since 2008, but until 2015 I supported the spread of North-West Indo-European with Corded Ware and a later Old European dialect *continuum* centred on the pan-European Únětice culture (Quiles 2012). These cultures were thought to be dominated by R1a-M420 lineages, so that R1b-M343 lineages (probably Vasconic speakers) would have acquired the language by way of cultural diffusion in western Europe, maybe by Bell Beakers along the Rhine.

Only after 2015—when, paradoxically, genetic papers seemed to support my preferred model—did I realise that Corded Ware may not have been linked to the expansion of Proto-Indo-European, and Volker Heyd’s theories seemed to take the lead, with R1a-M420 lineages potentially expanding Indo-Uralic through North Eurasia, but not Indo-European from the steppe, which would have been hitchhiked by R1b-M343 lineages which expanded Afroasiatic from Anatolia into south-eastern Europe (Quiles 2017).

After the most recent papers of 2017 and 2018, it seems more and more unlikely that the early arrival into eastern Europe and lack of expansions of R1a-M420 lineages could be associated with the spread of Indo-Uralic or Eurasiatic through North Eurasia, and therefore R1b-M343 lineages, with a likely origin in (and multiple expansions from) eastern Europe, seem like the most appropriate lines to follow most of the time for the spread of Pre-Indo-European languages.

These are simplistic assessments, and it should be obvious to anyone involved in the field that 1) the current picture shown by available ancient DNA research is clearly shifted towards Europe and R1b-M343 samples, for different reasons, which may be distorting our view of ancient population movements; 2) uniparental markers cannot be linked in a simplistic way to assess ethnolinguistic communities and their movements, because other relevant linguistic, archaeological, and genetic data must be assessed in order to obtain proper migration models; and 3) stages before Indo-Uralic are at best speculative, and are used only to give a coherent account of migrations coupled with reconstructed languages.

Even if all potential biases seem to be under control, a word of caution is due: This book tries to reflect the state of the art of linguistics and archaeology coupled with the available information of population genomics as of the day of its publishing. There is little in science that can be called definitive, and ethnolinguistic identification of prehistoric cultures is not even close to those discoveries and conventions that we could consider firmly established. I have no intention to invest myself into the defence of lost causes, so I would not mind changing any of my interpretations as new data is published: e.g. to argue that Ancient North Eurasian ancestry and Q1a2-M25 represent the Eurasiatic expansion; or to argue that R1a-M420 and Ancient North Eurasian or East Asian ancestry in eastern Europe connects all the necessary dots for the Indo-Uralic expansion, if the new data supports this.

David W. Anthony is a great example of an academic who has invested a lot of time and effort supporting an idea, and has nevertheless changed it as necessary: from a non-Indo-European Corded Ware culture unrelated to Indo-European-speaking Yamna, with certain neighbouring groups adopting the language through “patron–client relationships” (Anthony 2007; Anthony and Ringe 2015); to a Corded Ware culture that expanded with Yamna peoples from the steppe, based on the (then) recently described “Yamnaya ancestry” of genetic papers (Anthony and Brown 2017); to a Corded Ware culture that expanded from Yamna peoples in Hungary, at roughly the same time as it evolved into Bell Beaker, based on the R1a/R1b Y-chromosome bottleneck (Anthony 2017); this last one probably in need of a thorough revision today, as new data has appeared clearly contradicting it. Against this example of a dynamic researcher, there are dozens of known academics unwilling to change one iota of their previous theories, trying to adapt genetic data to their own models. I don’t have much doubts about my intentions or interpretations today, but I do hope that I will be able to change what needs to be changed in the future, like Anthony; but also, to distinguish what is wrong from what is not and needs to be defended in spite of what is fashionable, comfortable, or politically correct.

I. Palaeolithic

I.1. Modern humans

Initial Upper Palaeolithic industries associated with the spread of anatomically modern humans could have begun as early as 48000 BC, with Emirian lithics found in the Negev Desert ca. 45000–43000 BC. This first expansion was followed by another successful one from the Levant, represented by the Early Ahmarian (Near East), Kozarnikian (eastern Balkans), and Proto-Aurignacian (south-west and south-central European) lithic cultures.

Admixture with Neanderthals probably took place in the levant during these early population movements out of Africa, as seen in an Upper Palaeolithic Siberian—Ust'Ishim ca. 43000 BC (Fu et al. 2014), of hg. K-M9(xLT)—and an early Upper Palaeolithic East Asian population—Tianyuan ca. 40500 BC (Yang et al. 2017). The so-called Basal Eurasians, not yet sampled, do not show this admixture, which indicates that they formed part of another expanding group, probably located somewhere in the Near East.

By ca. 39000 BC, modern humans had spread into southern Europe, with transitional industries from Middle Palaeolithic Mousterian style (typical of Neanderthals) to Upper Palaeolithic cultures found widespread in Europe: Uluzzian in northern and southern Italy and Greece; Châtelperronian in northern Spain and western and central France; Szeletian in the Czech Republic and Hungary; and the Lincombian–Ranisian–Jerzmanowician from east to west across the Northern European plain.

These pioneer populations in Europe, represented by Ust'Ishim in Siberia and by the Oase1 individual from Romania ca. 38000 BC, who shows a recent Neanderthal contribution less than six generations back in his family tree, did not contribute detectably to any present-day European population, which suggests that later population expansions have wiped out most of their genetic contribution. It has been speculatively proposed that these populations were affected by the eruption of the Archiflegreo volcano ca. 37000 BC, like Neanderthals, and were thus more easily replaced by newcomers.

Populations that began to diverge 40,000 years ago or earlier in Eurasia may thus be simplistically divided into geographic regions—without care for sub-structured populations and gene flow—as (Suppl. Fig. 1):

- Ancestral North Africans (ANA): a deeply splitting ghost population without Neanderthal admixture, assumed to be present during the Upper Palaeolithic in northern Africa.
- Basal Eurasians (BE): another "deep" ghost population, not participating in the Neanderthal admixture, assumed to have diverged from other non-African Eurasian populations ca. 67,400–101,000 years ago. It experienced most of the common bottleneck of non-Basal Eurasians, which suggests their common involvement in their further migration to the Levant (Lazaridis et al. 2018).
- Upper Palaeolithic Siberians: represented by Ust'Ishim and Oase1, they stem from a common Main Eurasian population which admixed with Neanderthals.
- Early East Asians (EEA): represented by Tianyuan [4], mainly contributed to by a common source to Upper Palaeolithic Siberians

[4] Tentative SNP call O-M175 or P-295, obtained with Yleaf, from Wang et al. (2019) supplementary materials.

(ca. 98%). It also represents the ancestral population of eastern non-Africans (ENA) —i.e. modern Papuans and Onge, and a contribution of some Native Americans—which in turn contributes to present-day South and East Asians.

- Early West Eurasians (EWE): with the earliest representative samples being far eastern Europeans Kostenki14 and Sunghir3, their parent population—probably widespread through Eastern Europe, the Caucasus and the Near East—contributed for thousands of years to different Upper Palaeolithic and Mesolithic migrations, and their ancestry is found in present-day Europeans and Near Easterners.

I.2. Upper Palaeolithic

The Aurignacian lithic cultural complex appeared around 38000 BC in central Europe, and ca. 33000 BC in western Europe, replacing the earlier Middle and Upper Palaeolithic stone toolmaking styles under a unifying trend. The Goyet cluster (defined by GoyetQ116-1, ca. 33330 BC) appeared associated with the Aurignacian cultural complex, showing that a more homogeneous population accompanied the expanding culture. This genetic homogeneity is probably the result of inbreeding due to small population sizes, as can be inferred from the current estimates for the mean 1,500 (ca. 800–3,300) persons for western and central Europe (Schmidt and Zimmermann 2019).

The GoyetQ116-1 individual is more closely related to the EEA and ANS than any other subsequent European population. Its mitochondrial haplogroup M (found mainly among East Eurasian, Oceanian, and Native American populations) is probably related to this ancestral link (Yang et al. 2017). The ancestry related to Aurignacian samples would continue to contribute to the European stock for thousands of years after this culture's demise.

The Gravettian complex (ca. 31000–15000 BC) succeeded the Aurignacian. This culture is known for its Venus figurines, typically made from ivory or limestone carvings. The Věstonice genomic cluster (represented by Vestonice16, ca. 28060 BC) was also genetically quite homogeneous in samples studied from Italy, Austria, the Czech Republic, and Belgium. This population was related to an ancient hunter-gatherer population sampled in far eastern Europe (Kostenki and Sunghir) ca. 35500–30000 BC (Sikora et al. 2017). Samples from Goyet shared no ancestry with Aurignacian samples from the same site, supporting that this cultural change was also associated with a population replacement.

Although it is likely that this population came originally from the east, the primary centre of expansion of the Gravettian culture (and thus the Věstonice cluster), based on archaeological data, was located in the Middle Danube Basin, spreading to the Upper Danube Basin and into the mid–Atlantic France (Middle Rhine Group, Maisierian group) and south-western Europe (western Gravettian), as well as to eastern Europe (Dniester and Prut Basins) and the Russian Plains (Kostenki–Avdeyevo group).

Chronologically coincident with the Gravettian were the Ancient North Siberians, represented by two Yana RHS samples (ca. 29600 BC), of P1-M45 lineage, ancestral to haplogroups Q-M242 and R-M207 (Sikora et al. 2018). They share the most genetic drift with Ancient North Eurasians (ANE), represented by three individuals from Upper Palaeolithic south-central Siberia (from Mal'ta–Buret' ca. 22350 BC to Afontova Gora ca. 16000 BC), spanning the duration of the Late Glacial Maximum (LGM). Even though Mal'ta–Buret had Venus figurines with potential similarities to Gravettian ones, the ANE ancestry proper of this cluster is not found among Europeans until the Eneolithic steppe expansions.

The Mal'ta boy's paternal lineage diverged from haplogroup R-M207* shortly before its split into R1-M173 and R2-M479 subclades (Raghavan et al. 2014), which is estimated to have happened ca. 26200 BC. His so-called Ancient North Eurasian (ANE) ancestry contributed substantially to the genetic ancestry of Siberians, Native Americans, and Bronze Age Yamna individuals (Lazaridis et al. 2014), being close to modern-day Native Americans, Kets, Mansi, Nganasans, and Yukaghirs (Flegontov et al. 2016).

The Magdalenian culture spread after the LGM (ca. 23000–17000 BC) from a refuge in southern Iberia, chasing the retreating ice sheet expanding in a northeast direction with El Mirón genomic cluster. From the Late Magdalenian assemblages of Germany and Poland, the expansion of the Hamburgian and Creswellian technocomplexes ca. 13000 BC spread across the Northern European Lowlands south of the Scandinavian Ice sheet.

Relevant known populations before the Final Upper Palaeolithic period may be simplistically divided into geographic regions—without care for sub-structured populations and gene flow—as (Suppl. Fig. 2):

- Goyet cluster: stemming from an EWE source, they expand first with the Aurignacian, and then again from an Iberian refuge during the Magdalenian. During this initial expansion, and also later during the Gravettian, hg. C1a2-V20 (formed ca. 43000 BC, TMRCA ca. 41500 BC) dominates the ancient DNA record.
- Common West Eurasians (CWE): ghost population stemming from an EWE source, probably spread somewhere around the Black Sea. It contributes to different West Eurasian populations to the north (eastern Europe) and south of the Caucasus (Fertile Crescent) during the Palaeolithic.
- Ancient Middle Easterners (AME): Represented by two samples from the Dzudzuana cave in the southern Caucasus (ca. 25000–22000 BC), they show contribution from CWE (ca. 72%) and a BE or earlier BE-like population (ca. 28%). Their ancestral population contributed to Epipalaeolithic Levantine and Anatolian populations, so they are a likely proxy for a contemporary population spanning the whole Fertile Crescent (Lazaridis et al. 2018).
- Věstonice cluster: formed probably in far eastern Europe by an admixture of an EWE source close to CWE (ca. 62%), and from another EWE source close to the Goyet cluster (ca. 38%), it expanded west with the Gravettian expansion. The spread of haplogroup I-

M170 (formed ca. 40900 BC, TMRCA ca. 25500 BC) in Europe is probably associated with the expansion of certain groups of the Věstonice cluster.

- Ancient North Siberians (ANS): It diverged ca. 36000 BC from EWE (soon after this population split from East Asians), with further contributions from EEA (ca. 25%) also soon after the split EEA–EWE.
- Ancient North Eurasians (ANE): contributed to by ANS, an EWE source close to the Goyet cluster (ca. 75%) and an EEA population (ca. 25%). This component contributed substantially to the genetic ancestry of Siberians, Native Americans, and Bronze Age Yamna individuals (Lazaridis et al. 2014), being close to modern-day Native Americans, Kets, Mansi, Nganasans, and Yukaghirs (Flegontov et al. 2016). Their wide distribution of a consistent Initial Upper Palaeolithic technology in Siberia and neighbouring territories up to north Mongolia seems to be coincident with the eastward expansion of peoples through the steppe belt (Zwyns and Lbova 2018).
- El Mirón cluster: it derives most of its ancestry from Goyet (63%), and it has not been found in the previous Gravettian period. This is thus the first described case of a ‘resurgence’ of a population from an (as of yet) unsampled pocket that survived a previous population turnover, and persisted for a long time after their assumed disappearance. The main haplogroup associated with its expansion is I-M170 also found later in the Villabruna cluster, which suggests that Gravettian lineages admixed with a population of the Goyet cluster, and remained in isolation (most likely in Iberia) until the Magdalenian expansion.

I.3. Epipalaeolithic

Starting ca. 12000 BC with the first strong warming period after the last ice age, known as the Bølling-Allerød interstadial, a new migration replaced part of the European population, helped by the melting of the Alpine glacial wall that divided west and east Europe. Individuals associated with diverse Epipalaeolithic cultures (ca. 12000–5000 BC)—transition to the Epigravettian in southern Europe, and Magdalenian–to–Azilian transition in western Europe—fall into a newly emerged Villabruna genomic cluster, which displaced previous hunter-gatherer populations.

The population ancestral to the Villabruna cluster separated from the ancestors of contemporary populations found in the Near East. It is during this time that western European hunter-gatherers become much more closely related to modern Near Easterners, proving that the new migration likely happened from the Near East into Europe. The defining sample comes from an Epigravettian individual from Villabruna, Italy (ca. 13000 BC), of hg. R1b1-L754, and this lineage is also found in Loschbour (ca. 9775 BC), along with an individual of hg. I2-M438.

Other individuals include from Bichon, Switzerland (ca. 11700 BC), hg. I2a1a1b1-L286; Loschbour, Luxembourg (ca. 6100 BC), hg. I2a1a2-M423; as well as samples from La Braña, Iberia (ca. 5865 BC), hg. C1a2-V20; and Körös (Hungary ca. 5710 BC), hg. G-M201. Ancient individuals from France, Sicily, Croatia, France, and Germany share this ancestry, which suggests that the Villabruna cluster was widely distributed in Europe for at least six thousand years, and probably expanded from a south-eastern European refugium following the last Ice Age ca. 13000 BC (Mathieson et al. 2017).

Of the fifteen samples studied, four individuals from central and central-west Europe show a distinct component found in modern East Asians, particularly Loschbour and La Braña, which indicates gene flow from a population related to modern-day East Asians into some groups of the Villabruna cluster, consistent with gene flow between populations related to

East Asians (Fu et al. 2016). This supports the potential arrival of R1b1-L754 lineages from Asia associated with a male-biased migration of an eastern population.

Based on the most recent data of modern populations, an origin of the split into R1b-M343 and R1a-M420 is estimated ca. 20800 BC, with a TMRCA ca. 18400 BC for R1b-M343, and ca. 16200 for R1a-M420. The formation of R1b1-L754 is estimated ca. 16900 BC, with a time to MRCA ca. 15100 BC, suggesting successive migration events, starting probably near Siberia in Asia, based on the Mal'ta sample of hg. R-M207.

Hunter-gatherers from the Iron Gates prove the regional continuity of haplogroup R1b1-L754 (xR1b1a1-P297, xR1b1a1b-M269). These samples were probably from branches that have not survived in modern populations, and they cover an extensive period spanning from the first half of the 10th millennium to the first half of the 6th millennium BC, with the latest samples showing already Middle East farmer ancestry (Mathieson et al. 2017; González-Fortes et al. 2017).

More individuals possibly related to these ancient branches are found later in Ukraine, Iberia, and central European Neolithic in Quedlinburg as R1b1-L754 (xR1b1a1b-M269) ca. 3590 BC (Haak et al. 2015). These samples, coupled with individuals of hg. R-M207 found in Ganj Dareh (Iranian Neolithic) in the first half of the 9th millennium BC might suggest a southern Eurasian migration route for R1b1-L278 lineages, through the Iranian plateau.

The samples of basal R1b-M343* lineages in modern populations of southern Kazakhstan (Myres et al. 2011) and Iran (Grugni et al. 2012) give further support to the southern migration route into Europe. Basal R1b1-L278* lineage was found in five individuals—3 Italians, 1 West Asian, 1 East Asian—out of 5,326 samples studied (Cruciani et al. 2010) , which also point to a potential ancestral migration into Europe.

During the Bølling-Allerød interstadial, various divergent populations coexisted in Eurasia and Africa (Suppl. Fig. 3):

- Epipaleolithic Iberomaurusians: represented by samples from Taforalt (ca. 18000–8000 BC), of hg. E1b1b1a1-M78 (formed. ca. 17600, TMRCA ca. 11300 BC) they derive their ancestry from ANA (ca. 45%) and a mix of CWE (ca. 40%) and other "deep" ancestry (ca. 15%). They contributed mainly to Early Neolithic populations from Morocco, and also to the Natufian population.
- Epipalaeolithic Natufians: represented by samples from the Raqefet Cave (ca. 11300–10800 BC), probably all of hg. E1b1b1a1-M78, are a Levantine population of hunter-gatherers who lived in permanent dwellings and managed local wild plants. They show contribution from AME (73%), but also from ANA (ca. 27%), consistent with the spread of morphological features and artefacts into the Near East, as well as Y-chromosome haplogroup E.
- Anatolian hunter-gatherers (AHG): represented by an individual from Pınarbaşı in Northern Anatolia (ca. 13350 BC), of hg. C1a2-V20, mtDNA k2b, whose ancestry descends mostly from AME (>95%), with small contributions from an ENA/ANE source, from Villabruna, and possibly from the Levant (Feldman et al. 2019). It contributed to Early Anatolian Neolithic populations.
- El Mirón: While a Mesolithic individual from Chan in north-west Iberia (ca. 7200 BC) shows continuity with El Mirón ancestry, the La Braña brothers from ca. 1,300 years later, were closer to central European hunter-gatherers like the Hungarian Körös, with an even more extreme shift ca. 700 years later in Canes, also from the Cantabrian region, reflecting a gene flow from Villabruna affecting north-west Iberia but not the south-east or south-west, where individuals remained close to El Mirón. The incursion of Villabruna ancestry in Iberia is dated to at least 12000 BC, when a sample from Balma Guilanya in north-east Iberia shows it. Nevertheless, all these Mesolithic samples show still higher Goyet ancestry than non-Iberian

hunter-gatherers. One example of a late El Mirón-like individual from the south-east comes from Cueva de la Carigüela (ca. 9700–5500 BC) potentially of hg. I1-M253 (formed ca. 25500 BC, TMRCA ca. 2600 BC), and a certain I1-M253 is found in an older sample from Balma Guilanya, which could mean that this lineage expanded from Iberia to the north with the Magdalenian expansion or later population movements (Olalde et al. 2019; Villalba-Mouco et al. 2019).

- West European hunter-gatherers (WHG): derived from CWE, they are represented by the Villabruna cluster in Europe. Due to its common root with AME—relative to which it lacks BE-like contribution—they are supposed to represent a population in or near Anatolia that expanded to central Europe probably from a region near the Black Sea. It is possibly part of a big AME transitional cline that connected WHG and AHG during the Palaeolithic, since south-eastern European hunter-gatherers show extra Anatolian admixture, just like AHG shows small WHG admixture. This ancestry dominates over most European hunter-gatherer populations until the arrival of the Neolithic ca. 6000 BC. Samples like Villabruna in northern Italy (ca. 12000 BC), OrienteC in Sicily (ca. 12000 BC), Bichon in Switzerland (ca. 11700 BC), Croatia Mesolithic (ca. 7200 BC), Loschbour in north-west Europe (ca. 6100 BC), La Braña 1 in north Iberia (ca. 5900 BC), or Körös in Hungary (ca. 5700 BC), all form a close WHG cluster spanning 6,000 years from the Atlantic façade to Sicily in the south and to the Balkan peninsula in the south-east (Mathieson et al. 2018).
- ANE: represented in this late Upper Palaeolithic period by the Afontova Gora 3 sample from Lake Baikal, tentatively classified as of haplogroup Q1a-F1096 (formed ca. 24000 BC, TMRCA ca. 23900

BC) or possibly R1-M173[5] (formed ca. 26200 BC, TMRCA ca. 20800 BC). The creation of EHG ancestry (basically a WHG:ANE cline, see below) in Eastern Europe and the Caucasus was most likely associated with the westward migration of groups of ANE ancestry, probably mainly of hg. Q1a2-M25 (formed ca. 22400 BC, TMRCA ca. 14300 BC) and R1-M173 through North Eurasia. Samples of haplogroup Q-M242 found in a Baltic hunter-gatherer (ca. 6500 BC), and later in Eneolithic populations from the Caucasus, are likely remains of this early expansion. Modern-day Kets, Mansi, Native Americans, Nganasans and Yukaghirs show maximum ANE ancestry (Flegontov et al. 2016).

- Ancient East Asians (AEA): represented by hunter-gatherers from the Early Neolithic in Lokomotiv and Shamanka (ca. 5200–4200 BC) near Lake Baikal, they show predominantly East Asian ancestry closely related to ancient individuals from the Devil's Gate Cave (ca. 6000–5500 BC), and some ANE-related contribution (ca. 16%), representing thus another proxy for an ancestral ENA-like ancestry to compare with ANE (de Barros Damgaard, Martiniano, et al. 2018; Lazaridis et al. 2018; Sikora et al. 2018). They show one sample of haplogroup C2a1a1a-F3918 and other five probably N1a2-L666 (formed ca. 13900 BC, TMRCA ca. 6800 BC). A Jomon sample from Japan dated ca. 2,500 years ago, with close affinity with a 8,000-years old Hòabìnhian hunter-gatherer, and unaffected by ANE gene flow, supports a coastal route of the earliest wave of East Asian ancestry (Gakuhari et al. 2019), suggesting that the East Asian coast was a sink rather than a source during prehistoric population movements. The first appearance of AEA-related ancestry in Eastern Europe must have happened quite early, possibly later than the ANE expansion into

[5] Additional information: Q1a originally reported by YFull; tentative SNP call R1 obtained with Yleaf, from Wang et al. (2019) supplementary materials.

Europe, and possibly associated with the spread of R1a1-M459 (formed ca. 16200 BC, TMRCA ca. 12000 BC) from Siberia into the Pontic–Caspian area.

- Eastern hunter-gatherers (EHG): it can be modelled as an admixture of ANE (ca. 63%) with WHG (34%), with additional ancestry related to AEA (ca. 7%), but without additional AME contribution. It is represented by hunter-gatherers from eastern Europe, each with its specific contributions of different components, which suggests that it formed a quite stable east European cline between more WHG-like populations from the west and more ANE-like populations from the east. The presence of a Q1a2-M25 sample ca. 6500 BC in Zvejnieki points probably to the resurgence of this lineage that had spread ANE ancestry to eastern Europe, although R1a1-M459 lineages may have been involved in the creation of the cline, too. The first EHG sample is an individual from Sidelkino, from the Samara region (ca. 9300 BC), of mtDNA U5a2—with mtDNA U5 being a constant in prehistoric eastern European populations. The appearance of hg. J1-M267 in two early EHG samples from Karelia (ca. 6300 BC) may be related to an early expansion from the south, possibly of J1b1-Y6034 (formed ca. 12900 BC, TMRCA 9700 BC) from the Caucasus with ANE ancestry, creating the described cline of ANE:WHG:CHG ancestry (ca. 60:25:15) in these samples (Sikora et al. 2018).
- Caucasus hunter-gatherers (CHG): represented by samples from Satsurblia (ca. 11300 BC, haplogroup J1-M304), and Kotias Klde (ca. 7800 BC, haplogroup J2a-M410), both sites near Dzudzuana. They show AME ancestry (ca. 56-64%) and a contribution of ENA/ANE-like populations, apart from a small “deep” ancestry.
- Iran Neolithic (IN): represented by a Mesolithic child from the Belt Cave (ca. 12000–8000 BC), of hg. E1b1-P2, and individuals from Ganj Dareh in the Zagros Mountains (ca. 9000–8000 BC), of hg. R2-

M479. They form an EHG:ANE cline similar to CHG, and thus form likely an ancestral CHG/IN population formed mainly by AME ancestry (ca. 50–58%), where IN shows a slightly higher contribution of ANE, with a statistically significant greater contribution of “deep” ancestry likely from the south.

- Ancient Palaeosiberians (AP): represented by the Kolyma1 individual (ca. 7800 BC), they derive their ancestry from a mixture of EEA and ANS ancestry similar to that found in Native Americans (but with greater EEA contribution, 75% vs. 63%), with a closer relation to Mal’ta than to Yana RHS. The divergence of AP/Native Americans and present-day East Asians (Han Chinese) is estimated to have happened ca. 22000 BC, with AP/Native Americans showing further contribution (ca. 18000 BC) related to ANS (Sikora et al. 2018).
- Ancient Ancestral South Indian (AASI): hypothesised South Asian hunter-gatherer ancestry deeply to present-day indigenous Andaman Islanders (Mallick et al. 2016), in particular the sampled Onge population, mainly of hg. D-M174 (Thangaraj et al. 2003), and mtDNA M2 and M4 (Reich et al. 2009; Moorjani et al. 2013).

i.3. Nostratians

Based on the most recent data of modern populations, an origin of the split into R1b-M343 and R1a-M420 is estimated ca. 20800 BC, with an expansion of R1b-M343 (TMRCA 18400 BC), then R1b1-L278 (formed ca. 18400, TMRCA ca.16900 BC). The finding of intrusive haplogroup R1b1-L754 (formed ca. 16900 BC, TMRCA ca. 15100 BC) with a homogenous WHG ancestry in Europe, and the consistent presence of mtDNA hg. U5b in different samples of the Villabruna cluster, support a male-biased migration coincident with the Bølling-Allerød interstadial.

The Mal'ta individual and the finding of the other main R1b-M343 subclade, R1b2-PH155 (TMRCA ca. 5200 BC), among early Xiongnu individuals in East Asia—and later accompanying Turkic peoples—supports a split of R1b-L278 in eastern Europe or central Eurasia, and was most likely associated with the expansion of ANE and/or EHG ancestry from Asia, possibly in successive waves of expansion that also accompanied haplogroups Q1a2-M25 and R1a-M459 to the area.

This eastern origin may justify the presence of East Asian ancestry among some samples from the Villabruna cluster associated with expanding R1b1-L754 lineages. Whether R1b-M343 lineages traversed the Middle East or expanded from the Pontic–Caspian region into Europe is unclear, although the high variability of ancient subclades found to date in eastern Europe and the Caucasus supports the regions on both sides of the Urals as the most likely cradle of R1b-M343 expansions.

Sampled hunter-gatherers from south-eastern Europe show the long-term regional continuity of haplogroup R1b1-L754 (xR1b1a1-P297, xR1b1a1b-M269), found in the Iron Gates—and also later in Mesolithic and Neolithic populations from Ukraine, the Balkans, Central Europe and Iberia. They have WHG (87%) and EHG (13%) ancestry, show mtDNA K1 and H (not present in WHG and EHG individuals), and many of these samples have been confirmed as of subclade R1b1b-V88 (formed ca. 15100 BC, TMRCA ca.

9700 BC), which must have split at the same time as R1b1-L754 was expanding into Europe. European R1b1b-V88 lineages cover thus an extensive period spanning from the first half of the 10th millennium to the first half of the 3rd millennium BC, and are found widespread from Iberia in the west to the north Pontic area in the east (González-Fortes et al. 2017; Mathieson et al. 2018).

The samples of basal R1b-M343* lineages in modern populations of southern Kazakhstan (Myres et al. 2011) and Iran (Grugni et al. 2012) give further support to an eastern origin in Central Asia. Basal R1b1-L278* lineages were found in five cases out of 5,326 cases studied – three Italians, one West Asian, one East Asian (Cruciani et al. 2010) –, which also point to a potential ancestral migration into Europe. Nevertheless, population movements after their initial expansion may have obscured the original migration route, and an expansion through Anatolia cannot be excluded.

Tracing backwards potential Eurasiatic and Afroasiatic movements, and based on male-driven population expansions, the clearest link to an expanding Nostratic-speaking community is represented by the expansion of R1b1-L754 lineages, starting probably after ca. 16000 BC through the North Pontic area into south-eastern Europe, acquiring along the way the characteristic CWE-like ancestry of the Villabruna cluster.

The presence of R1b1b-V88 lineages widespread among European hunter-gatherers point to a likely early "southern Nostratisation" of Europe from east to west. The expansion of R1b1b-V88 subclades within Africa is most likely linked to the spread of Proto-Afroasiatic (see below *§ii.4. Early Afrasians*). The expansion of R1b1a1-P297 into north-east Europe, later emerging with post-Swiderian cultures, marks the clearest trace of the potential Eurasiatic expansion (see *§ii.1. Eurasians*). Even though the precise origin of expansions of R1b1-L754 subclades remains unclear, the regions surrounding the Pontic–Caspian area are the best candidates at this moment.

While the formation of hg. R2-M479 was quite early (ca. 26200 BC), its lineages survived probably somewhere in Asia until its successful expansion (based on its TMRCA ca. 14300 BC), and should probably be identified with the additional ENA/ANE contribution to Iranian Neolithic (and possibly CHG) ancestry, since they are found in samples from Ganj Dareh during the 9th millennium BC. Because one sample is R2a-M124 (formed ca. 14300 BC, TMRCA ca. 9600 BC), Iran Neolithic individuals are probably close descendants from this haplogroup's successful expansion. Haplogroup R2a-M124 seems to be prevalent among ancient and modern Dravidians (see *§viii.20. Dravidians and Indo-Aryans*), and is also found in the Caucasus (Huang et al. 2017).

A connection of Dravidian with R1b-M343 is not straightforward, then, lacking fitting ancient DNA samples. Nevertheless, the likely initial expansion of R1b1-L754 lineages with ANE ancestry, as well as early expansions through the Caucasus or Turan, may have contributed to the development of other Nostratic communities in the Near East. Similarly, there is no clear connection between this haplogroup and Kartvelian, although the complex evolution of multiple small communities in the Caucasus probably allowed for many ethnolinguistic changes in the region, associated with different haplogroup expansions.

The expansion of R1b1a1-P297 lineages apparently associated with Eurasians (see below *§ii.1. Eurasians*) and the later emergence of R1b1a2-V1636 lineages (TMRCA ca. 4700 BC) in the Pontic–Caspian steppe region (see below *§iv.2. Indo-Anatolians*) supports the expansion of their upper clade R1b1a-L388 (TMRCA ca. 13600 BC) from far eastern Europe, having separated (ca. 15100 BC) with sister clade R1b1b-V88 from the ancestral R1b1-L754 trunk.

This early split of R1b1a-L388 may account for the separation of Eurasians from Pre-Kartvelians, who would have expanded close to the Caucasus with R1b1a2-V1636 lineages, while Eurasians expanded through the north. The early separation of R1b1b-V88 from the eastern European *cradle* of hg. R1b1-L754 and of ANE/EHG ancestry expansions would support a closer connection of ancestral Eurasiatic, Kartvelian, and possibly also Dravidian communities with each other than with Afroasiatic. The presence of basal R1b1a-L388 subclades in modern individuals from Turkey, Bulgaria, and Italy would also suggest eastern European routes of expansion for this lineage, rather than southern routes through the Caucasus or West Asia.

The timing of expansion and separation of these lineages from the common R1b-M343 trunk (Suppl. Graph. 19) coupled with known admixture events fit some of the previously published 'shape-shifting' Nostratic macro-languages (Campbell 1998), as well as roughly the dates published with help of language guesstimates coupled with archaeology (Beridze 2019) and statistical models (Pagel et al. 2013), which essentially predict an earlier separation of Dravidian, followed by that of Kartvelian from the common Eurasiatic superfamily (Figure 4).

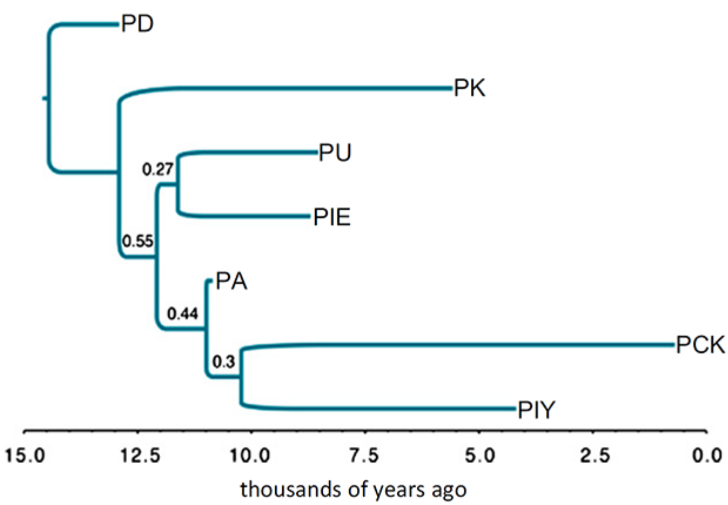

Figure 4. Consensus phylogenetic tree of Eurasiatic superfamily rooted tree with estimated dates of origin of families and of superfamily by Pagel et al. (2013). P proto followed by initials of language family: PD proto-Dravidian, PK proto-Kartvelian, PU proto-Uralic, PIE proto–Indo-European, PA proto-Altaic, PCK proto–Chukchi-Kamchatkan, PIY proto–Inuit-Yupik. Consensus tree rooted using proto-Dravidian as the outgroup. The age at the root is 14.45 ± 1.75 kya (95% CI = 11.72–18.38 kya) or a

slightly older 15.61 ± 2.29 kya (95% CI = 11.72–20.40 kya) if the tree is rooted with Proto-Kartvelian.

II. Mesolithic

II.1. North-Eastern Technocomplex

Blade production by pressure technique is a marker of a particular craft tradition that emerged in the Mongolian area ca. 20,000 years ago, and spread from east to west during the last glacial maximum, reaching the Baltic Sea and Scandinavia in the Mesolithic.

In the north, the population of the final Palaeolithic Swiderian culture of deer hunters, which had developed in Poland on the sand dunes left behind by retreating glaciers, migrated during the Palaeolithic–Mesolithic transition at the turn of the 11th–10th millennium BC to the north-east following the retreating tundra (Terberger et al. 2018), which is evidenced by a centuries-long settlement break before a new populations arrived (Kobusiewicz 2002). Morphological similarities in the tanged points of the East European Swiderian points with Kunda and Butovo cultures supports groups migrating north during the Late Pleistocene / Early Holocene (Zaliznyak 1999).

Post-Swiderian cultures developed in particular the surface pressure flaking technology further, and technical differences with Swiderian cultures include single platform cores, pressure blade debitage, inset technology, etc. (Darmark 2012). The culture expanded in the Baltic and in the east European forest zone, north of the (then unstable) Pontic–Caspian area, especially during the Early Mesolithic (ca. 9000–8300 BC) and Middle Mesolithic (ca. 8300–6000 BC), although the earliest date for similar material is currently set at the end of the 11th millennium BC. The Kunda culture developed around the eastern Baltic, from the Polish Plains to the Gulf of Finland; the Butovo culture in the Volga and Oka regions; and the Veretye culture in the eastern part of Lake Onega (Suppl. Fig. 4).

During the Early Mesolithic period, human settlement shifted from the major river valleys to the inland lake regions, and changes are seen in the extraction and processing of lithic raw materials, technology, and tool morphology. There is a rich bone and antler inventory—harpoons with large, widely spaced barbs, slotted and needle-shaped points, daggers, etc.—and a less diverse lithic inventory—flint end-scrapers and blade inserts, rarely tanged points (Damlien et al. 2018).

A typical feature is the use of imported high-quality Cretaceous flint, originating from areas to the south, in the forest zone of western Russia. In the Middle Mesolithic, settlements concentrate in inland lake basins, the most extensively excavated site being Zvejnieki II, in the northern region of the Kunda culture. Compared to the previous period, there is a richer lithic inventory, dominated by side- and end-scrapers, inserts, and some burins, and mainly local raw material is used (Damlien et al. 2018).

Mesolithic arrowheads from Butovo (Figure 5) show that they were made using a standard operation chain, with sophisticated technology, and some of them were treated with special care. They were mainly used for hunting, for a short time, but use-wear and traces of repair in some specimens suggest they were used for a long time. These arrowheads show more differences than common traits with Dubensee and Maglemose cultures of western and central Europe. Slotted bone points with flint inserts appearing in Denmark and Scania in the second part of the Boreal period differ in the position and morphology from East European artefacts (Zhilin 2017).

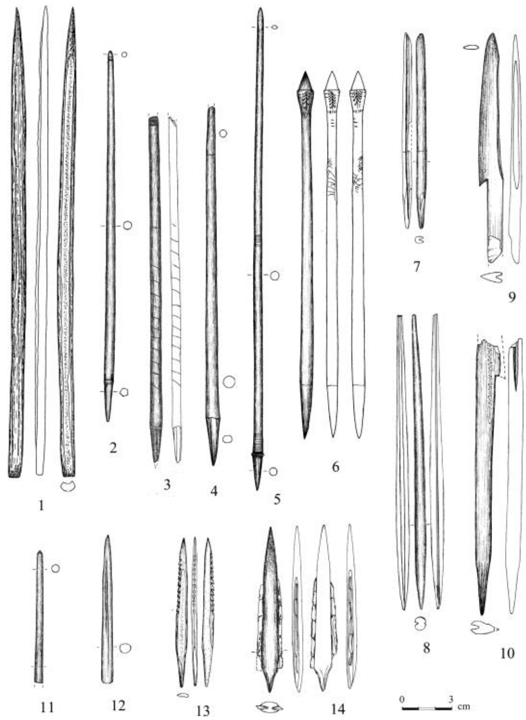

Figure 5. Bone arrowheads from the early Mesolithic layer IV. From Zhilin (2017).

On the other hand, the technology and typology of early Mesolithic arrowheads from the Eastern Baltic to the Upper Volga area show similarities that indicate regular communication and the existence of social networks among populations of these regions. This is further confirmed by the spread of Pulli type flint arrowheads, some types of retouched inserts, and specific types of flint raw materials. Further developments in technology during the Boreal period show a resemblance between Veretye and Butovo cultures, differing from the Kunda culture, but still with contacts between the regions (Zhilin 2017).

The Kunda–Butovo complex is linked together thus by lithic provenience from hundreds of km apart, and by a similar technology. Peat bog sites of the Trans-Urals area also produced bone arrowheads: needle-shaped, narrow flat slotted, one-winged with barbs, paddle-shaped and arrowheads with thickened head, some of them looking very similar to bone arrowheads from Mesolithic peat bog sites of Butovo, Veretye, and Kunda cultures (Zhilin 2017).

Although differences in detail can be seen, the transmission and maintenance of the technology require intimate interaction, and, in conjunction with the movement of raw materials, indicate the presence of a social network in the area. The typological homogeneity of assemblages between regions spanning the Baltic to the Ural Mountains led Kozłowski (2009) to call it the 'North-Eastern Technocomplex'. Further in the Trans-Urals and Siberia, needle-shaped and slotted arrowheads can be compared with similar artefacts from Eastern Europe.

ii.1. Eurasians

Following the French technological approach, along with the concept of *chaîne opératoire*, material culture such as lithic technology can be argued to represent a manifestation of culturally transmitted knowledge that is learned and shared among a group of people and transmitted between generations, thereby reflecting social traditions. The specific combinations of tehnology (including operational sequence, combination of raw materials, tools, gesture, etc.) are part of a craft tradition, a knowledge and know-how shared by a specific social group. While single technological elements can be transmitted easily within a generation or peer group, complete production concepts are more likely to be learned and passed unchanged through many generations (Damlien et al. 2018).

The early successful expansion of haplogroup R1b1a1-P297 (TMRCA ca. 11300 BC) may be associated with the spread of post-Swiderian cultures in north-eastern Europe, linked thus to the North-Eastern Technocomplex and potentially to the expansion of Eurasiatic, whereas the earlier successful expansion of its parent haplogroup R1b1a-L388 (TMRCA ca. 13600 BC) in eastern Europe may have brought R1b1a1-P297 in contact with the disintegrating Swiderian culture. Samples from the Kunda and the succeeding Narva cultures show an ancestry intermediate between WHG (ca. 70%) and

EHG (ca. 30%). The earliest samples of Kunda in Zvejnieki during the 8th–6th millennium BC are of hg. R1b1a1-P297, and there is continuity of this lineage until the end of the 4th millennium in the Baltic (Jones et al. 2017; Mathieson et al. 2018).

Other samples of hg. R1b1a1-P297 are also found (at least since the 6th millennium BC) in the Volga–Ural region. Subclades R1b1a1a-M73 found in Siberia (see *§v.8. Palaeosiberians*) and later in Asian populations, as well as the expansion of R1b1a1b-M269 much later from the Volga–Ural area (see below *§iii.5. Early Indo-Europeans and Uralians* and *§viii.21.1. Yukaghirs*) support this early expansion of R1b1a1-P297 lineages through eastern Europe into the Trans-Urals area up to the Altai Mountains. The finding of R1b1a1-P297 subclades in modern East Asian territories from Russia, China, or Japan further support the later association of some eastern European or central Asian groups with these lineages.

II.2. Colonisation of Scandinavia

The ice sheet retracted from northern Europe allowed for the colonisation of the Scandinavian Peninsula from about 9700 BC, according to the archaeological record, both in southern and northern Scandinavia, while ice still dominated the interior.

The peninsula seems to have been colonised first from the south by peoples from central Europe, related to late-glacial lithic technology (direct blade percussion technique), which brought WHG ancestry with them. Komornica traditions from western Latvia show technological similarities with the western Baltic region, shared with Maglemose cultures across the Polish Plain to the islands of eastern Denmark and southern Sweden, where the core platforms were generally kept unprepared, and formal microliths were an integrated element of the lithic tool tradition, suggesting that the pressure blade technology was not adopted completely (Damlien et al. 2018).

An invasion from the north-east (through Finland) by post-Swiderian Mesolithic groups from east Europe is evidenced by the arrival of EHG ancestry with them. Their technology is represented by their pressure blade technology in central and western Scandinavia, where the core platform was formed and repeatedly rejuvenated by detachments of core tablets, and by systematically faceting the platform surface. Formal microliths are generally absent, and blade inserts dominate. This is clearly documented in Zvejnieki II, in northern Latvia (Damlien et al. 2018).

This regional variation in pressure blade technology is an expression of two different culturally derived traditions that existed synchronously in the Northern European Plains and around the Baltic Sea during the Middle Mesolithic (Figure 6). The adoption of the earliest form of pressure blade technology in Maglemose/Komornica (dating to the early Middle Mesolithic in post-Swiderian cultures) points to the adoption of technology by western groups, and thus to the existence of two main distinct cultural, economic, social, and communication networks in northern Europe (Damlien et al. 2018).

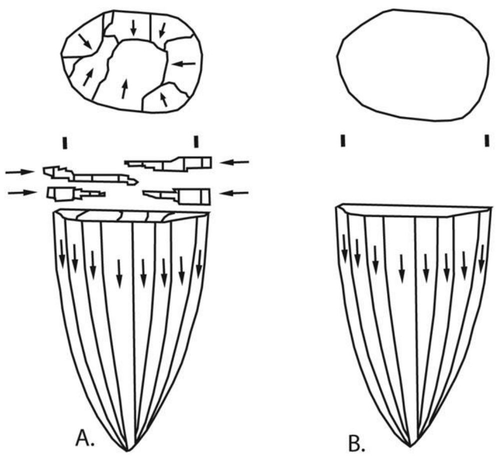

Figure 6. Different types of core platform rejuvenation and preparation. A: Platform preparation by systematic faceting and repeated rejuvenation. B: Unprepared platforms (modified after Sørensen et al. 2013, fig. 1). Image from Damlien et al. (2018).

These population movements left a paradoxical pattern of increased EHG ancestry in northern and western Scandinavia, and WHG ancestry in eastern and central Scandinavia, which correlates with Baltic samples (Suppl. Graph. 3). It has also been shown that selection drove the unique combination of light skin and hair and varied blue to light-brown eye colour, as part of the adaptation to a different environment, contrasting with WHG who had the specific combination of blue eyes and dark skin (Günther et al. 2017).

ii.2. Northern Europeans

Individuals from Mesolithic Scandinavia, which define the so-called Scandinavian hunter-gatherer (SHG) ancestry, show exclusively I-M170 subclades, probably resurged from the previous Magdalenian-Hamburgian expansions, and mtDNA haplogroups U5 and U2 (Mathieson et al. 2017). The first sample of haplogroup I1-M253 is probably found in Gotland ca. 6950 BC, which points to the survival of these lineages in pockets of Scandinavia until the formation of the Nordic Late Neolithic.

The expansion of the pressure blade technology proper of post-Swiderian cultures was also driven by I2-M438 lineages, which probably ‘resurged’ in certain Baltic communities at the end of the 7th millennium, side by side with hg. R1b1a1-P297. For example, Zvejnieki hunter-gatherers show six individuals of hg I2-M438 (ca. 6000–4775 BC), with two I2a1a-P37.2, two I2a1b1a2-CTS10057 (formed ca. 8500 BC, TMRCA ca. 8500 BC), and two I2a1a2a1-S2639 (formed ca. 5000 BC, TMRCA ca. 4700 BC).

The assemblages of Motala hunter-gatherers from south-western Sweden, for example, have been described as having general traits in common with Maglemosian cultures (e.g. microblade technology), but differ in other respects (e.g. an absence of geometrical microliths), with further similarities and differences with the “quartz and pecked axe complex” found in north-east and central Sweden. Because of that, it is considered a transition zone, a mixture of cultural contacts (Eriksson et al. 2018).

The east–west and north–south mixture of ancestry and lineages in Scandinavia is thus further complicated by cultural contacts. Motala hunter-gatherers, sampled since the 8th millennium up to the 6th millennium BC, show mainly I2a1a2-M423 lineages (formed ca. 16400 BC, TMRCA ca. 9200 BC). An individual of eastern pressure blade technology from Huseby Kiev (ca.

7800 BC) shows mainly WHG ancestry, belonging to the *south-eastern* SHG group, in spite of its culture belonging to the expansion from the north-east, which may support cultural diffusion, but also (probably more likely) the gradual admixture during the population expansion, and later population replacement from the south (Kashuba et al. 2019).

The same WHG-related ancestry is found in another sample of Maglemosian culture from Stora Förvar (ca. 6600 BC), and in an individual associated with handle core technology from Motala (ca. 5640 BC), which supports continuity of this ancestry in the region. Furthermore, it seems that EHG ancestry did not reach southern Denmark before the Neolithic (Jensen et al. 2018).

II.3. Pontic–Caspian zone

The end of the last Ice Age ca. 14000–12000 BC brought instability to the Pontic–Caspian area: meltwater flew torrentially from the northern glaciers and the permafrost into the Khvalynian Sea (the Caspian Sea is a small remaining part of it). A shoreline between the Middle Volga and the Ural rivers restricted east–west movements south of the Ural Mountains (Anthony 2007).

By 11000–9000 BC water may have poured into the Black Sea (Major et al. 2006; Ryan 2007), enlarging it and creating the Sea of Azov. Although the magnitude and rapidity of this flow remains controversial (Yanko-Hombach, Gilbert, and Dolukhanov 2007), it is agreed that meltwater created unstable shores in eastern Europe (Patton et al. 2017).

Deglaciation and palaeoclimatic changes were probably more important in their potential for environmental, cultural, social and historical changes of this region, though. A significant deterioration is found first during the Younger Dryas, a severe cold spell that lasted between 10800 and 9500 BC. Then a warming trend began, with climate aridisation and reduction of overall biomass density seen in the region during the transition to the pre-Boreal period, with large group segmentation, local population dispersion, increase in population mobility, and decrease in population density (Smyntina 2016).

In the Boreal period, the Pontic–Caspian steppe became stable with an increase in climatic humidity, and a growth of biomass density. Hunters, probably incoming from eastern and western regions, settled there and population density increased (Anthony 2007).

II.3.1. North Pontic steppes

In the Pontic steppes, Crimea shows new technology of flint blade production from a Near Eastern inspiration in the Murzak–Koba culture (ca. 10th–8th millennium BC). Reindeer hunters of the western region, in the Dniester valley, became deer hunters and riverine fishers during the Early Mesolithic. In the Dnieper–Donets steppes, bison and horse hunters of the Late Palaeolithic became deer and horse hunters of the Early Mesolithic. Early Mesolithic horse hunters also appeared in the Dniester–Prut steppes (Biagi and Kiosak 2010).

The Near East component is still visible in the Epigravettian Kukrek and Grebeniki cultures. Kukrek appeared as heir of this Near Eastern tradition in the late 8th millennium BC, and included the eastern part of the north Pontic area, expanding to the north (Biagi and Kiosak 2010).

The north-western Pontic region was thus exploited by intertwined communities distinguished by different material cultures: the non-geometric Anetivka variant of Kukrek, and the geometric Grebeniki material culture, offspring of Early Mesolithic Tsarinka flint knapping tradition, continuing thus earlier western Pontic traditions. Two basic inventions are attributed to this period: the first attempts at aurochs domestication, in the Lower Danube region, and a significant intensification of the use of wild plants, fish, and other river resources (Smyntina 2016).

The next development was the transition to the stage of food-producing economy, with two cultures appearing in the north Pontic area: the Azov culture in the east, and the Bug–Dniester culture in the west. Both have pre-pottery stages starting around 7500–6000 BC, with the Azov culture being a continuation of the Kukrek tradition. The Bug–Dniester culture (emerging ca.

6500 BC) was in close contact with the Criş–Starčevo culture from the Balkans, and existed for about a thousand years, until they became integrated into the Early Trypillian ethnocultural complex (Telegin et al. 2015).

In the Dnieper rapids—represented by the Vasylivka site—the Kukrek tradition was replaced by the Surskii culture—with stone vessels characteristic of the Neolithic of Asia Minor—and then by the Middle Neolithic Dnieper–Donets I (Anthony 2006), which replaced it also ca. 5500 BC. The earliest Mariupol-type cemeteries of the Dnieper–Donets culture (Figure 7), such as Vasylivka II and Marivka, as well as the early horizons of the Rakushechny Yar sites in the Lower Don area and the monuments of the Kaia-Arsy type in the Crimea, all date approximately to 6500-5500 BC (Telegin et al. 2015).

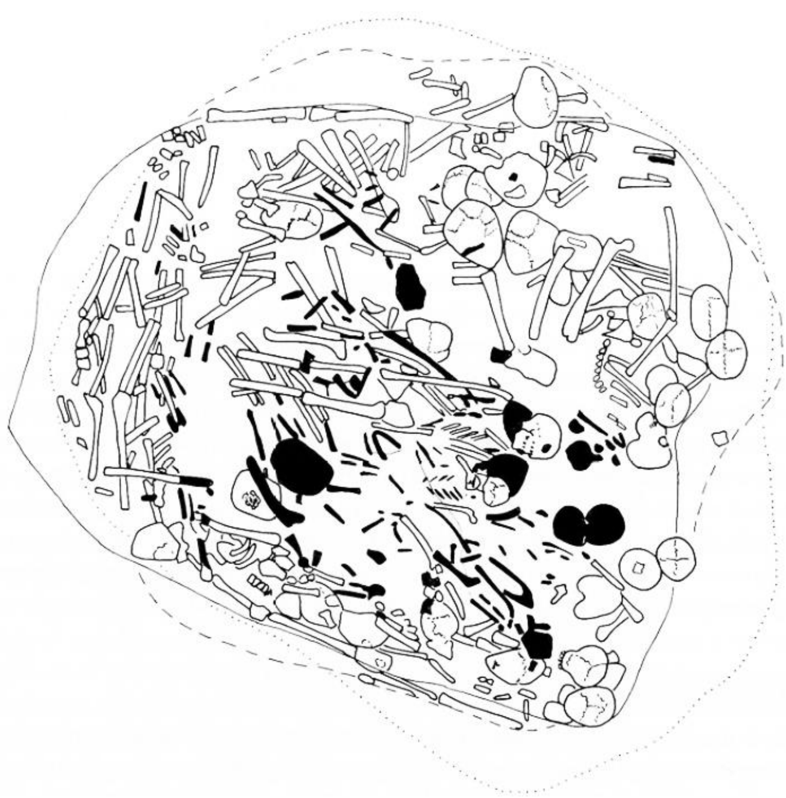

Figure 7. Dnieper–Donets culture collective burials in pit 3 at Nikolskoye. Burnt bones are shown in black. After Telegin. Image modified from Whittle (1996).

In the forest-steppe area, the Mesolithic is represented by the Zimovniki culture (in its different stages, since the Early Mesolithic), from north-east Azov to the Don–Volga interfluve, with a material culture that has been linked to the lithic industry of the Caucasus. This culture is probably related to the emergence of the Late Mesolithic–Neolithic Donets culture, in the Don Right Bank valley. The dispersal of these Mesolithic materials, possibly up to the Volga–Oka interfluve, attest to possible trans-regional ancient population migrations (Fedyunin 2015).

II.3.2. North Pontic forest

In the north Pontic forest area, the Swiderian culture had been replaced by local groups which grew from its tradition. Early west Mesolithic forest hunters from flooded areas between Britain and Scandinavia migrated to the east into Middle European lowlands, forming the Duvensee cultural unit (Maglemose culture) in the 8^{th}–7^{th} millennium BC. The only group to reach into the north Pontic forest-steppe region comes from the Komornica culture, from the Vistula river basin (Zalizniak 2016).

The eastward migration of west European Late Mesolithic groups, as well as the appearance of post-Maglemosian cultures, have been suggested as the result of further floodings in western Europe, specifically the flooding of Doggerland, ca. 6200 BC. In the southern part of the east European forest zone, between the Vistula and the Dnieper, Janislawice became the dominant post-Maglemosian culture. There is no influence of the Caucasus here (Zalizniak 2016).

Two main groups developed in the area: the Tacenki group around the Kyiv Polesia, and its offshoot the Kudlaievka in the valley of the upper Dnieper and Desna, under influence from the Kukrek tradition. Similar findings in the River Donets and to the north are thought to derive from a migration of population from the Kudlaievka culture in both directions. The adaptation of Janislawice to Caucasian–Pontic traditions, including animal husbandry, happened late, and only after the expansion of this culture into the forest-steppe (Zalizniak 2016).

II.3.3. North Caspian steppes

To the east, the Early Mesolithic forager camps (ca. 8000–7000 BC) inhabited the North Caspian depression, then filled with lakes, in a cooler and moister climate. The economy of these groups, like that of north Pontic groups, depended on equid hunting, and their camps probably represented single families or small hunting parties. Their garbage dumps contain almost exclusively bones of onagers, and their flint tool inventories mainly geometric microliths (Anthony 2006).

During the Late Mesolithic (ca. 7000–6000 BC), the North Caspian area became increasingly dry, with pollen evidence suggesting that desert conditions spread precisely during this time, with a peak dry episode ca. 6000 BC (related to the cold oscillation ca. 6200 BC in the northern hemisphere), after which humid conditions returned. Camps reached larger sizes, hunters preferred a grey flint different from the previously prevalent yellow-grey flint, and geometric microliths diminished (Anthony 2006).

Toolmaking traditions recognised in these sites include many different lowland steppe foraging groups, from the North Caspian area (Istai IV type), West Caspian steppes (Kharba type), and Azov–Crimean steppes (Kukrek and Zimovniki). When pottery-making emerged in this area, Early Neolithic cultures of this Azov–Caspian region (Surskii, Kairshak III) made pots with similar shapes and similar patterns of decoration. Because of that, Vasiliev advanced the idea that the dry Azov–Caspian steppe constituted a ‘cultural region’ during the Late Mesolithic and Early Neolithic, a network of interacting forager bands. Different from this common material culture was that one seen east of the Caspian Sea and east of the Urals, which belonged to distinct social networks (Anthony 2006).

II.3.4. Hunter-gatherer pottery

The oldest known pottery appeared in East Asia, with findings in the Yangze Basin (20th–17th mllennium BC), and further examples in northern China (11th millennium), the Korean Peninsula (11th–10th millennium BC). In Japan, pottery was apparently introduced during the incipient Jōmon phase (16th–13th millennium BC), and was probably related to the introduction in North Asia from the east, with findings spanning ca. 15th–12th millennium BC (Piezonka 2016).

In the Trans-Baikal area, the first findings are dated ca. 13th–11th millennium BC, but it seems to have been a still-stand zone, because pottery appeared to the west only millennia later, in west Siberia and the Trans-Uralian regions. While some initial findings can be dated to the 10th–8th millennium BC, the start of a westward cultural wave can be dated only to the first half of the 8th millennium BC, with widespread findings in cultures of the North Asian regions dating to the 7th and 6th millennium BC (Piezonka 2016). On the other hand, the period between 11th-8th millennium seems to be one of expansion from east to west.

Before the arrival of farmers to the western frontier of the Pontic–Caspian steppe, pottery was produced in the Volga region by the Elshanian culture ca. 7000–6500, with the oldest pottery in Europe coming from the Samara region. This material culture was probably derived from the Eastern Asian tradition of the Late Pleistocene, which arrived through a path following Siberia and the Trans-Urals (Piezonka 2015). The earliest Trans-Uralian sites include Yurtobor and Lake Andreevskoe, in the Tobol-Ishim region, of the late Mesolithic Boborykino culture—featuring round- and flat-based bots with incised and impressed decoration—and Sumpanya in the Konda River Basin (Gibbs and Jordan 2013). The scarce sites investigated and variable dates obtained from them (ca. 12000–8000 BC) make it impossible to ascertain a precise origin of eastern European pottery, though.

From this source, the first Neolithisation wave reached hunter-gatherer groups of the Pontic–Caspian steppe, starting with the Lower Volga region (Suppl. Fig. 5), whose oldest pottery is dated ca. 6200 BC, with similarities to those of the Kairshak culture in the northern Caspian steppes, whose first sites with the oldest pottery appeared ca. 6500 BC (Vybornov 2016). From the north-western Caspian region pottery spread south- and westward into north Pontic societies, appearing in different steppe regions simultaneously ca. 6200–6000 BC, including the Bug–Dniester culture (Zaitseva et al. 2009).

Pots were made of a clay-rich mud collected from the bottoms of stagnant ponds, and they were formed by the coiling method and baked in open fires at 450–600º C. These pots are bottom-tappered and non-decorated in the Middle Volga (Elshanian culture); non-decorated and with scoring marks with round and flat bottoms in the North Caspian steppe; non-decorated in the Lower Don; and non-decorated or sparsely decorated in the Dvina–Lovat’ region (Zaitseva et al. 2009).

Sparsely decorated pottery (decorated with little punctures, and having a tapered bottom) dispersed north into the forest zone ca. 6000 BC or slightly earlier, from the Upper Volga and Dvina–Lovat’ regions to the east (into the Dvina–Pechora region) and west (into the eastern Baltic), reaching the Upper Volga, Serteya, and Valday cultures, and later the Narva culture. It reached the Bug–Dniester culture in the Southern Buh valley ca. 6200–6000 BC, just before the western pottery type was adopted in the Middle Dniester valley ca. 5900–5700 BC (Vybornov, Kosintsev, and Kulkova 2015).

Pottery production increases at the end of the 7th millennium and beginning of the 6th millennium, with the second stage of Elshanian pottery appearing ca. 5750–5500 BC, with pottery assemblages also found in the North Caspian region. More pottery decorated with triangular impressions can be traced to the second half of the 6th millennium in the region (Mazurkevich and Dolbunova 2015).

In the forest-steppe of the Don River region, sites appear in the upper parts of the first terrace above the floodplain, and sometimes on bedrock shores. Pottery of the Karamyshevo type appear through direct contacts with the population of the Elshanian culture, which had the skills and arrived in the Don region probably at the end of the 6th millennium BC, with Karamyshevo culture prevalent throughout the first half of the 5th millennium BC, eventually produced from sanded silty clay containing natural inclusions, like the pottery of the Middle Don culture (Smolyaninov, Skorobogatov, and Surkov 2017).

The Middle Don culture, in turn, appears to be contemporaneous with early Karamyshevo, with the southern periphery of the Upper Volga region also coincident with early stage of both, hence connecting it to the Valday and Volga–Oka groups that formed the Upper Volga culture. It is difficult to pinpoint exactly the intertribal communication networks between Upper Don River basin and those of the Upper Volga, as is the relationship to the communities of the Dnieper–Donets culture around the mid–5th millennium BC (Smolyaninov, Skorobogatov, and Surkov 2017).

A second expansion of eastern pottery reached the eastern Baltic region ca. 5500 BC, expanding from the Dnieper region to the north-west, generating the sparsely decorated Dubičiai pottery (later evolving into the Neman culture), and influencing the north European regions from the Narva to the Ertebølle cultures (Piezonka 2015).

A third expansion of eastern pottery spread from the Volga–Kama region to the east ca. 5000 BC, connected to influences from beyond the Urals, showing a more elaborately decorated ware (with bands of pits and impressions made from comb stamps), spreading north and west in the Sperrings and Säräisniemi 1 cultures (Piezonka 2015).

ii.3. Indo-Uralians

The successful expansion of haplogroup R1a-M459 (formed ca. 20800 BC, TMRCA ca. 16200 BC) may have been associated with waves of migration of ANE/EHG ancestry into eastern Europe from northern Eurasia. An individual from Vasylivka ca. 8700 BC, of hg. R1a1-M459 (Jones et al. 2017), supports this haplogroup as one of the prevalent Epipalaeolithic lineages of north Pontic hunters. The spread of R1b1b-V88 lineages (TMRCA ca. 9700 BC) in the North Pontic area, with the first sample found in Vasylivka ca. 7050 BC (Mathieson et al. 2018), may be linked to remnants of ancestral populations expanding westward, but they could be more directly associated with the eastward expansion of the Grebeniki tradition, of west Pontic origin, close to Balkan hunter-gatherers of the same haplogroup (see *§i.3. Nostratians*). A sample of hg. I2a1a-P37.2 in Vasylivka ca. 8100 BC may also represent either an earlier Epipalaeolithic population, or a recent migration of Iron Gates hunter-gatherers or post-Swiderian migrants.

Mesolithic samples from the north Pontic area are intermediate between EHG and SHG, with further contribution of WHG ancestry (Mathieson et al. 2018), which—together with their position in PCA—support close contacts of post-Swiderian and Maglemosian cultures in the region. The expansion of eastern ancestry detected in north Pontic samples (from the Middle Volga) and in a Middle Volga sample (from further east) also support westward migration waves coinciding with the expansion of hunter-gatherer pottery (see below *§iii.5. Early Indo-Europeans and Uralians*).

A sample of a Mesolithic hunter-gatherer at Lebyanzhinka in the Samara region, dated ca. 5600 BC, shows hg. R1b1a1-P297^{+} (Mathieson et al. 2015), while R1b1a1a-M73 is found later in Donkalnis, in the Baltic region (ca. 5200 BC), belonging to the Narva culture (Mittnik, Wang, et al. 2018). Similarly, expanding Indo-Anatolians show hg R1b1a1b-M269 (see below *§iv.2. Indo-Anatolians*), apart from other likely local haplogroups. These lineages are compatible with the previous expansion of R1b1a1-P297 lineages with the North-Eastern Technocomplex (see *§ii.1. Eurasians*).

Nevertheless, the presence of R1b1a1-P297 late in the Baltic, after the resurgence of I2-M438 lineages, could also suggest a back-migration of certain groups associated with the westward expansion of hunter-gatherer pottery from the Trans-Urals into the Pontic–Caspian and north-eastern European regions. This is supported by the presence of AEA ancestry in two individuals, from Samara and Karelia (Lazaridis et al. 2018), and the appearance of haplogroup R1b1a1-P297 in Karelia ca. 5600 BC (Mathieson et al. 2015). The presence of R1b1a1-P297 lineages in Latvia since the Mesolithic until the arrival of Corded Ware does not help distinguish between continuity, resurgence, and back-migration events.

Samara and Karelia hunter-gatherers also show in 'speculative' estimates further contribution of El Mirón ancestry compared to the older Sidelkino sample (ca. 9300 BC), and higher than the one found in other EHG samples from Karelia, in south-eastern Europe, or in the north Pontic region during the Mesolithic or Neolithic (Lazaridis et al. 2018). This contribution is thus compatible with the expansion of populations related to northern Mesolithic Europe, and thus post-Swiderian cultures.

The ancestry of later Eneolithic individuals of the Khvalynsk culture (5th millennium BC) is also found in two Sintashta outliers from Kamenyi Ambar (ca. 2000–1650 BC), one of hg. R1b1a1-P297, the other R1b1a1a-M73 (Narasimhan et al. 2018), both probably related to local groups of the southern Urals and Trans-Urals region, remnant populations of these groups expanding hunter-gatherer pottery to the west. The same haplogroup R1b1a1a-M73 is found further east among the Botai, supporting the widespread distribution of these groups beyond the Urals (see *§v.9. Pre-Tocharians* and *§v.8. Palaeosiberians*). Like these late outliers, Khvalynsk-related individuals on the Cis-Urals probably hosted some West Siberian Hunter-Gatherer (WSHG) ancestry, and were thus most likely part of an ancestral EHG:WSHG cline from the Cis-Urals to the Trans-Urals and West Siberian region.

R1a1-M459 lineages continued probably in groups of the Pontic–Caspian region, evidenced by one individual from Deriïvka (ca. 6900 BC), a hunter-gatherer from Karelia (ca. 6300 BC), and an individual of the Khvalynsk culture from Samara (ca. 4600 BC). The expansion of R1a1a-M198 lineages (formed ca. 12000 BC, TMRCA ca. 6600 BC) and the finding of sister clade R1a1b-YP1272 (TMRCA ca. 5300 BC) in a Maikop outlier from the northern Caucasus, and in an individual from Kudruküla, Estonia (Saag et al. 2017), of the Comb Ware culture (ca. 3000 BC), suggest—together with their early split date—an early expansion of R1a1-M459 subclades from within eastern Europe, probably associated with the spread of some groups of hunter-gatherer pottery within the forest zone[6]. the with later expansions likely associated with specific groups of hunter-gatherer pottery.

If post-Swiderian cultures are associated with the expansion of Eurasiatic languages into eastern Europe and the Trans-Urals region, the westward expansion of hunter-gatherer pottery from the Elshanian culture in the Volga–Ural region—probably originally associated with R1b1a1-P297 lineages in the Volga–Ural area, and continued after the resurgence of local R1a1a-M198 lineages mainly in the forest zone—can be linked to the expansion of Indo-Uralic from the east. The emergence of the elk as an animal of great symbolic value in the east European forest zone, appearing in rock art, as well as in elk-head staffs (see below Figure 12) and other elk-head sculptures since the 7th

[6] The finding of two isolated R1a1a-M198 samples in Lokomotiv (Mooder et al. 2005) associated with Kitoi material culture (dated ca. 6000-5200 BC), among sixteen reported haplogroups, with the rest being K-M9 (likely N-M231) and one C2-M21, in the western shores of Lake Baikal (Moussa et al. 2016), may suggest an expansion of these lineages from the Trans-Urals region. However:

a) the earliest reported R1a1-M459 lineages are all from eastern Europe (Mathieson et al. 2018);
b) there are no calibrated dates for those samples, paternal lineages for Kitoi seem too heterogeneous, and there are known later eastward expansions of hg. R1a1a1b-Z645 to the region (see *§viii.21.2. Turkic peoples and Mongols*);
c) recently reported samples from the region during the Early Neolithic have not obtained any R1a-M420 subclade, but are consistent with the presence of N-M231 and C2-M217 (de Barros Damgaard, Martiniano, et al. 2018);
d) the obtained strontium isotope ratios that serve to confirm their local origin (Moussa et al. 2016) cannot differentiate between earlier and later periods; and
e) based on the study of modern populations, basal R1a-M420* and R1a1-M459* subclades have only found around the Caucasus, not among Asian or Siberian populations (Underhill et al. 2015; Karafet et al. 2018).

The most likely interpretation for both samples, until confirmed in different ones with proper radiocarbon dates, is that they belong to later archaeological layers, or to contamination.

millennium BC, may have also been associated with this cultural expansion, which may have included also the spread of symbolic red ochre in paintings and graves (Norberg 2019), eventually appearing among Comb Ware groups.

II.4. North Africa

During the African Humid Period (AHP), starting ca. 12800–10000 BC, hunter-gatherer groups repopulated the Sahara, marked landscapes with rock art, and occasionally created cemeteries.

The Typical Capsian culture (ca. 7500–6000 BC) is characterised by large tools, mainly burins, scrapers made on blades, with blade production involving knapping schemes derived from simple or complex core preparation. These indicate the use of soft and hard hammer percussion for blades and flakes, which are then retouched to produce a variety of tools. Sites show accumulation of land snail shells, ash, burnt rocks, knapped flint, worked (human and not human) bones, and mammalian faunal remains. Capsian sites are concentrated on the high plateaus of eastern Algeria and southern Tunisia, although the culture shows variants to the west and east into Lybia (Rahmani and Lubell 2012).

Cord-wrapped roulettes are among the earliest cord-based decorative tools in Africa, appearing at Aïr Massif in Niger, later in the Sahara region between Algeria and Libya ca. 8th–6th millennium, as well as on the Atlantic coastline and Mauritania’s interior dating from the 6th–5th millennium BC. Vessels with flat bases are also found along the western coast up to pre-Saharan Morocco. These features appear in Morocco’s Middle Neolithic pottery, which suggests contacts between the populations of the interior potentially related to the end of the AHP.

Before the expansion of Neolithic farmers, clear links can be seen between both shores of the Mediterranean in Mesolithic hunter-gatherer blade and trapeze industries from the North African Upper Capsian, the Castelnovian in Italy and southern France, and the Geometric Mesolithic in the Iberian

Peninsula. This north–south network of connections is also seen later during the Mediterranean expansion of the Neolithic (Guilaine 2017).

ii.4. Early Afrasians

Proto-Afroasiatic is proposed to have emerged in the southern fringe of the Sahara in an “upside-down” view (Bender 2007), which would put the Afroasiatic homeland near Megalake Chad during the African Humid Period (ca. 9000–3000 BC). This period was probably marked by a Sahelo-Sudanian palaeoenvironment of isolated wetlands and small lakes, with a pale-green and discontinuously wet Sahara forming north–south and east–south pathways (and a continuous east–west corridor in the southern half of the current desert) that allowed for human migrations (Quade et al. 2018).

This corridor would have allowed for a sizeable population expansion in south-central Saharan territory, for an eastward expansion of Cushitic and Omotic, and for a migration of Hamito-Semitic speakers (including possibly Berbero-Semitic) to the north-east. This model agrees with Chadic languages being the most divergent of the Afroasiatic group, excluding Omotic, whose population has been shown to be mainly of sub-Saharan ancestry, in contrast to other Afroasiatic peoples (Baker, Rotimi, and Shriner 2017).

R1b1b-V88 lineages are found widespread in north and central Africa, mainly among Chadic-speaking peoples, but also in modern populations of northern and eastern Africa (Figure 8), with a “star-like” topology estimated to have begun ca. 5850 BC (Figure 9)—roughly at the same time as Saharan populations adopted pastoralism—and tracing a trans-Saharan axis (D’Atanasio et al. 2018):

- R1b1b2a2-Y8447, the main African subclade (formed ca. 5500, TMRCA ca. 5000 BC).
- R1b1b2a2a-V1589/Y7771 (formed ca. 5000 BC, TMRCA ca. 3100 BC) and most other rare African R1b1b-V88 lineages (not considered below) are distributed widely, in descending proportion, in central Sahel (around the prehistoric Megalake Chad), in eastern Libia and

north-west Egypt, in south Egypt and north Sudan, and in central Sudan and east Sahara.

- R1b1b2a2aX-V1589 (TMRCA ca. 3700 BC), with a distribution similar to the parent haplogroup R1b1b2a2a-V1589/Y7771.
- R1b1b2a2aX-V4759 (TMRCA ca. 2700 BC) peaking in eastern Libia and north-west Egypt, and spread also through the Maghreb and south-western Africa.
- R1b1b2a2a1-V69 (formed ca. 3000 BC, TMRCA ca. 2600 BC), peaking around lake Chad, and also found in south Egypt, Sudan, and eastern Africa and Arabia.

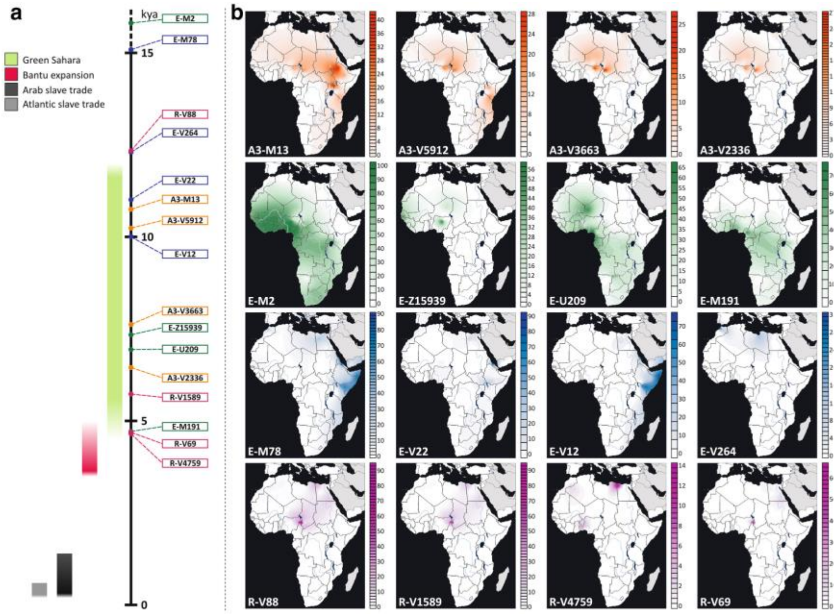

Figure 8. Image modified from D'Atanasio et al. (2018): "Time estimates and frequency maps of the four trans-Saharan haplogroups and major sub-clades. a) Time estimates of the four trans-Saharan clades and their main internal lineages. To the left of the timeline, the time windows of the main climatic/historical African events are reported in different colours (legend in the upper left). b) Frequency maps of the main trans-Saharan clades and sub-clades. For each map, the relative frequencies (percentages) are reported to the right."

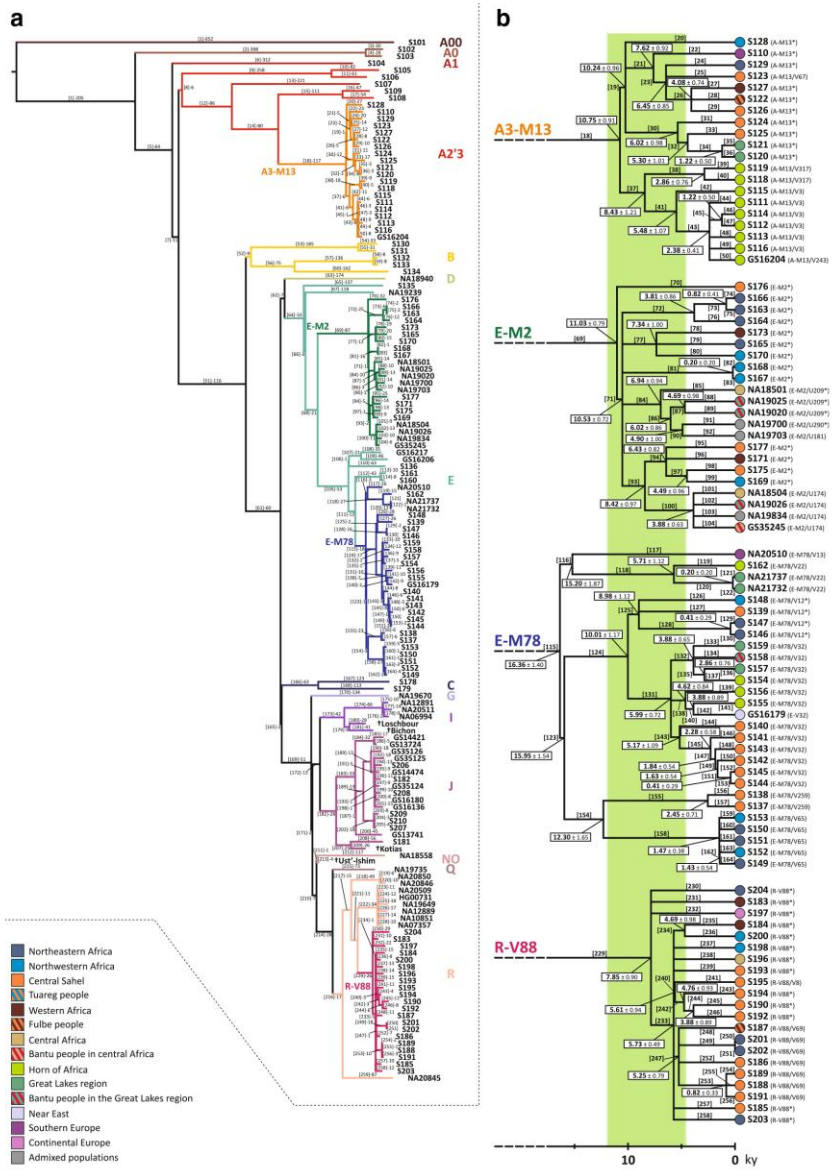

Figure 9. Image modified from D'Atanasio et al. (2018): "Maximum parsimony Y chromosome tree and dating of the four trans-Saharan haplogroups. a) Phylogenetic relations among the 150 samples analysed here. Each haplogroup is labelled in a different colour. The four Y sequences from ancient samples are marked by the dagger symbol. b) Phylogenetic tree of the four trans-Saharan haplogroups, aligned to the timeline (at the bottom). At the tip of each lineage, the ethno-geographic affiliation of the corresponding sample is represented by a circle, coloured according to the legend

(bottom left). The last Green Sahara period is highlighted by a green belt in the background."

R1b1b-V88 lineages related to the Villabruna cluster probably crossed the Mediterranean into northern Africa, most likely through the southern Italian Peninsula, eventually expanding with the Capsian tradition. This is supported by rare subclades found in southern Europe, like R1a1a1a2-M18 (split ca. 10300 BC), present mainly in Corsica and Sardinia; R1b1b2a-Y8451/V2197 (formed ca. 7500 BC, TMRCA ca. 5500 BC) and R1b1b2a1-V35 (split ca. 6700 BC), present mainly in Sardinia (Cruciani et al. 2010). The presence of the rare mtDNA haplogroup J/T in Epipalaeolithic samples from Afalou, as well as in modern populations of northern Morocco (1.8%), Sicily (1.8%), and other Italian populations (1.6%) also point to ancient contacts of west Africa with Italy (Kefi et al. 2018).

A migration of these lineages through Iberia seems unlikely, because there is large genetic continuity of an endemic element related to ANA (found in Epipalaeolithic Iberomaurusians and in Early Neolithic samples) in north-west Africa until the Late Neolithic (Fregel et al. 2017), where only later does ancestry from Iberia appear associated with the expansion of European Neolithic, probably through the Strait of Gibraltar (Fregel et al. 2018). The presence of sub-Saharan admixture in Middle Neolithic and Chalcolithic samples, as well as the finding of mtDNA hg. L2a1 in a Bronze Age sample from south Iberia point to a north–south genetic structure in pre-Neolithic Iberia, with hunter-gatherers probably showing resemblance with sub-Saharan Africans (González-Fortes et al. 2019).

Alternatively, the finding of subclade R1b1b2a-V2197—prevalent among Sardinians and most African R1b1b-V88 carriers—in the Els Trocs individual and two ancient Sardinian individuals (ca. 3400–1000 BC) may be interpreted as part of the Early European Farmer expansion through the Mediterranean, with an infiltration of Mesolithic R1b1b-V88 lineages among Anatolian farmers in the Balkans. The coalescence times between the Sardinian and African R1b1b-V88 haplotypes, coupled with autosomal traces of Holocene admixture with Eurasians in ancient samples, may thus be interpreted as a more recent maritime wave of Cardial Neolithic migrants along the West Mediterranean coasts in the 5th millennium, and their subsequent movements across the Green Sahara (Marcus et al. 2019). This is also supported by the finding of R1b-M343 in a coastal site of Cueva de Chaves, likely from an Early Neolithic context (Villalba-Mouco et al. 2019). Nevertheless, the association of R1b1b-V88 lineages with the expansion of the Villabruna from eastern Europe, and its likely presence in the Villabruna individual himself (reported as R1b1-L754), suggests that the haplogroup might have expanded with Villabruna-like ancestry during the Epipalaeolithic, reaching north-east Iberia ca. 12000 BC (Villalba-Mouco et al. 2019).

There is a cline of ANA:Natufian ancestry in North Africa from east to west (Rodríguez-Varela et al. 2017), but a hint of Villabruna ancestry can also be inferred in all modern north African populations west of Libya, which is consistent with gene flow from Iberia during the Late Neolithic (Lazaridis et al. 2018), but could also be at least partially related to the expansion of R1b1b-V88 lineages through southern Italy in the 7th–6th millennium BC.

R1b1b-V88 is found at high frequencies among the Toubou population (34%) inhabiting Chad (Haber, Mezzavilla, Bergström, et al. 2016), who also show 20%–30% ancestry coming from outside of Africa, related to Eurasian herders (Schlebusch et al. 2017), potentially linked to this ancient migration, since a good proxy for this ancestry (apart from ancient Levantines) are present-day Sardinians (Pickrell et al. 2014).

From north-central Africa and through the Green Sahara, with gradual desiccation of the desert until ca. 4000–3000 BC (Drake et al. 2011), Afroasiatic speakers of R1b1b-V88 lineages could have expanded in all directions following for example the researched Fezzan–Chad–Chotts, and Chad–Chotts–Ahnet–Moyer pale green areas. The role of certain E1b1b1a1-M78 lineages (split ca. 13200 BC)—widespread in eastern Africa—in secondary expansions of Afroasiatic languages seems very likely:

E1b1b1a1b2-CTS9547/L677 (formed ca. 8000 BC, TMRCA ca. 2400 BC) in east and north-east Africa; E1b1b1a1a1-V12/Z1216 (formed ca. 9900 BC, TMRCA ca. 8000 BC) in the east, peaking in the Horn of Africa; and E1b1b1a1a2a1-CTS194 (formed ca. 2600 BC, TMRCA ca. 200 BC) in Libya and the Maghreb (D'Atanasio et al. 2018).

II.5. Caucasus Mesolithic

In the Caucasus, at least four regional Mesolithic traditions can be distinguished, linking the late Upper Palaeolithic traditions of foragers with the arrival of a farming economy: the north-east Pontic area, extending to the steppes of the northern foreland; the south-western Imeretian variant; the Trialeti highlands, where communities had access to nearby obsidian sources; and the Dagestan Mesolithic. The Trialetian Mesolithic is probably the best known, representing a wide-spread industry that reached into the Trans-Caspian region, eastern Anatolia and the Iranian Plateau, although there is a lack of absolute dating (Sagona 2017).

The Imeretian culture developed on the slopes of the south-western Caucasus, with an origin in the Gravettian cultures of the region, which maintained contacts with the areas of Syria–Palestine and the Zagros Mountains. The introduction of micro-burin technique and a Natufian retouch, together with the geometric microliths, which appear most frequently in North Africa and the Near East, show an intensification of contacts with the population of Natufian culture of the Levant during the Holocene. At the same time, these new elements reach communities of the north-western Caucasus (Sagona 2017).

Kotias Klde, a karstik cave above the Kvirila River in western Georgia, and the Darkvety rock shelter, forms part of the Trialetian tradition. The lithic industry in Kotias Klde is relatively homogeneous in both types and technology, and comparable industries are found in distant territories, in particular at Ali Tepe in the Elbruz region of Iran, and Hallan Çemi. While a chronology is difficult to establish, it seems that the Trialetian elements appear first at Ali Tepe (ca. 10500–8870 BC), slightly later at Hallan Çemi (ca. 8600–7600 BC) (Sagona 2017).

There is a 1,000–year gap between the Epigravettian tradition of the Dzuzuana Cave and the Mesolithic findings of Kotias Klde, a seasonal camp by then, which suggests the arrival of new peoples, hunters of wild boar and brown bear during the late spring and early summer. In the southern Caucasus, the Chokh variant apparently continues the earliest ceramic tradition, but in Georgia there is a clear distinct period with Neolithic geometrics and the trapeze microlithic. Their diet was mostly composed of mammals, mainly deer (ca. 50%), but also brown bear (ca. 34%) probably mainly for fur and symbolic reasons. Unlike their Upper Palaeolithic predecessors, they did not hunt other ungulates, such as aurochs, steppe bisons, Caucasian tur, and wild horses (Sagona 2017).

The Chygai rock shelter, in the northern foothills of the western Caucasus, represents the lithic industry of the north-western Caucasus region. Their technological change is gradual, until the abrupt appearance of geometric microliths, especially trapezes, which mirrors the technological change of Crimea (see *§II.3.1. North Pontic steppes*). Remains of small mammals like ovicaprids and deer species are predominant in the early period, while larger animals such as bison and wild pig are hunted later on (Sagona 2017).

ii.5. Caucasus hunter-gatherers

Different groups of Caucasus hunter-gatherers with strong differences in admixture emerging in the ancient DNA record support the existence of multiple small populations living in partial isolation, probably helped by the region's orography. This is evidenced e.g. by the signs of recent consanguinity of the Mesolithic individual from Satsurblia; by the existence of a prehistoric genetic and cultural barrier around the Caucasus Mountains (Wang et al. 2019); and by the partial continuity of ancestral Y-chromosome and mtDNA haplogroups into the modern population of the southern Caucasus (Jones et al. 2015).

Close cultural contacts of the Imeretian culture linking the southern Caucasus and the Zagros Mountains probably reflect an ancient, Upper Palaeolithic network that allowed for the spread of ANE ancestry in the mainly AME-like population of the region, possibly through expanding Q1a2-M25 lineages from West Siberia. This is supported by its modern distribution in eastern Europe and central Asia, with a higher frequency in the Iranian Plateau under Q1a2a-L712 subclade (formed ca. 14300 BC, TMRCA ca. 11300 BC), apart from ancient samples in Aleutian Islanders, ancient northern Athabaskans, and in a sample from Cukotkan Ust'Belaya culture (Flegontov et al. 2016), as well as its estimated expansion ca. 10000 BC (Grugni et al. 2019). The resurgence of a fully ANE-like individual of Q1a2-M25 lineage in the Lola culture during the Bronze Age proves the persistence of small, isolated ANE-like populations in the Caucasus since the arrival of these migrants.

II.6. Fertile Crescent

Epipalaeolithic Natufians were probably the first to exploit cereals occasionally, and there is proof of preparation and consumption of bread-like products ca. 12500–9500 BC, before agriculture was firmly established (Arranz-Otaegui et al. 2018).

The earliest pastoral systems developed in multiple regions across the Fertile Crescent within sedentary communities of hunter-gatherer-agriculturalists who began controlling and managing small populations of wild caprines and bovines by the early 9th millennium BC. This early stage of animal domestication during the 9th and early 8th millennium BC emerged first along the Upper Euphrates river, and was characterised by highly variable management techniques and relatively low herd productivity, with small controlled animal populations and wild phenotypes (Arbuckle and Hammer 2018).

At Ganj Dareh, the economy was focused on the pre-domestic management of goats, including the intensive slaughter of yearling males, probably designed to reduce the number of aggressive adult males in herds. This system was not copied elsewhere, and local domestication systems were the norm. Only after the mid–8th millennium were dramatic changes seen across south-west Asia, constituting a true “pastoral revolution”: shift toward intensive caprine pastoralism, widespread appearance of domestic phenotypes, and spread of caprine husbandry outside the Fertile Crescent, with the standardisation of targeted culling of young male animals (Arbuckle and Hammer 2018).

The emergence of sedentism in central and southern Anatolia began in the 9th millennium BC, after a period of mobile groups in the Epipalaeolithic. Local building techniques, burial customs, and agriculture were gradually changing through contacts, especially with south-east Anatolia and the Levant. In south-east Anatolia, a gradual disintegration of the Aceramic Neolithic lifeway and a replacement by a society formally based on kinship appears starting with the Mature Aceramic III period (ca. 8000 BC), and continuing through the early part of the Pottery Neolithic (Rosenberg and Erim-Özdoğan 2011).

These social changes are intertwined with important economic changes involving the development of the full southwestern Asia domesticate complex, and technological advances like the widespread adoption of ceramic technology, although specifics of how they are related are not known (Rosenberg and Erim-Özdoğan 2011).

ii.6. Early agriculturalists

The presence of further contribution of “deep” ancestry in Iran Neolithic farmers compared to CHG, and the lack of such ancestry in Anatolian Hunter-Gatherers—who, on the other hand, seem to show Natufian-related ancestry—support the expansion of this “deep” ancestry into the Zagros Mountains and the Caucasus from a southern (probably south-western) population that did not undergo the Palaeolithic bottleneck with Neanderthal admixture (Lazaridis et al. 2018). Available samples with a similar cluster to Iran Neolithic include the following:

A sample from the Hotu Cave in the South Caspian region (dated ca. 6100 BC, although archaeologically attributed to the Mesolithic–Neolithic, ca. 9100–8600 BC) shows an ancestry similar to Iran Neolithic samples, but with contribution from EHG (ca. 10%), which supports the existence of an ancestral cline EHG:CHG (or WHG–ANE:CHG–IN) from Eastern Europe to the Middle East (Lazaridis et al. 2016). While this EHG/ANE contribution found in CHG/IN probably came from the north, with the expansion of haplogroup Q1a2-M25, the expansion of R2-M479 (and possibly that of R1b-M343 lineages before it) is likely the reason for the presence of slightly elevated ENA-like ancestry in Iran compared to CHG.

The five early Neolithic Aceramic Anatolian farmers sampled to date (ca. 8300–7800 BC) and later Ceramic farmers (ca. 7000–6000 BC) form a close cluster with AHG. Aceramic farmers derive most of their ancestry from AHG (ca. 90%), and the rest probably from a source near Iranian/Caucasus ancestry, which may have diffused via contacts through eastern Anatolia, hence allowing for the spread of cultural innovations. They show the emergence of haplogroup G2-P287 with a sample of G2a2b2b-PF3359 (formed ca. 12400 BC, TMRCA ca. 10200 BC)—found today mostly in Sardinia—and one sample of haplogroup C-M130, common in Palaeolithic populations (Feldman et al. 2019).

Later Ceramic farmers also derive their ancestry primarily from AHG (more than 75%), but there is gene flow from the Levant to Anatolia during the early Neolithic. In turn, Early Pre-Pottery Neolithic farmers (ca. 8300–6700 BC) from the southern Levant can be modelled as a two-way admixture of Natufians with Aceramic farmer contribution (ca. 18-21%), which supports reciprocal genetic exchange between the Levant and Anatolia during the early stages of the transition to farming (Feldman et al. 2019). Continuity in the Levant can be inferred also from the presence of haplogroup E1b1b1a1-M78 in three individuals, together with, two hg. H2-P96, one T1-L206 (xT1a1-L162, T1a2-L131) and one F-M89^{+} (Lazaridis et al. 2016).

III. Neolithic

III.1. Neolithic package

In the Anatolian plateau, full farming villages developed ca. 7500–7000 BC, at the same time as pottery. Around 7000–6400 BC, the full Neolithic package conquers the western part of Anatolia and the Greek region, reaching Crete ca. 7000 BC (in aceramic version), Thessaly ca. 6500 BC, and western Greece ca. 6400 BC, indicating a rapid diffusion process. Around 6500 BC, the majority of settlements in the Anatolian plateau were abandoned: new settlements appeared on trade routes, which suggests a trend to control long-distance exchange networks, which is also evidenced by the intensified contacts between regions seen in material culture and in the exchange of ideas (Özbaşaran 2011). This coincides with another pause in the expansion of Neolithic pottery lasting two to three centuries.

The rapid expansion of Neolithic farmers has been put in relation with changes in climate (ca. 6600–6000 BC), although the increase of intergroup violence associated with environmental and economic stress show only some variation in intensity (to profit from a weakened adversary), but do not correlate with all evidence of conflict. Instead, the true reason for emerging warfare is probably associated with the new essential aspect of territoriality for the economically superior (and demographically expanding) farming societies, and thus conflicts arise from either politically motivated expansion, or from political power imbalances, which may in turn be associated with drought, epidemics, or as a consequence of climatic stress (Clare and Weninger 2016).

The succeeding episodes of population growth and sudden collapse identified in the expansion of Neolithic farmers suggest that they correspond to the demographic signature of travelling waves (and not travelling wave-fronts, proper of classic demic diffusion, where the population of previously occupied territories is kept at carrying capacity after the wave-front passes through them). That is, the ‘boom’ is associated with the arrival of new people, whilst the ‘bust’ should be understood as outgoing migrants resuming their spread into a new region. Only the regions being passed by the travelling wave experience a noticeable demographic pressure, while the meta-population follows a neutral growth curve (Silva and Vander Linden 2018).

The Neolithic package covers a whole series of technical innovations that accompany the domestication of plants and animals, like ceramics and polished stone, changes in dynamics of territorial occupation and exploitation, organisation of domestic areas and forms of social production, social dynamics and reproduction. Settlements are variable depending on the geographical area, but they generally consist of traits signalling a more permanent occupation compared to foragers, such as domestic areas that include houses, grain storage, graves, hearths, and ovens. Tools and materials suggest that settlements are also areas of production and consumption (Guilaine 2017).

iii.1. Aegean farmers

Signs of the Neolithic package appear only after ca. 7000 BC in west Anatolia and the Aegean. Studies of human ancestry support the arrival Anatolian farmers into central and western Europe with the Neolithic expansion (Brandt et al. 2013; Olalde et al. 2015; Szecsenyi-Nagy et al. 2017), also signalled by an expansion of hg. G2a2-CTS4367 (formed ca. 15800, TMRCA ca. 14900 BC), found first in Anatolian Aceramic (ca. 8000 BC), and in most Anatolian Neolithic individuals spanning the whole 7th millennium BC.

Consistent with a migration to the west, north Aegean Neolithic individuals ca. 6350 BC from Barcın (north-west Anatolia) and Revenia (northern Greece) share the closest genetic relationship with central Anatolian Neolithic individuals from Boncuklu (Pre-Pottery Neolithic) and Tepecik (Pottery Neolithic), closer than these central Anatolian groups among each other, and a closer relationship than Anatolian Neolithic samples with Iran Neolithic farmers, Natufians, and WHG (Kılınç et al. 2017).

The contribution of Iran Neolithic ancestry and their close affinity with Levantines may be explained by a contribution from a similar Anatolian Neolithic group, close to the central samples studied from Boncuklu and Tepecik, receiving more of the known previous Middle Eastern gene flows, especially Iran Neolithic contributions from the east; the closer relationship of Aegean individuals with WHG points to the survival in Aegean populations of the ancestral AME cline formed between WHG–AHG (see *§I.3. Epipalaeolithic*).

This ancestral AME cline does not allow us to fully discard an initial hypothetical out-of-the-Aegean model, or a Neolithisation driven by coastal and interior interaction networks connecting populations through the Aegean and the Levant. Nevertheless, later samples from north-western Anatolia (Kumtepe ca. 5000 BC) and south Greece (Franchti Cave and Diros, ca. 4000 BC) lack noticeable WHG-like ancestry, which suggests that Neolithic migration waves fully replaced the local population (Kılınç et al. 2017), a fact that points to similar demographic dynamics in the previous centuries.

III.2. European Neolithic

III.2.1. Mediterranean

The coastal spread in the western Mediterranean was much faster than in central Europe, which may be explained by long-distance maritime travel and exploration combined with demic expansion in coastal areas and assimilation of local foraging communities (Rigaud, Manen, and García-Martínez de

Lagrán 2018). Through the Mediterranean, different chronological and geographical traditions appear.

The *Impressa* ware develop around 6000 BC in the Ionian Sea, and constitutes the first step in the expansion to the west. It replaces the monochrome pottery around the southern Adriatic, appearing first in west Greece and south-eastern Italy, and spreading fast to the north into Dalmatia, and to the west into southern Italy and Sicily (Suppl. Fig. 6). The primary distribution of the "leap frog" type of impressed ware led by small pioneering units with a well-established agropastoral economy is seen rapidly expanding in western Mediteranean sites ca. 6000–5600 BC, such as Sicily, Tuscany, Liguria, Provence, Languedoc, Valencia (Guilaine 2017).

The common material culture element is thus pottery impressed with diverse instruments, such as the *Cardium edule* shell in the western Mediterranean, from the Adriatic coast to Portugal. A secondary phase of generalisation and regional settlement starting ca. 5600/5500 BC sees the development of specific Early Neolithic cultures, such as Stentinello in Sicily and Calabria; Tyrrhenian Cardial in Latium-Tuscany-Sardinia-Corsica; regional groups of the Franco-Cantabrian Cardial (Provence, Catalonia, Valencia, Andalusia). Cardial groups spread also into Morocco, either from Sicily or Iberia (Guilaine 2017).

In Iberia and southern France, agriculture spreads rapidly as flora diversity increases with the arrival of farming/herding communities, transforming the – until then – intact temperate forest areas. For hundreds of years a clear increase in demography, technological developments and cultural practices unfold, and during the Middle Neolithic the proportion of dominant species changes to those resistant to constant cuts (deciduous *Quercus*, evergreen *Quercus*, *Olea*, *Pinus halepensis*), and open areas multiply. Cycles of land exploitation, associating wood cutting, farming and herding, followed by woodland regeneration are common (Guilaine 2017).

III.2.2. Central Europe

While economic practices changed, some cultural traits like funerary practices did not accompany the ‘Neolithic package’ acquired in the Balkans by local fisher-hunter-gatherers. It seems that farmers and their domestic animals spread fast, in ca. 10 human generations, from sub-Mediterranean Macedonia to the northern limits of the temperate Balkan Peninsula and the adjacent Carpathian Plain, which may have put serious difficulties for the spread of cattle until selective pressure could provide genetically-driven adaptations to harsh environments (Ethier et al. 2017).

The early 6th millennium pioneer settlers in the interior of the Balkans were probably the first to face these challenges. Among their response to unfamiliar ecological conditions, the easiest adaptation was to adjust the species mix in favour of crop and livestock taxa that reproduced best in the new environment. However, farmers from the southern Balkans (modern-day Bulgaria and northern Macedonia) chose a strategy of diversification, exploiting a very broad spectrum of crops, probably to reduce climate-related losses. With their expansion to the northern Balkans and the Carpathian Basin, farmers abandoned many leguminous crops, and reduced the spectrum of cultivated plants (Ivanova et al. 2018).

On the other hand, the faunal assemblages were clearly structured by climate: sheep, goats, and pigs were reduced, while cattle and wild spaces increased in frequency during the northward expansion of farming. This, in combination with dietary evidence – such as organic residues in ceramics and stable isotope values in human bones – suggests that animal husbandry and especially dairying became of key importance for the initial establishment of farming beyond the Mediterranean areas (Ivanova et al. 2018).

The Linearbandkeramik (LBK) culture brought (starting ca. 5700–5600 BC) the first farming settlements to central European uplands as well as the North European Plains along the Oder and Vistula rivers. It expanded by colonising habitats favourable to agriculture, through a progressive migration of farming peoples from the Danube Valley to the north and west. Its economy was based almost entirely on domesticated plants and animals, and settlements were concentrated on fertile loess soils along streams. Analysis of isotope in skeletons in the Rhine Valley suggest that peoples of local origin may have been involved in the establishment of these early farming communities (Midgley 2004), which suggests short-range migrations.

Early Neolithic warfare in central Europe shows violent organised conflict between independently acting (probably territorial) groups connected by kinship ties. Massacres seem to cluster near the end of the LBK period, in the decades before 5000 BC, which suggests profound changes that affected interlinked social and natural landscapes: climate-induced drops in agricultural production with mounting claims to inherited agricultural land and increasing hierarchical differentiation are likely factors for the rise of social tensions and lethal conflicts between local groups. Evidence of perimortem collective lethal violence, as well as possible torture, mutilation, execution, dismemberment and cannibalism, including children, shows violence was a major societal issue for later LBK populations (Meyer et al. 2018).

iii.2. Early European farmers

Neolithic farmers from Europe derive from a single Balkan population closely related to north-western Anatolians which split in two routes: one related to Danubian populations, represented by the Linearbandkeramik complex from central Europe; and another associated to the Impressa complex of Croatia and Epicardial Early Neolithic from Iberia. However, this north-west Anatolian Neolithic (NWAN) ancestry is distinct from the central Anatolian source found in Aegean Neolithic samples, being shifted away from CHG and towards WHG compared to them (Mathieson et al. 2018).

Neolithic populations from the Balkans during the 6th millennium BC cluster closely with north-western Anatolian Neolithic individuals, deriving most of their ancestry from them (ca. 98%) and the rest from WHG, consistent with archaeological evidence. An exception is found in individuals of the mid–

6th millennium BC from Malak Preslavets, in the west Pontic area south of the Danube, where higher contributions of WHG (ca. 15%) and EHG (4%) are found, possibly representing populations close to the highest density of hunter-gatherers (Mathieson et al. 2018).

The Iron Gates zone represents a region of interaction between groups in both ancestry and subsistence strategy, based on strontium and nitrogen isotope data: two individuals from Lepenski Vir (ca. 6200–5600 BC), of entirely NWAN ancestry, were migrants from outside of the region and ate primarily terrestrial diet; another (ca. 6070 BC) had a mixture of NWAN and hunter-gatherer-related ancestry and consumed aquatic foods; and a fourth, earlier individual from the same site (ca. 7850 BC), had entirely hunter-gatherer-related ancestry. Another individual from Padina (ca. 5950 BC) also shows a mixture of NWAN and hunter-gatherer-ancestry, confirming the approximate date and region of interaction of both groups (Mathieson et al. 2018).

Hunter-gatherer ancestry of expanding farmers is more similar to eastern WHG individuals—like Villabruna (ca. 12000 BC) and Körös (ca. 5700 BC)—in the east, and more similar to western WHG individuals—like La Braña 1 (ca. 5900 BC) and Loschbour (ca. 6100 BC)—farther west, which shows that their admixture derives from populations with which they lived in close proximity. In particular, LBK individuals show a greater affinity to Loschbour hunter-gatherers, whereas Iberian Early Neolithic populations have La Braña-related ancestry (Lipson et al. 2017).

The increase in hunter-gatherer ancestry after the Early Neolithic period is lower in Hungary than in LBK and Mediterranean farmers from Iberia, and closest to the more eastern WHG individuals (from Villabruna and Körös), with limited intra-population heterogeneity, which points to the relative isolation of this group, close to the original source of expanding LBK farmers. In Iberia, the average admixture date is estimated ca. 5650 BC, but probably closer to ca. 5900 BC when considering only the oldest individuals assessed, which suggests—given the start of farming in Iberia ca. 5500 BC—the presence of a small proportion of hunter-gatherer ancestry in earlier Cardial Neolithic populations acquired along their migration route (Lipson et al. 2017). El Mirón-like ancestry is found in Early Neolithic individuals in higher proportions than those outside Iberia, and especially to the south, suggesting a north–south cline of admixture with hunter-gatherers who carried mixed Upper Palaeolithic ancestry (Villalba-Mouco et al. 2019).

Y-chromosome haplogroup G2a2-CTS4367 becomes also increasingly mixed with I-M170 lineages with time, especially in the Iberian Peninsula. G2a2a-PF3147 lineages (formed ca. 14900, TMRCA ca. 9700 BC), are found in Anatolian Neolithic samples from Tepecik and Barcın (and also later in Maikop from Novosvobodnaya), also early in Croatia Impressa (ca. 5560 BC), and later in Iberia, but especially in LBK samples. Haplogroup E1b1b1a1b1-L618 (formed ca. 10000 BC, TMRCA ca. 6100 BC) is also found in Cardial from Croatia (ca. 5900 BC), in Iberian Epicardial (ca. 5000 BC), and in Late Neolithic Lengyel (ca. 4740 BC), which supports its presence—probably originally from a Levantine source—in expanding Anatolian farmers.

Haplogroup G2a2b-L30 (formed ca. 14900 BC, TMRCA ca. 12500 BC), present in Anatolian Neolithic groups from Boncuklu and Barcın, as well as Greece Neolithic, seems to be more restricted to south-eastern European groups (although it is also present in the Iberian Chalcolithic), which suggests different bottlenecks during the expansion of Early European farmers from an original population with more varied male lineages.

The two major Neolithic migration waves of Neolithic settlers, from Danubian and Mediterranean routes, did probably encounter in the Paris Basin LBK and Cardium groups during the Early/Middle Neolithic transition. Cultural exchanges are observed in the region at the end of the Early Neolithic between north-eastern LBK-derived cultures Rubané Récenet du Bassin Parisien (RRBP) and Villeneuve-Saint-Germain (VSG), and Cardial farmer groups from southern France. This interaction is supported by the admixture found in ancient mtDNA from the Gurgy necropolis (Rivollat et al. 2015).

Resurgence of hunter-gatherer ancestry is also seen in Middle Neolithic samples from France (Brunel 2018).

Population continuity is observed in ancient samples through the British and Irish Mesolithic, characterised by WHG ancestry sharing high genetic drift with contemporaries from France and Luxembourg. This continuity is broken with the arrival of agriculture, introduced after a millennium–long lag between the establishing of farming in the mainland by incoming continental farmers, evidenced by a massive shift in population structure, with little evidence for local admixture. There seems to be two geographically distinct entries of Neolithic farmers, the main one through the Mediterranean route of dispersal entering from north-western mainland Europe, given the more immediate affinities with Iberian Neolithic individuals (Brace et al. 2018; Cassidy 2018; Kador et al. 2018). This affinity of Middle Neolithic samples from Britain to Iberia may be explained as from a source close to La Braña and El Mirón, but also to other intermediate unsampled regions in western Europe with higher Goyet-like contribution (Villalba-Mouco et al. 2019).

While farmers and hunter-gatherers lived in settlements in close proximity during the Neolithic in the Balkans, in western, central and northern Europe, there are signs of long periods with minimal admixture (Mathieson et al. 2017). During the Middle Neolithic, a resurge of male-biased hunter-gatherer ancestry is seen in central Europe and Iberia. Persistent frontiers between hunter-gatherers and farmers are found in central and northern Europe, coincident with the loess belt of the northern European plain, to the north of which early farming techniques were probably not suitable. It is likely that new climates and environments led to the eventual breakdown of demic diffusion, and the spread of Neolithic traits by cultural diffusion (González-Fortes et al. 2017).

That resurgence of hunter-gatherer ancestry, with a ca. 4:1 WHG:EHG contribution, is found in the Balkan Neolithic in the territory of present-day Bulgaria, close to the Danube river. This suggests a heterogeneous landscape of farmer populations with different proportions of hunter-gatherer ancestry during the early Neolithic, probably due to pockets of hunter-gatherers surviving close to the coast and major rivers (Mathieson et al. 2018). There is no sign of increasing WHG ancestry in Britain as the Neolithic progresses, which discards a resurgence of hunter-gatherers (Brace et al. 2018), although there is evidence for local Mesolithic survival and introgression in southwestern Ireland, long after the commencement of the Neolithic, also implied in haplotypic-analysis (Cassidy 2018).

In Iberia, the resurgence of hunter-gatherer-related ancestry after 4000 BC occurs in higher proportions in groups from the north and centre, and is closely related to later north-western (Canes1-like) hunter-gatherers than to the El Mirón-like hunter-gatherers from the south-east (Olalde et al. 2019).

III.3. Caucasus

The Neolithic arrived in the Caucasus during the 7th millennium BC. Farmers began to settle in the Kura–Araxes interfluve, bringing with them traditions different to those found in Anatolia and the Zagros Mountains, developing regional cultures which shared affinities with traditions in northern Mesopotamia and north-western Iran. Three Neolithic traditions can be distinguished: the Shulaveri-Shomu culture, in the central and southern regions; the western Caucasus and east Pontic region, concentrated on the area of Colchis in the foothills and along the coast; and the central and northern Caucasus, from the Surami massif to the piedmont of the northern Caucasus (Sagona 2017).

Certain Georgian sites ca. 6th–5th millennium BC show a transitional material culture (“Pre-Pottery Neolithic”), different from both the Trialetian Mesolithic and Pottery Neolithic traditions. The Pottery Neolithic of central and southern Caucasus is represented by the Shulaveri-Shomu culture, which refers to three groups: the main one, centred in the middle reaches of the Kura River; another one between the Nakhichevan region, Mil Plain, and the Mugan steppes; and the third in the Ararat Plain. This culture is thought to have been started by immigrants from northern Mesopotamia or Iran, interacting with Late Mesolithic communities (Sagona 2017).

In the Kura corridor, the typical Caucasian Neolithic village (small hamlets averaging about 1–1.5 ha) consists of high-density, cell-like compounds of round or oval houses, measuring ca. 2.5–5 m in diameter, and linked by low walls. The building on top of old structures represents a conservative building code, a tradition strongly related to the own ancestors, and thus kinship organisation, with a mentality reminiscent of Çatalhöyük. Some settlements may have been left seasonally, and courtyards were important communal areas, enclosed by small storage cells and houses (Sagona 2017).

In the Ararat plain, similar settlement plans and round structures can be seen. In the southern Caucasus a shift to fully rectangular constructions can be seen in the second half of the 6th millennium BC, reflecting a change in the social organisation, from a more communal-based village to one orientated towards the nuclear family. The plain Neolithic ceramic wares represent a local production displaying affinities with the northern Iranian Plateau (Halaf) or Anatolia (Sagona 2017).

All Shulaveri-Shomu groups are characterised by the abundance and diversity of flake tools, large quantity of scrapers, the adoption of advanced blade techniques, and ground stone artefacts, with the lithic assemblage predominantly formed by obsidian. Their economy is based on animal husbandry, raising sheep, goats, pigs, and cattle, and complementing them with hunting and fishing. Farming included a diversity of crops greater than neighbouring regions (like Northern Iran or the eastern Caspian regions). The beginnings of the wine culture is associated with this culture (Sagona 2017).

The fully-fledged Neolithic farming communities from the Mil Plain, ca 5600–5400 BC, had strong ties to northern Iran and the south Caspian region, but interaction with Shulaveri-Shomu appears to be minimal. Communal co-operation is evident, with a sub-circular planning of mud-brick constructions, with ditched enclosures pointing to potential cattle corrals, enclosed marketplaces, fortifications, or even astronomical observatories with ritual values (Sagona 2017).

Burials do not show unity among the different cultures: most findings involve inhumations, many in a crouched position, positioned either on their back or on the left or right sides (no gender differentiation). Common is the use of figurines depicting humans. Metalworking begins in the Caucasus in the late 6th – early 5th millennium, with emerging jewellery industry, including bead production and far-flung connections with central Asia and its borderlands (Sagona 2017).

In central and northern Caucasus, the evolution of the 7th to the 6th millennium is marked by a change in lithic typology and stone resources, the appearance of Pottery Neolithic, and the addition of agriculture to the subsistence economy (Sagona 2017).

III.4. Africa

Levantine herders probably introduced domestic livestock in northern Arabia, with Natufian and Pre-Pottery Neolithic spreading across Arabia during the African Humid Period ca. 8000–4000 BC (with an unknown timing). Depictions of domestic goats in rock art points to caprine pastoralism typical of the Jordanian Badia, although cattle is found in early remains, too (Scerri et al. 2018).

The Upper Capsian culture followed the Typical Capsian phase after a change to bladelet production (ca. 6200 BC), normally produced by pressure technique that required preparation of sophisticated mitred cores. A consistent range of bladelet blanks are produced, which in turn allowed for the production of standardised tools. This technological change is synchronous with an environmental shift, probably under the influence from expanding Neolithic cultures (Rahmani and Lubell 2012).

Neolithisation along the Mediterranean fringe of the African continent is not well documented, but it seems to have happened late and simultaneously with the northern Mediterranean. In the Egyptian Delta, the introduction of an agropastoral economy from the neighbouring Middle East occurs ca. 6000 BC or earlier, and reaches later Libya over the course of the 6th millennium (Guilaine 2017). Along the coastline there is clearly a rapid extension, probably related to an expansion from the Levant in the east, too.

In the southern Mediterranean, bifacial pressure flaking follows farming westward during the first wave of distribution, unlike in the northern Mediterranean, where Impressed Ware is not accompanied by this technique (it appears in Iberia only in the mid–4th millennium). In north-west Africa, wheat and sheep—species of oriental origin—are evidenced in the Maghreb at the turn of the 6th to 5th millennium BC, with the introduction of bifacial arrowheads, associated with the expansion of the Neolithic of Capsian tradition. Bifacial thinning using pressure flaking associated with agriculture is known thus only in the Levant, Anatolia, and Northern Africa until ca. 3500 BC (Darmark 2012).

As herding economies entered the Sahara, monumental sites commenced with pastoralist cemeteries along the Nile and in the south-central Sahara (ca. 6000–5500 BC), including personal adornments in some burials. Slightly later (ca. 5400–4500 BC), rock art, platforms, and/or standing stones, as well as ritually interred cattle appear.

While population levels peaked between 6000–5500 BC, northern Africa underwent over the following millennium a population decline driven by a millennium-long dry event starting ca. 6000 BC. After ca. 5000 BC, domestic cattle, sheep and goat spread throughout northern Africa, which was followed by a second population boom lasting until ca. 3500 BC.

iii.4. Northern Africans

Large genetic continuity in north-west Africa can be inferred from the Early Neolithic samples of Ifri n'Amr or Moussa (ca. 5200 BC), which shows hg. E1b1b1b1a-M81 (formed ca. 11900 BC, TMRCA ca. 800 BC). Although their position in PCA is intermediate between Iberomaurusians and modern

North African populations, this has been interpreted as driven by isolation and genetic drift (Fregel et al. 2018).

While a population related to north-western Anatolian Neolithic farmers spread westward into Europe, farmers related to those of the Levant spread southward into north-east Africa (Lazaridis et al. 2016; Schuenemann et al. 2017).

III.5. Pontic–Caspian steppe

Contacts of north Pontic cultures with Criş settlers from the Starčevo–Kőrös–Criş culture about 5800 BC introduced domesticated cattle to the Bug–Dniester culture. Up to the mid–6th millennium BC, the only domesticated animal present in the steppe was the dog. From the mid–6th millennium BC, bone remains of domestic animals are found in the north Pontic steppes, and slightly later in the Volga–Ural steppes (Vybornov et al. 2016).

No signs of cultural assimilation have been found with the introduction of Neolithisation to the Bug–Dniester culture, though. The later invasion of Linear Pottery sites ca. 5500–5200 BC respected a similar cultural frontier, geographically coincident with the Dniester. Therefore, the language of western Neolithic settlers—assumed to come from the Middle East, if language accompanied the spread of Neolithic technology—was probably not transferred to north Pontic herders (Anthony 2007).

The economy of the Pontic–Caspian steppes did not diverge significantly from a settled hunter-fisher system, though, with elements of animal husbandry found only in the steppe Neolithic cultures, as evidenced by the numerous long-term Mariupol-type cemeteries in the Dnieper region. In the Volga region, a number of forest-steppe settlements provided material with approximately equal number of bones of domesticated and wild fauna, with a considerable proportion represented by horse (Rassamakin 1999).

Neolithic period settlements and temporary encampments had an essential hunting economy, as proved by the overwhelming predominance of wild fauna. The shift to imported food-production economy in native foragers seems to have happened first during the Early Neolithic, possibly in the Bug–Dniester settlements through contacts with Criş settlers, ca. 5800–5500 BC. From the Bug–Dniester culture domesticated cattle, sheep, and goats spread quickly from about 5200 BC east- and northward into Pontic–Caspian sites, reaching Khvalynsk and the Samara region about 5100 BC (Anthony 2007).

The domesticated horse must have appeared at roughly the same time, having almost disappeared form the archaeological record during the previous Mesolithic period. Examples of horse remains include also sites on the steppe margins, such as the Pit–Comb Ware settlement of Pogorelovka, in the forest zone of the Dnieper left bank; and Neolithic settlements with a developing agricultural economy, such as those of the Bug–Dniester and Linear Pottery cultures (Anthony 2007).

The Mariupol culture, appearing ca. 5400–5200 BC, refers to the most distinctive regional aspect of the Neolithic Dnieper–Donets culture, around the Dnieper rapids, with the appearance of deep ossuary pits filled with multiple layers of skeletons, accompanied by copper objects, ceramic vessels, polished axes, and other unusual grave gifts, and correlates with the appearance of domesticated animals in the Dnieper valley (Anthony 2006).

In the Late Neolithic Don–Volga–Ural area there was the Orlovka culture in the steppe Volga basin, the Lower Don culture to the south-west, the Samara culture in the east, and the Voronezh-Don culture between the Volga and Don sites. These four cultures were related, and some researchers combine them into the Mariupol cultural-historical area, with similarities between their material culture suggesting a human migration ca. 5200–5150 BC to the north from the steppe Don region into the valleys of the Don, Medveditsa and Volga, reaching the Voronezh basin (Kotova 2008).

The first settlements of the Samara culture are found at Syezzhe during the mid–6th millennium BC, showing rituals and decorations made of shells and the fang of a wild boar, stone axes and other goods, similar to those found at Mariupol in the north Pontic area (Figure 10). Differences in pottery in the

Volga–Ural region seems to indicate the arrival of migrants distinct from the previous Elshanian territory (Morgunova 2015):

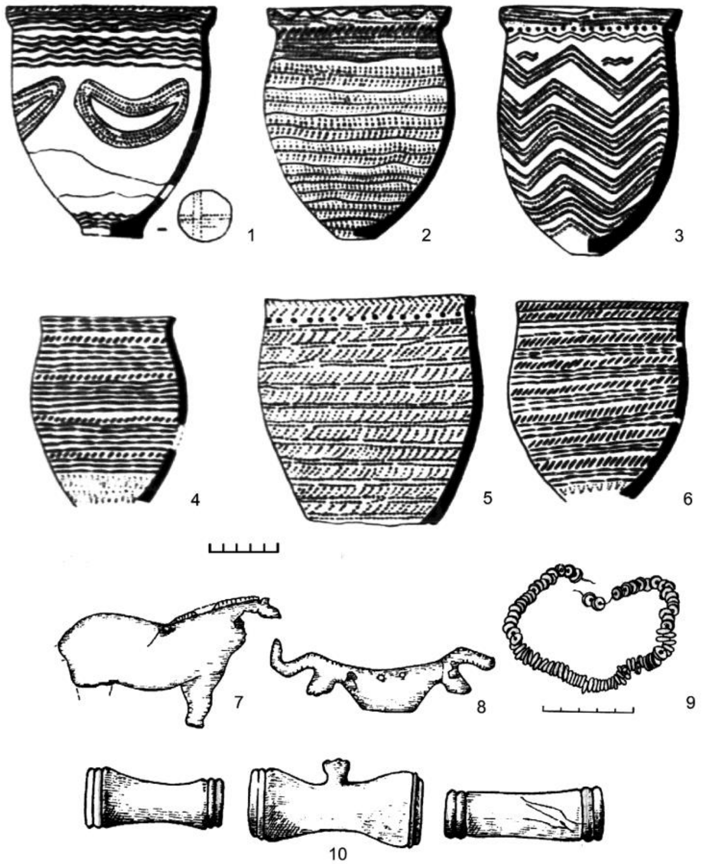

Figure 10. Materials from the Syezzhe burial ground: 1–3 pottery I group; 4–6 pottery II group; 7–8 bone amulets; 9 shell beads; 10 ornament from wild boar fang. From Morgunova (2015).

- The first type of pottery includes high vessels with small flat bottom, pronounced rim-like collars, made of clay containing silt with an admixture of shell, and shaped using plastic moulds. The surfaces were painted with ochre, and motifs are complex with meander patterns and zigzags, made with incisions and comb stamps.
- Pottery of the second type differs from the first typologically and technologically: necks are prominently made with the help of rows of

> deep pits and grooves; bottoms are large and flat; and not all vessels have collars. They are made from silt produced in water basins, and surfaces are covered with motifs made with comb stamps, which point to a connection with local Neolithic cultures.

Based on the evolution of pottery, those of the first type seem to have been made by a small group of foreigners that became assimilated by the second group. Due to the similarity with Mariupol pottery, foreigners apparently came from the west, and their influence is seen ca. 5300–4800 BC, corresponding to the dating of the Azov–Dnieper culture and Trypillia A1 (Morgunova 2015).

Their burial ritual consists in the extended position on their backs, similar to the Dnieper–Donets culture, with a ritual deposit of red ochre, broken pottery, shell beds, a bone harpoon, and bones of two horses. These are funeral feast deposits similar to the above-grade deposits found later at Khvalynsk (Anthony 2007).

The important social and economic significance of the horse – in terms of horse remains and symbolism – in the Pontic–Caspian steppe clearly points to the eastern area of the steppes between the Tisza and the Urals as the most likely zone of earliest domestication, as well as (later) use for transport and horseback riding, although the precise dates of each event are not known.

The first quantitative leap is seen in the Middle Volga region (in a close relation to the Volga–Ural region) during the Neolithic. The Samara culture reveals itself as a specialised horse-breeding group based on the increase in the number of horse remains, and in their wide inclusion in cults, rituals, and funerary ceremonies, evidenced by horse pendants, ornamented metacarpi, horse bones, and sacrificial altars. The domesticated horse expanded only later to the western agricultural zones (Dergachev 2007).

A third expansion of hunter-gatherer pottery spread from the Volga–Kama region to the east ca. 5000 BC, connected to influences from beyond the Urals, showing a more elaborately decorated ware (with bands of pits and impressions made from comb stamps), spreading north and west in the Sperrings and Säräisniemi 1 cultures (Piezonka 2015).

iii.5. Early Indo-Europeans and Uralians

The appearance of I2a1b1a2-CTS10057 lineages (formed ca. 8800, TMRCA 8800 BC) in Baltic hunter-gatherers in the 7th–6th millennium BC and slightly later in Ukraine Neolithic cultures—presumably all of hg. I2a1b1a2a2-Y5606 (formed ca. 7900 BC, TMRCA ca. 6800 BC)—points probably to continuous connections of the north Pontic region with the Baltic area, either as remnant populations of the post-Swiderian expansion, or—more likely, since this lineage is also found in hunter-gatherers from the Iron Gates and in later Balkan populations—through the late spread of hunter-gatherer pottery to the north. This is supported by the difference in ancestry between Mesolithic and Neolithic samples, with a clear shift towards WHG (Mathieson et al. 2018).

This conceivable expansion of I2a1b1a2-CTS10057 lineages with hunter-gatherer pottery in mainly east–west and south–north migration waves, coupled with the equally inferable expansion of R1a1a-M198 lineages through the forest zone, suggests that these stepped cultural expansions in eastern Europe were to some extent driven by acculturation of certain groups or alternatively by the resurgence of hunter-gatherer groups among migrating settlers, evidenced by their different Y-chromosome bottlenecks.

Haplogroup I-M170 is found in sixteen samples of the Dnieper–Donets culture from Volynsky and Deriïvka sites spanning the whole 6th millennium, and one sample of the Azov–Dnieper culture from Vovnihy (Mathieson et al. 2018). Eleven individuals of R1b1b-V88 lineages found in Deriïvka during the second half of the 6th millennium BC, at the same time as other I-M170 lineages, may represent a resurgence of this haplogroup from the previous Mesolithic population of the area, rather than an actual population movement from the west Pontic area.

Two samples of the 5th millennium BC, presumably from early Sredni Stog cultures, show genetic continuity with ancestry similar to the previous samples of the north Pontic area: one from Deriïvka (ca. 4630 BC), and one from Vovnihy (ca. 4430 BC), of hg. I2a1b1a2-CTS10057 (Mathieson et al. 2018). Another sample from Deriïvka (ca. 4870 BC) is a clear outlier with fully Anatolian farmer-like ancestry, clustering closely with Balkan Neolithic and Chalcolithic samples, but shows haplogroup I2a1b1-M223, and thus probably continuity of the male population of the west and north Pontic area.

Most likely, the population of the Don–Volga–Ural region eventually represented the Early Proto-Indo-European community by the time of the coexistence of western (Mariupol) and eastern (Samara–Orlovka) communities. The presence of R1b1a1-P297 subclades in a hunter-gatherer from Samara ca. 5600 BC and later in Khvalynsk ca. 4700 BC (see below *§iv.2. Indo-Anatolians*) supports the continuity of these lineages in the Don–Volga–Ural region and the North Caspian steppes, at least since the expansion of Elshanian pottery, in a population possibly already admixed with other lineages typical of Pontic–Caspian steppe and forest-steppe cultures—like R1b1a-L388, R1b1b-V88, R1a1-M459, or I-M170. This haplogroup variability supports the nature of the region during the Mesolithic as the sink of multiple migration waves, supporting thus the described interaction of cultures.

The likely presence of West Siberian hunter-gatherer ancestry (see *§v.8. Palaeosiberians*) in Khvalynsk seems to support this influence from the east. Ancient contacts between Pontic–Caspian and Kazakh steppe populations are also suggested by the cline formed between Eneolithic samples from the Northern Caucasus Piedmont (see below *§iv.2. Indo-Anatolians*) and West Siberian HG ancestry. This cline can be inferred from the ancestry of Maikop samples from the North Caucasus steppe (see below *§V.2.2. Maikop*), which can be roughly described as of North Caucasus steppe and West Siberian HG ancestry.

The expansion of material culture from the west may alternatively suggest an expansion of certain lineages from a Lower Volga region into the Volga–

Ural forest-steppes, to form the Orlovka and Samara cultures. A less likely possibility is the integration of lineages from North Caspian (Kairshak and related) groups in the area during the formation of the Samara culture. The presence of materials related to Khvalynsk—probably representing a late expansion—and Mariupol groups—possibly through imports—near the Moksha, Sura and Oka rivers (Artemova, Ikonnikov, and Prikazchikova 2018) attests to the continued strong connection of the Volga–Don forest-steppe and forest regions during the Neolithic.

Indo-European has been considered a branch of Indo-Uralic that was transformed under the influence of a Caucasian substratum (Kortlandt 2002; Bomhard 2017), which would imply the absorption of certain Caucasian traits by an Indo-Uralic branch already separated from Uralic. This event can be inferred in genetics from the admixture in the Volga–Ural region, evident in the diversity of haplogroups—including the likely local "resurgence" of R1b1a2-V1636, R1a1b-YP1272, and Q1a2-M25 lineages (see below *§iv.2. Indo-Anatolians*)—and in the eventual admixture with local steppe populations of elevated ANE/CHG ancestry.

On the other hand, haplogroup R1a1a1-M417 (formed ca. 6600 BC) was probably expanding with other R1a1a-M198 lineages, within the north-east European forest zone, likely resurging over an Indo-Uralic-speaking community, and expanding over likely Eurasiatic-speaking groups—which may account for the lack of the strong Caucasian-like features proper of Indo-European—perhaps already close to the north Pontic area. Whether these lineages expanded Early Proto-Uralic through north-eastern Europe, or they acquired the language when infiltrating the north Pontic post-Swiderian cultures, remains unclear.

IV. Early Æneolithic

IV.1. Central Europe

IV.1.1. Post-LBK

About 4900 BC, central Europe continued to be occupied by peoples descended from LBK communities, such as the Rössen culture in central and southern Germany, the Stroke-Ornamented Pottery culture of eastern Germany and Bohemia, and the Lengyel culture of Poland, Slovakia, and Hungary. These groups followed the same way of life as LBK farmers through most of the 5th millennium BC. An important development of this period is the exchange with Mesolithic foragers of southern Scandinavia, represented mainly by stone axes (Midgley 2004).

The Mesolithic Ertebølle culture is found ca. 5400–3950 BC in the western Baltic area, including southern Scandinavia and northern Germany between the Elbe and the Oder rivers, roughly contemporary with LBK communities to the south. It comprises an older, aceramic phase (ca. 5400–4600 BC), and a younger phase with pottery, T-shaped antler axes, and imported axes. T-shaped antler axes had a wide Neolithic distribution, appearing first in southern regions, like agriculture and cattle. Flint technology was based on blades used to produce arrowheads with a transverse edge, end scrapers with a convex edge, and tanged scrapers with a concave edge (Midgley 2004).

Contacts with other Mesolithic groups of the Atlantic façade and Comb-Ceramic groups in the eastern Baltic are evidenced by their similar pottery, featuring shallow, oval bowls (presumably used as lamps), and pointed-bottom vessels including small beakers and medium and large pots used for drinking, cooking, and perhaps storage. This pottery is only rarely found in groups to the south. Settlements appear in coastal and riverine zones apt for fishing, and comprise large central sites occupied more or less continuously, as well as small, seasonal sites. Burials can be found far from the coast and on high elevations, and consist mostly of inhumations, usually in the extended supine position, with men given knives, daggers and axes, and women ornaments (Midgley 2004).

IV.1.2. Megalithic culture

Megalithic tombs appear in western Europe among post-Neolithic societies along the western Mediterranean but principally expands along the extensive Atlantic façade, reaching from western and northern Iberia, France, Sardinia, mainland Italy, and the British Isles to the Shetland Islands, the Northern European Lowlands and Scandinavia. Tens of thousands of large stone burial monuments were built, using large boulders to form chambers and passages covered with mounds of earth or cairns of stones (Müller 2014).

The first grave chambers start ca. 4700 BC in north-western France, from pre-megalithic monumental sequence and transitional structures, as a response to different influences: the Blique/Epi-Rössen tradition of non-megalithic long barrows of the Passy type were erected in the Paris Basin; the eastern concept of trapezoidal-rectangular long barrows reached the northwest coast of France; and stone cists and early passage graves, similar to Epicardial and Cerny grave traditions further to the south, are found in these and other mounds (Schulz Paulsson 2019).

The culture appears in Corsica and Sardinia as simple dolmens ca. 4200 BC, while on the British Isles it emerges ca. 4000 BC, and in north-central Europe and southern Scandinavia they start ca. 3650 BC within the Funnel Beaker culture, starting on the western coasts of Oland and Gotland. The *allées couvertes* and gallery graves both developed as of ca. 3600 BC in inland settings from Brittany over to the Paris Basin and to central Germany (Müller 2014). The distribution emphasises the maritime linkage of these societies and a diffusion of the passage grave tradition along the seaway, accompanied by economic and social changes in Europe (Schulz Paulsson 2019).

Most tombs were collective burials, opened repeatedly to bury bones of newer generations, pushing bones of earlier generations aside to make space. They clearly represent ceremonial monuments, where the deceased members of the same community or clan were buried together (Midgley 2004). The high mobility of Neolithic society probably facilitated the diffusion and convergence of the new architectural developments and underlying ideology, but there is also evidence of demic diffusion (Müller 2014).

iv.1. European Neolithic farmers

Samples from Late Mesolithic/Neolithic sites show continuity of I-M170 lineages and previous ancestry; so e.g. in a sample from central Norway (ca. 3940 BC) of hg. I2a1a2-M423 (Günther et al. 2017), in subsequent samples of the Nordic Neolithic, and in samples from the Zedmar culture (ca. 4500–3000 BC), related to Mesolithic Ertebølle, showing typical hunter-gatherer mtDNA U5b1 (Bramanti et al. 2009).

In Neolithic individuals from southern France and Britain there is a greater affinity to the Iberian Early Neolithic farmers than to central European ones. This is confirmed by haplotype matching, consistent with the same ancestral populations bringing the Neolithic to Britain and Ireland. Chronological modelling suggests that NWAN-related ancestry arrived in Britain ca. 3975–3722 BC, marginally earlier in the west and rapidly dispersing to other regions (Olalde et al. 2018; Brace et al. 2019).

The Middle Neolithic resurgence of hunter-gatherer-related ancestry in central Europe and Iberia was driven more by males than by females, evidenced by the expansion of hunter-gatherer-associated Y-chromosome haplogroups I2-M438, R1-M173, or C1-F3393 in seven out of nine male individuals in Iberian Neolithic and Copper Age, and nine out of ten individuals in Middle–Late Neolithic central Europe, including the Globular Amphorae culture (Lipson et al. 2017).

Similarly, there is continuity of Mesolithic I2a2-M436 lineages in the British Isles, with fifteen out of nineteen samples reported in Great Britain (ca. 8750–2500 BC) corresponding to this subclade, at least during the Neolithic probably corresponding to I2a1b1a1a1-L1195 (formed ca. 5100 BC, TMRCA ca. 3600 BC) at least three of them from the south-west (ca. 4000–3500 BC) of subclade I2a1b1a1a1b-L1193 (TMRCA ca. 3500 BC). At least one sample from the centre (ca. 3600 BC) is of hg. I2a1a2a-L161.1, which appears more often among megalithic builders.

Individuals buried in megaliths from the British Isles (ca. 3800–3100 BC) and Ansarve in Scandinavia (ca. 3500–3200 BC) show an ancestry similar to other contemporaneous farmer groups, with a majority of their ancestry related to Early Neolithic farmers and a partial admixture component related to European Mesolithic hunter-gatherers. The genetic connection found between western European Neolithic groups from the British Isles to Scandinavia is driven by NWAN-related ancestry, rather than hunter-gatherer-related ancestry, and seems not to include central European farmers, which suggests a migration along the Atlantic coast (Sánchez-Quinto et al. 2019).

Kinship of buried individuals is reflected in Y-chromosome haplogroups, with only I-M170 lineages reported: at least four I2a1b1a1a1-L1195 out of nine in Scotland, one of them of subclade I2a1b1a1a1b-L1193; at least five out of eight I2a1a2a-L161.1 in Scotland and Sweden, with three I2a1a2a1a1-Y3749/FGC7126 (formed ca. 4900 BC, TMRCA ca. 3400 BC) reported in

Ansarve (Sánchez-Quinto et al. 2019). Both subclades may also be related to the Neolithic expansion of Atlantic farmers through the Mediterranean route.

Individuals from megalithic burials in the north (with over-representation of males) do not show systematic differences with geographically proximate non-Megalithic burials. Societal complexity during the Neolithic contrasts with the identification of a highly inbred elite individual in Ireland, strongly suggesting that the elaboration and expansion of megalithic monuments was associated (at least in some regions) with dynastic hierarchies (Cassidy 2018).

IV.2. Khvalynsk–Novodanilovka

A climatic improvement is seen peaking in the mid–5th millennium BC, with mild summers and winters, less precipitation, and an increase in steppe grass-cover with more varied vegetation (Binney et al. 2017). These changes favoured the importance of a subsistence economy based on animal husbandry, which had spread into the Pontic–Caspian area only centuries earlier. This specialisation was coupled with fundamental innovations (Parzinger 2013):

- Kurgan burials substituting flat graves.
- Dead in the crouched position, substituting the previously standard supine position.
- Rich grave goods revealing social stratification.
- Animal husbandry including widespread horse imagery and likely horse domestication.

IV.2.1. Genesis and expansion of Khvalynsk

Early Khvalynsk (ca. 5300–3900 BC) probably began from an autochthonous group of the Middle Volga region—near the site that gives the culture its name—closely related to the previous Neolithic Volga–Ural groups (Samara and Orlovka), expanding rapidly into neighbouring regions. Changes during the second stage of sites showing continuity with Samara material culture, at the beginning of the 5th millennium, are marked by strong influences from the Khvalynsk culture, with pottery showing technological changes and more variety, as well as typical Khvalynsk features, such as clays containing silt, wicker elements in ornamentation, etc. Pottery also partly continues the previous Syezzhe tradition. (Vybornov et al. 2016).

The Khvalynsk culture started to settle in the south of the Volga valley, reaching about 4900 BC wormwood deserts to the north-west of the Caspian area, and the Mangyshlak Peninsula in the east of the Caspian area, witnessed by many finds of ceramics with comb decoration, where the Khvalynsk population partly assimilated the native inhabitants of the North Caspian culture in the Lower Volga. A part of the North Caspian culture probably migrated to the Saratov Trans-Volga region, where it was assimilated to the Orlovka culture (Kotova 2008).

The Khvalynsk culture expanded to the south and west along the Lower Danube into the north Caucasian region from ca. 4800 BC, with the Nalchik cemetery in the northern Caucasus steppe being synchronous with this early stage (Vybornov et al. 2018). At the same time, Khvalynsk expanded to the west into the Don–Kalmius interfluve, developing a significant area in the north Pontic region with the so-called Novodanilovka group, including synchronous findings reaching the lower Danube region and beyond with the so-called Suvorovo group (Kotova 2008).

The sudden expansion of Khvalynsk settlers from the Volga–Ural in all directions (Figure 11) marks the development of a Khvalynsk–Novodanilovka cultural-historical area, dominating over the steppes from the lower Danube to the Middle Volga, the Caucasus, and the Trans-Caspian area showing common funerary sacrifices of domesticated sheep, goats, and cattle, connected with an increase in the number and diversity of new types of body ornaments in graves, some made of exotic materials, including copper, and polished stone maces (Anthony 2016).

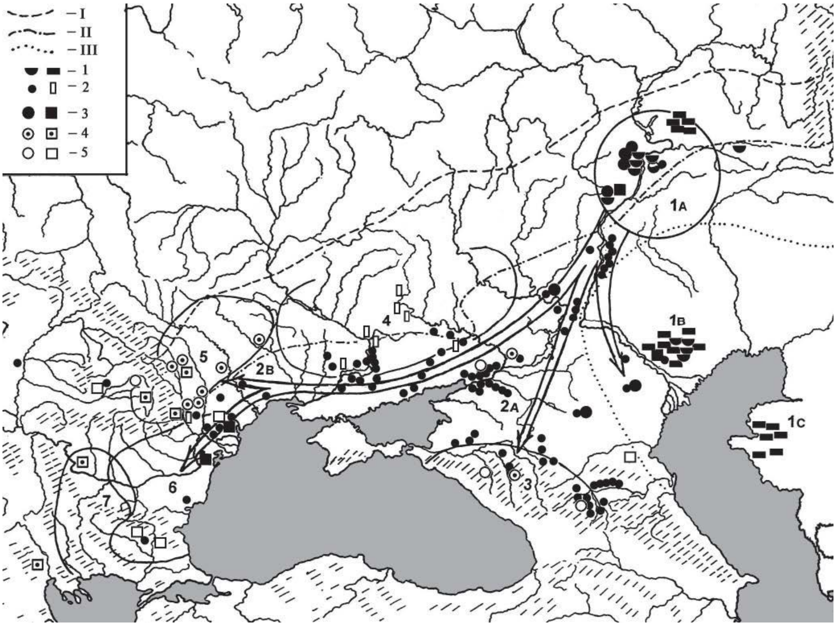

Figure 11. Map with likely route of migration of Khvalynsk settlers into the northern Caucasus and the Balkans. I) southern border of forest-steppe; II) southern border of steppe; III) border of semidesert. Cultures: 1) Burial complexes and settlements of Khvalynsk (1A – Middle Don; 1B – Northern Caspian; 1C – Western Caspian); 2) Burial complexes and remains of the Novodanilovka type (2A – Eastern; 2B – Western); 3) Pre-Maikop (Steppe Eneolithic); 4) Sredni Stog; 5) Cucuteni–Trypillia; 6) Bolgrad–Alden' – Gumelniţa–Karanovo VI; 7) Krivodol–Sălcuţa. From Dergachev (2007).

IV.2.2. Horses

The Khvalynsk culture, genetically related to Samara, preserves traditions of the ritual, cultural meaning, the treatment of the horse imagery in funeral contexts, including altars, horse bones, and funerary rites. At the same time, it is in this precise culture that the image of the horse—included in the social symbolism, such as horse-head pommel-sceptres—acquires for the first time a special, maximum social significance. The appearance and subsequent widespread distribution of similar social symbols in the whole Khvalynsk–Novodanilovka cultural-historical area, through the expansion of Novodanilovka-type objects, could be considered as another qualitative leap in the social significance of the horse.

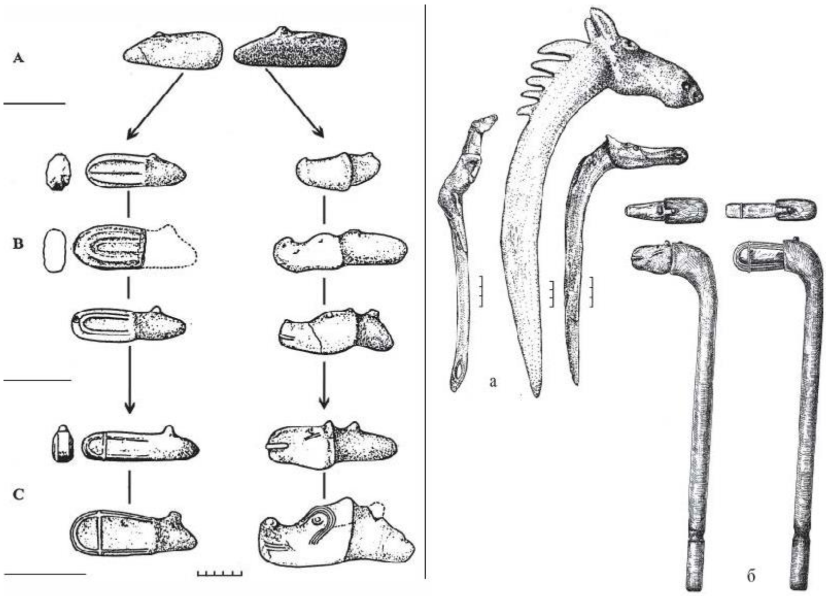

Figure 12. Left: Development of sceptres after Dergachev (2007), with more abstract (left) and more realistic (right) horse-head motif. Right: Restoration of sceptres: (a) Models for restoration – Late Mesolithic and Neolithic elk-head staffs from the east European forest zone (b) supposed appearance of Eneolithic sceptres on the hundle with the clutch. From Dergachev (2007).

Especially relevant is the position of stone-carved horse-head pommel-sceptres (Figure 12), whose almost synchronous appearance during the first half of the 5th millennium bc in Khvalynsk–Novodanilovka sites can be followed with certain precision into different subgroups, according to subsequent developments in their shape (Figure 13). Sceptres are an important cultural phenomenon, with strong symbolic functions as a divine object, used in times of peace, in times of war, and in a system of ritual power. The account of the divine and human genealogy of Agamemnon's sceptre in the Iliad bears testimony to their likely increased relevance for earlier warrior-priest chiefs (Dergachev 2007):

"Then among them lord Agamemnon uprose, bearing in his hands the sceptre which Hephaestus had wrought with toil. Hephaestus gave it to king Zeus, son of Cronos, and Zeus gave it to the messenger Argeïphontes; and Hermes, the lord, gave it to Pelops, driver of horses, and Pelops in turn gave

it to Atreus, shepherd of the host; and Atreus at his death left it to Thyestes, rich in flocks, and Thyestes again left it to Agamemnon to bear, that so he might be lord of many isles and of all Argos."[7]

The explosion of horse symbolism has been interpreted as a signal of the start of horse-riding technique in the eastern cultural area, with the horse becoming a necessary instrument for long-distance travel, for transport, for raids, and for war (as a means for quicker movements rather than their use for mounted war *per se*), facilitating thus the culture's rapid expansion. While bone remains show a similar proportion in the contemporary early Sredni Stog groups of the north Pontic steppe and forest-steppe areas during the 5th millennium BC, supporting the relevance of the domesticated horse in their subsistence economy, horse remains are strictly limited to an economic context, without social or symbolic meaning (Dergachev 2007).

Clear archaeological evidence for the development of horseback riding is found in the early–to–mid–4th millennium BC in the Botai-Tersek culture of central Asia, in the expansion of Repin herders, in Maikop and Transcaucasian cultures, and in Armenia. Archaeology points thus a likely expansion of the technique from a single source at the turn of the 5th–4th millennium BC, which is compatible with an earlier, autolimited expansion of incompletely tamed horses (not adapted for many relevant tasks seen in later cultures) with Khvalynsk chieftains in the mid–5th millennium BC (see *§V.7.2. Late Repin*).

Horse palaeontological and archaeological data suggests that the Urals were a potential constraint for the dispersal of horses between Europe and north-central Asia, and that suitability for the species steadily improved in western and south-eastern Europe from ca. 6,000 to 3,000 years ago. The Caspian Sea was possibly the westernmost boundary of Asian horses, which probably became adapted to the new areas in the Pontic–Caspian steppes and to the west from the 5th millennium BC on (Leonardi, Boschin, et al. 2018).

---

[7] *Homer. The Iliad with an English Translation* by A.T. Murray, Ph.D. in two volumes. Cambridge, MA., Harvard University Press; London, William Heinemann, Ltd. 1924. Retrieved (2018) from <http://www.perseus.tufts.edu/>.

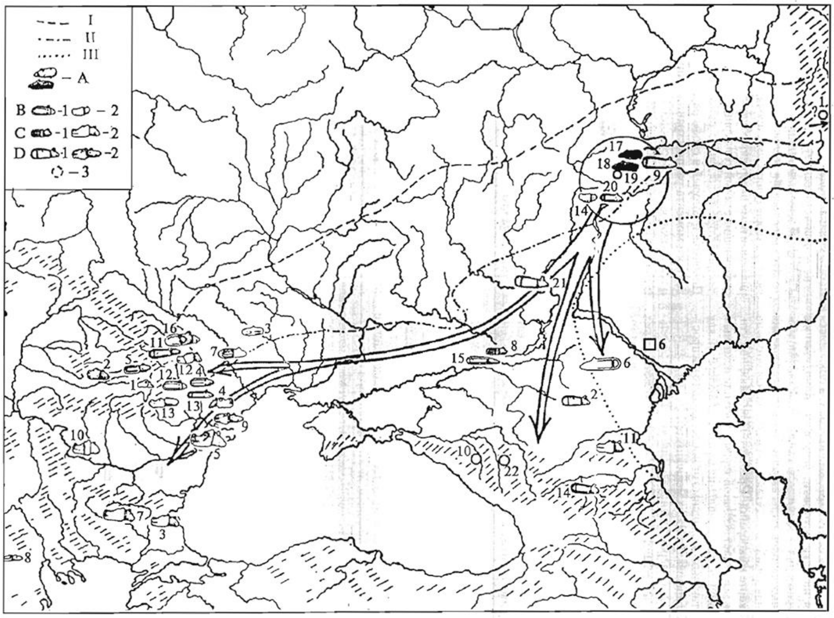

Figure 13. Map of regional–chronological morphological developments of horse-head sceptres. A) Original (Khvalynsk) variant. B) More complex forms including schematic Byrlelesht' and realistic Khlopkovo-Ariushd variants. C) Transitional forms, including schematic Konstantinovka-Velen' and realistic Drama-Fedeleshen' variants. D) Extremely complex forms, including schematic Arkharinskiy and realistic Kasimcha-Suvorovo variants. From Dergachev (2007).

IV.2.3. Kurgans

The use of barrow burials or *tumuli* has been argued to appear as a local north Caucasian feature, with origin in the 5th millennium BC, and also in the southern Caucasus, with the Leilatepe culture, from where it spread north. Other barrows are later found up to north-west Iran. Although evidence is too scarce to select a precise origin, the early Khvalynsk–Novodanilovka burials, on the Pontic–Caspian steppes, are the first to feature rich, ochre-sprinkled graves under kurgan-like structures (Korenevskiy 2012).

The addition of the tradition of ochre staining (originally from the steppes) to the emerging proto-kurgans supports that these structures emerged with the contacts of steppe cultures with the Caucasus. The standard posture on the back with knees raised, with their heads to the north and east (Anthony 2007), characteristic of Khvalynsk-type burials, point to the expansion of the

Khvalynsk–Novodanilovka cultural-historical area as the starting point of this tradition in the steppes.

All members of society are considered represented in the earliest Khvalynsk cemeteries, although there is a clear emerging trend during their expansion for elite male burials to predominate. Rich grave assemblages include stone clubs and axes, animal-head sceptres, long flint blades, and ornaments for clothing, many made of copper. These rare copper objects like rings and beads, most likely from western industries, are more common in elite male graves, as are animal sacrifices and red ochre (Murphy and Khokhlov 2016).

The emerging kurgan structures were probably not simple pits filled with earth. There was a belief that the funerary structure was the place where the buried moved to another world, and in that sense similar funerary structures reflect certain egalitarian ideas, so the evolution from collective necropolis to the rich grave assemblages reflect the meaning of prestige objects as symbols that emphasise social status, and thus an evolution to a kinship-based, elite-dominated organisation into small families, as well as a potential function in the transition to the afterlife (Korenevskiy 2012).

The new social elites identified themselves through grave goods and grave construction, marked the status with clothing (copper jewellery) and symbols of power (mace and sceptre). The existence of similar children's graves supports the membership to social groups being acquired by birth. This common evolution in the whole Khvalynsk–Novodanilovka cultural-historical area supports the emergence of tightly structured elite social groups expanding from the east (Parzinger 2013).

Ceremonial skull-scraping of the parietal bone, consisting of one to seven gouges about 2–3 cm in length in the parietal bone surface, may appear mainly in mature adults (Khokhlov 2016), with some cases clearly associated with elite burials. Zoomorphic sceptres represented probably a ritual source of power for Khvalynsk chieftains, political and/or religious leaders, as evidenced by the unique zoomorphic carving found in Ekaterinovka (a riverine settlement) in the second half of the 5th millennium, resembling a toothed fish or reptile, rather than the most common horse-related motifs expanding with Novodanilovka–Suvorovo settlers. The finding of similar elk-head staffs in Mesolithic–Neolithic cultures of northern and eastern Europe and the Trans-Urals region may suggest an ancient cultural connection of this tradition through northern Eurasia.

Early kurgan-like or *proto-kurgan* constructions in the Pontic–Caspian steppes are found thus associated with the expansion of Khvalynsk–Novodanilovka chiefs, featuring similar constructions to mark elite graves: rooves made from separate slabs with cairns are known in the Dnieper and Volga regions (17% of burials in early Khvalynsk were superimposed with stone cairns or had a single stone marker); cists with cairns are known from the northern Donets and Azov areas; and a unique cromlech is found in the Dniester–Danube area, among Suvorovo graves. Apart from these stone constructions, in the Volga and northern Caucasus region sometimes natural hills or small earthen or wooden constructions are used as burial markers (Rassamakin 1999).

IV.2.4. Khvalynsk economy

Stable isotopes in the bones of Khvalynsk individuals show that their diet depended to a large extent on fish (Schulting and Richards 2016), although domesticated animals also feature prominently in the Khvalynsk culture, accompanying thus a food-producing economy (Vybornov, Kosintsev, and Kulkova 2015).

Sheep and goats were sacrificed more than any other species in ochre-stained ritual deposits in Khvalynsk; cattle predominated on the lower Dnieper; and horse bones dominated in between. Given the data from the predominant diet, domesticated animals may have been reserved for their use as a ritual and feasting currency associated with the political competition between a new social rank of elites (Anthony 2016; Anthony and Brown 2011).

There is an evident causal relationship between the emergence of a warrior class of social leaders and the spread of cattle herds through widening grazing lands, and between their rapid westward spread and imagery evidencing the domestication of the horse (and its use as a riding mount). Deposits from Ukraine, the Caucasus or the Urals were not used at this moment, so metal imports came probably from Balkan and Carpathian mines, which supports a dense network of extensive trading links through the north Pontic steppes up to the Volga (Parzinger 2013).

The Khvalynsk expansion represents thus the start of the Eneolithic era, as the time of development of a prestigious economy that marked social elites through different valuable objects, many of them obtained through exchange networks, reflecting the direct or indirect involvement of the owners. Among them were items requiring high skills or complex manufacturing techniques (different woollen tools, sceptres, stone bracelets); tools that occupy an important role in labour, war and industry (stone flat axes, arrowheads, knife-like plates, and chips of flint); iconic objects (bone plates from canine fang, pins, bone sticks with a hole); beads (from bone, stone, shell, and bead washers that could be collected in whole garlands, acquiring a special value); copper jewellery (beads, rings, bracelets) (Korenevskiy 2012).

IV.2.5. Suvorovo

Since the early 6th millennium BC objects and ideas flew in a single direction, from central (Linearbandkeramik) and south-eastern (Old European) cultures to the Pontic–Caspian steppe. This changed from the mid–5th millennium on, when movement is seen also from the steppe to the west, driven by the newly found human mobility (Heyd 2016).

The Suvorovo–Novodanilovka group appear in the north-west Pontic area, the Lower Danube, and Dobruja, reaching to the south the Upper Thracian Plain and northern Greece, and to the east the east and central Carpathian Basin, up to central Europe. They are recognised by their rich individual primary graves displaying ostentatious prestige goods, whose inventory included jewellery (shell necklace, copper goods, rarely gold), tools (flint and copper) and weaponry. The most conspicuous objects are the high technology flint inventory, with axes, long blades, and triangular silex spearheads sticking out (Heyd 2016).

Individuals were laid on their back, extended or crouched, with slightly bent knees on the side, and oval to square graves (Figure 14). Ochre staining of the entire grave is the norm, including whole ochre pieces. A short, still quite shallow mound can be seen over the grave, sometimes with circular stone structures either around the grave (as in Suvorovo) or around the mound. Zoomorphic (usually horse-head) sceptres were particularly common in the south, while in the north-west and west Pontic areas (and in the east Carpathian Basin) they represent mostly isolated finds, and comparable pieces are abstract stone sceptres and stone mace heads with knob decoration. The farthest south that these materials are found is Suvodol–Šuplevec, northern Macedonia, in the south-east Balkans (Heyd 2016). To the west, the farthest finds are in the Csongrád–Kettőshalom site, dated ca. 4370–4240 BC (Horváth et al. 2013).

The most recent radiocarbon dates show that these findings appear in south-east Europe from about 4600 BC—contemporaneous with the rich graves of the Necropolis from Varna I—to ca. 4000 BC. Steppe imports are found in Gumelniţa, in the Lower Danube region, from about 4400 BC, pointing to an established trade network (Reingruber and Rassamakin 2016). A the end of the Early Eneolithic, the Varna necropolis ceases to function, and the Suvorovo elites disappear, although Cernavodă I, continues to show burials similar to north Pontic findings ca. 4000–3750 BC (Heyd 2016).

While the Suvorovo expansion marked the beginning of long-distance exchange of prestige goods with the steppe, and they did not represent a massive migration, the “infiltration” of settlers was enough to cause the abandonment of settlements by the Gumelniţa population of the left bank of the Danube when the steppe tribes appeared. There is little evidence of armed conflict, so it is possible that the crisis of local agricultural economy may have caused this abandonment. There may have been a gradual, peaceful process of assimilation of the Suvorovo settlers by the local Gumelniţa population, favoured by the crisis of the local agricultural economy, which is seen by many scholars as the process by which the Cernavodă I culture came into existence (Heyd 2016).

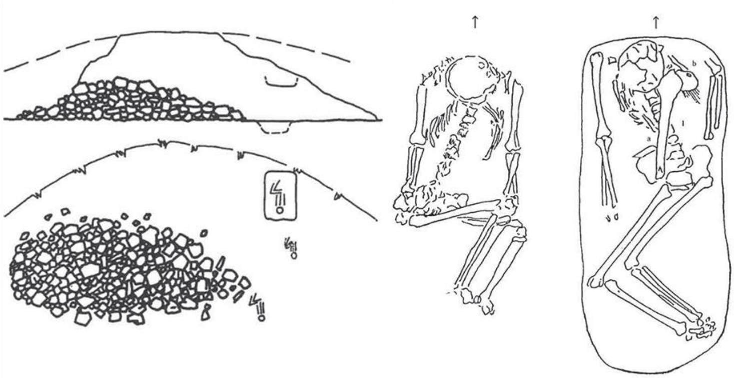

Figure 14. Suvorovo/Novodanilovka graves Kjulevca, and Targovište-Gonova Mogila, grave 1 (Bulgaria) after Govedarica (2004) and Heyd (2016).

These kurgan findings show funerary rites and technology, but there are no associated settlements. They appear in parallel to complex organised settlements like those of Cucuteni–Trypillia, Bolgrad–Aldeni, Varna, Kodžadermen–Gumelniţa–Karanovo VI and related cultures, with which they participate in economic exchange (Suppl. Fig. 7). Based on the number of graves among these groups, we can say that the size of the infiltration must have been rather small (Heyd 2016).

IV.2.6. Varna

It was probably the arrival of Suvorovo migrants what triggered the idea of lavish grave furniture and the display of wealth, prestige, power, and social position in the graves of Copper Age sedentary farming communities of south-eastern Europe. The Varna I cemetery is the clearest representative of the expansion of the new mentality to the Balkans, and has been recently dated more exactly to ca. 4590–4340 BC (Krauß et al. 2017).

Characteristic ceramics are based on features known from the late Chalcolithic ceramic complexes in Durankulak (tell and necropolis), Devnia, the Varna lake settlements and necropolis. Fine ceramic is thin-walled, with a light grey turning into black, burnished, smoothed surface, with pots having upper cylindrical and rounded parts or being bi-conical forms with vertical handles. The composite S-profile and strongly outward curved mouth rim were one of the most typical elements of the complex, together with ring-like bottoms, and the most emblematic ornamentation was the "Ezerovo" type, in which the motif's background was engraved and encrusted, with the ornament itself remaining embossed, as well as the flutted decoration (Petrova 2016).

While the richness displayed by the Varna cemetery and its accumulation of wealth are unique in south-eastern Europe, similar accumulations of material wealth are encountered in isolated finds all over the Balkans and the Carpathian Basin, reaching Greece and Anatolia. Metallurgy requires material and skills which are not readily available, which means that elites kept control of them by limiting people's ability to access and produce metals themselves. In fact, except for the distinct material culture, the rich Varna burials and the Novodanilovka burials are essentially equivalent (Heyd and Walker 2004).

Graves and hoards demonstrate thus sharp inequality over wide parts of south-east Europe in the 5th and 4th millennium BC, showing thus social stratification, also displayed in the form of house sizes and pottery inventories (in quantity and quality) within settlements. There is thus a pattern of robust social institutions and enhanced complexity, of lineages and powerful chieftains, of networks and bonds persistent in time and space, reflected in Varna, in mega-villages of middle and late Trypillia, and in many other sites in south-eastern Europe (Heyd and Walker 2004).

iv.2. Indo-Anatolians

Three samples dated after ca. 4700 BC have been analysed from the Khvalynsk cemetery, described as hosting typically southern and northern individuals. One high-status burial, buried supine with raised knees and an assemblage of 293 copper artefacts (this grave alone accounting for ca. 80% of copper objects in the Khvalynsk cemetery) represents thus a high-status individual, member of an elite group of patrilineally-related families that was probably successful during the Indo-Anatolian expansion, reported as of haplogroup R1b1-L754[8] and mtDNA H2a1, unique in the region (Mathieson et al. 2015).

The individual of haplogroup R1a1-M459 (xR1a1a-M198), mtDNA U5a1i, also buried on his back with raised knees, probably represents a commoner, remnant of a local population, showing more EHG-like ancestry. An old male of Q1a-F903 lineage (probably Q1a2-M25, see above *§ii.5. Caucasus hunter-gatherers*), mtDNA U4, and higher CHG/ANE component related to steppe eneolithic samples, who died from blows to his skull, suggests that the origin of this extra ancestral component found in Khvalynsk (and much elevated later in sampled Yamna) individuals comes from the admixture of Samara hunter-gatherer-like elites from the Don–Volga–Ural region with northern Caucasian or northern Caspian steppe populations, or both, during their expansion.

Two individuals from Progress in the Northern Caucasus Piedmont (dated ca. 4600 BC and 4150 BC), of haplogroup R1b1a2-V1636^{+}, and one from Vonyuchka (ca. 4300 BC) show elevated ANE ancestry[9], which confirms the presence of this component in regions of the northern Caucasus with early pit

[8] Tentative analysis with Yleaf does not yield a subclade beyond R1b1-L754 in Wang et al. (2019) supplementary materials. It is probably safe to assume, as did the authors of the paper that published the sample (given the relevance of its assemblage, and the likely influence of his family in the Khvalynsk expansion) that it may have belonged to haplogroup R1b1a1b-M269.

[9] Both populations can be modelled as of EHG (ca. 40–60%) and the remainder from a CHG-related basal ancestry, with Vonyuchka slightly shifted to Iran Neolithic, whereas Maykop receives CHG-related ancestry (ca. 86%) apart from Anatolian Neolithic (ca. 10%) and EHG (ca. 4%), according to Wang et al. (2019) supplementary materials.

grave burials—related to the Don–Caspian steppes—and support its expansion in the Don–Volga–Ural region linked to steppe elites, likely through exogamy of expanding Khvalynsk settlers (Suppl. Graph. 4). Both Eneolithic Samara and north Caucasus steppe populations analysed to date show no gene flow from Anatolian farmers, unlike contemporary samples from the north Pontic region and later samples from the Yamna culture (Wang et al. 2019).

The finding of R1a1b-YP1272$^+$ as a Maikop outlier in the same kurgan in the late 4th millennium (see below *§v.2. Early Caucasians*), and of R1b1a2-V1636$^+$ among Yamna individuals of the Caucasus in the early 3rd millennium BC (see below *vi.1. Disintegrating Indo-Europeans*) further supports the possible relevance of these lineages in the Indo-Anatolian expansions associated with Khvalynsk, or else their widespread presence among Pontic–Caspian steppe populations before the Khvalynsk expansion.

Based on continuity of ancestral components in later samples from Afanasevo, the early Khvalynsk community eventually stabilised (probably after ca. 4500 BC) in its admixture, remaining close to the analysed samples from the north Caucasian steppes, deriving more than 60% of ancestry from EHG, and the remainder from a CHG-related basal ancestry (Wang et al. 2019), in what can be taken a model of the so-called "Steppe ancestry" in later samples. This homogenisation of the Don–Volga–Ural, Kuban, and north Pontic areas suggests continued exogamy of Khvalynsk clans dominated by elite males with other related groups from the steppe.

Other analysed elite Khvalynsk individuals (ca. 4250–4000 BC), from the riverine Ekaterinovka settlement, whose material culture is interpreted as chronologically intermediate between late Samara and early Ivanovska–Khvalynsk materials (Korolev, Kochkina, and Stashenkov 2019), have been reported by Khokhlov (2018) as within the R1b1a1b-M269$^+$ tree (formed ca. 11300 BC, TMRCA ca. 4400 BC), which confirms the continuous presence of R1b1a1-P297 subclades in the region. The estimated split and successful spread of R1b1a1b1-L23 (formed ca. 4300 BC, TMRCA ca. 4200 BC), subclade of R1b1a1b-M269, further supports its association with patrilineally-related clans that expanded with early Khvalynsk around the mid–5th millennium BC.

The finding of a rare R1b1a1b-M269 subclade R1b1a1b2-PF7562 (formed ca. 4400 BC, TMRCA ca. 3400 BC) in the Balkans, Central Europe, Anatolia, and the Caucasus (Myres et al. 2011; Herrera et al. 2012) may support their association with the early spread of Indo-Anatolian speakers, although their late TMRCA points to a recent expansion linked to the spread of Yamna migrants (see below *§vi.1. Disintegrating Indo-Europeans*).

The earlier, Epipalaeolithic–Early Mesolithic origin of haplogroups R1b1a2-V1636, R1a1b-YP1272, and R1b1a1b-M269 compared to their late estimated successful expansion around the mid–5th millennium BC supports their emergence among local populations of diverse haplogroups around this time of population movements in the region. Since R1b1a1-P297 lineages were probably the latest to successfully spread into the Volga–Ural area, the presence of other lineages among Khvalynsk males suggests the resurgence of indigenous haplogroups, probably prevalent among certain local Pontic–Caspian groups before the expansion of the North-Eastern Technocomplex and hunter-gatherer pottery.

Steppe ancestry has been found in one female child from the Varna I cemetery (ca. 4711–4450 BC), from the earliest burials of the first phase, richly furnished; in a young male from Smyadovo (ca. 4550–4450 BC), of a Balkan Copper Age culture (Mathieson et al. 2018), of hg. R-M207[10]; and in a Greece Neolithic sample, probably also from the middle to late 5th millennium BC (Wang et al. 2018). All these samples prove the expansion of Suvorovo settlers to the south into the southern Danube regions and beyond, up to northern Greece (Suppl. Graph. 5). However, the presence of few individuals with

[10] The sample has been officially and repeatedly reported as of hg. R-M207. It is also positive for SNPs CTS9018, CTS9018, PF6452 (defining the R1b1a1b-M269 tree), but shows negative SNPs for P equivalent, which makes its actual haplogroup unclear. Additional information by Richard Rocca.

Steppe ancestry among two dozen Copper Age Balkan samples from the region (ca. 5000–4000 BC) further supports the nature of the Suvorovo expansion as a rapid infiltration of few steppe chieftains among local east Balkan populations.

The presence of R1b1-L754 samples in the north Pontic region and in the Balkans during the 5th millennium does not prove they belong to the known lineages associated with Khvalynsk, and the presence of confirmed R1b1b-V88 subclades in both regions (Mathieson et al. 2018) frustrates their interpretation as belonging to any specific subclade. On the other hand, the presence of I2a1b1a2a2-Y5606 in Neolithic samples from the north Pontic area, and of I2a1b1a2a2a-L699 lineages expanding with Yamna (see *§vii.5. Palaeo-Balkan peoples*), suggests that some of these lineages were also integrated in the Khvalynsk society, and may appear associated with Suvorovo–Novodanilovka settlers. Other Pontic–Caspian steppe lineages, like R1a1-M459 or Q1a-F903, could have also accompanied these early Indo-European elites, before the further Y-chromosome bottlenecks seen in Repin and early Yamna.

IV.3. Eastern Europe

IV.3.1. Metalworking

The Copper Age began in Bulgaria ca. 5200–5000 BC, but Old European copper-trade network included the Pontic–Caspian steppe groups only after ca. 4600 BC. In the period ca. 4800–4000 BC, Trypillia ceramic imports appear at the Neolithic Dnieper sites. In the forest-steppe region, they occur on a number of sites belonging to the Kyiv–Cherkassy variant of the Dnieper–Donets community, and later imports reach into the forest zone, into the territory of the Pit–Comb Ware culture. Prestige objects begin to appear at this time on the north Pontic region, too, marking the beginning of the prestige exchange (Rassamakin 1999).

There is no gap between the Neolithic cemeteries of Nikolskoe, Lysogorskoe or Mariupol and the emergence of the first Sredni Stog burials, which mark the advent of the Eneolithic. In fact, certain prestige objects appear in Neolithic cemeteries before their demise, and flint workshops on the Donets—which become quite relevant during the beginning of prestige exchange in the region—can be traced back to the late Neolithic (Mariupol) industry (Rassamakin 1999).

The expansion of Khvalynsk–Novodanilovka connected Early Eneolithic sites, from the Lower Danube (Suvorovo, Cernavodă I) to the Kuban region, bordering on the pre-Caucasus region (with pre-Maikop Trans-Kuban culture) to the steppe and forest-steppe Volga region of the Khvalynsk culture. The expansion of Suvorovo to the Lower Danube, with its contact with rich local agricultural settlements, sets into motion a long-distance prestige exchange system, and the tradition of rich burial assemblages that expands through cultures of the north-west and north Pontic region (Rassamakin 1999).

The economy of the region included sheep–goat, cattle, and horse bones, and it seems that sedentarism was the rule, with hunting playing a significant part in the diet. Trade in this period was based around copper and copper artefacts, from two main extraction regions: the Middle Danube area and

Thrace. Finds from the steppe up to Khvalynsk show that Novodanilovka was associated not only with the distribution of the first copper artefacts in the steppe, but also with the establishment of an independent metalworking focus in the Black Sea region, which used Thracian–Lower Danubian and Middle Danubian ore, as well as Trypillian, Varna, and Gumelniţa technology (Rassamakin 1999).

The lack of complex copperworking in early Khvalynsk suggests that all the copper finds in the Volga and pre-Caucasus region were imports from the west, and rich copper assemblages in the Dnieper and Donets regions seem to occur at regular intervals or suitable stopping places along the main route (Figure 15), which—together with the flint processing remains—points to north Pontic groups as intermediaries (Rassamakin 1999).

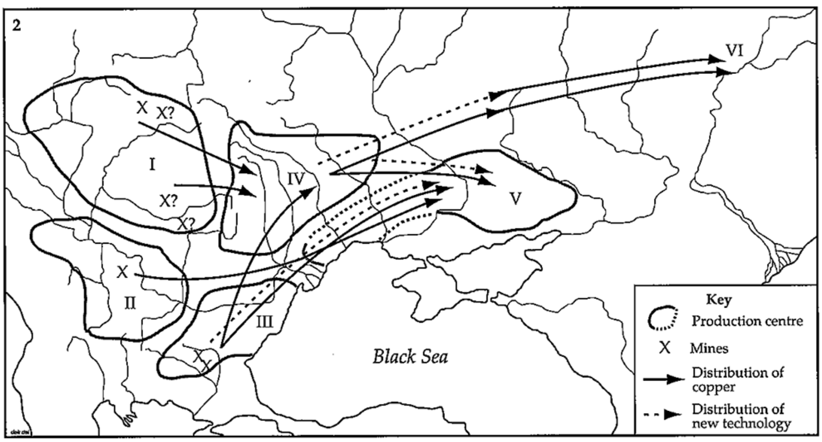

Figure 15. Distribution of copper and new technology in the steppe area from the different production centres (after Ryndina 1993, fig. 1). I-VI are production regions (metalworking centres): I) Tisza – Transylvania; II) Middle Danube; III) Thracian – Lower Danube; IV) Carpathian-Dnieper; V) Northern Pontic; VI) Middle Volga. From Rassamakin (1999).

Metal hoards of the initial Chalcolithic (ca. 4800–4200 BC) coexist with the first great wave of the Alpine jadeites. The Danubian axe and adze hoards phenomenon flourishes in central Europe, covering the area between the Meuse and the Vistula rivers. By 4600/4500 BC, a 'Europe of hoards' extends from Brittany to the Carpathian Mountains, in non-metalworking Neolithic societies. Isolated finds of giant (‘elite’) mounds, the Carnac mounds, built for a single individual, are found in this copperless western Europe at the same time as those in Varna I. A vast distribution network of Alpine axeheads and its corresponding hoard phenomenon in the west is thus comparable to the contemporaneous copper hammer-axe horizon in the initial east European Chalcolithic (Jeunesse 2017).

Late LBK groups, including the Lengyel, Tiszapolgàr and Bodrogkeresztúr cultures, as well as contemporaneous cultures of northern and western France, like the Cerny culture of long barrows (ca. 4800–4300 BC), show some burials with stereotypical grave goods (weapons for men, ornaments for women) which stand out from other burials, showing thus the elite status of certain individuals (usually males), although without much difference with other graves (Jeunesse 2017).

IV.3.2. Early Sredni Stog

The Bug–Dniester culture follows a division being proposed between an aceramic phase dated to ca. 5500–4900 BC and a ceramic phase ca. 4900–4400 BC, with apparent similarities in fabric, form, and decoration of pottery with the parallel developments in the Dnieper–Donets culture. This change marks the transition from Mesolithic hunter-gatherer societies to Neolithic ones, featuring domesticated animals and arable agriculture (wheat and barley, as well as millet, oats, vetch and rye) to differing degrees (Telegin et al. 2015).

The early Sredni Stog culture is characterised by a distinctive incised line and dot decoration, that spans from the Lower Don in the east to the Cucuteni–Trypillia settlements. Similar pottery decoration connected these cultures to earlier north Pontic Neolithic decorative features. Typical assemblages of these sites include typologically distinctive flint and stone artefacts, such as long knife-like blades, triangular flint spears and arrowheads, and flat axe-adzes, as well as distinctive perforated antler artefacts (Rassamakin 1999).

Early Sredni Stog settlements in the north Pontic area include the earliest burials of Stril’cha Skelya, Oleksandriia on the Oskol (a tributary of the

Donets), Aleksandrovsk on the Donets, Igren VIIII, Razdolnoe on the Kalmius, as well as Vasylivka, Deriïvka 2 on the Dnieper, the island of Vinogradny, and Sredni Stog II; possibly some burials of the Lower Don, a border with the eastern region, may have part of the culture, too. Contacts with neighbouring steppe cultures are evident in imported Sredni Stog materials in the Khvalynsk settlement of Kara-Khuduk in the Caspian region, and in pre-Maikop Svobodnoe in the Kuban region (Rassamakin 1999; Manzura 2005).

Chronologically, the culture corresponds to the Cucuteni–Trypillia A3–4 and B1 agricultural settlements (ca. 4800–4000 BC), which show the same type of pottery in terms of technique and decoration, also found in Gumelniţa A2 (ca. 4500–3950 BC). The first copper and gold objects in the north Pontic region are associated with this period. Flint extraction and flint-working loci including mines appear in the Donets zone, the products of which correspond to artefacts from prestige burial assemblages. Oleksandriia was one such flint-processing locus, where a large quantity of both finished projectile tips, axes, long blades, semi-finished products, and also production waste was found (Rassamakin 1999; Manzura 2005).

Early contacts of north Pontic populations with the Hamangia culture from the Dobruja region (ca. 5250–4500 BC) is seen in imports including adornments from copper, cornelian, marine shells and pots in steppe sites, and plates from bone and nacre, pendants from teeth of red deer in Hamangia sites. The Hamangia influence was especially important in the burial rites of the steppe population, and may have caused the use of stone in graves and above them, pits with alcove, and new adornments of burial clothes. The strongest impact is seen to the north of the Sea of Azov in the early Sredni Stog culture, with the adoption of the new religious element potentially connected with the formation of the centre of steppe metal working (Kotova 2016).

IV.3.3. Cucuteni–Trypillia

The Cucuteni–Trypillia agrarian culture sites show complicated rules and networks of social organisation at different levels, which may be reconstructed as follows (Müller et al. 2015):

- the household level shows open communication between neighbours and the whole settlement, linking together neighbouring households but not separating them from others (peaceful neighbourhood principle);
- specialisation between households at an economic level in respect to their integration in processing primary (e.g. cereal) and secondary (e.g. weaving) products, with smaller houses showing more primary activity, and larger houses showing fewer activities of primary subsistence production;
- household clusters of ca. 5 houses link households spatially (house-ring principle), potentially based on generational contracts / lineages;
- the economic and political linkage of households to quarters, represented by mega-structures as the focal point and by supra-household economic specialisations (mega-structure principle);
- the overall settlement, which needs a political institution to direct the spatial planning of the site and combined economic activities (mega-site principle).

During the 5th millennium, a strong, long-lasting, east–west orientated exchange network can be observed in the north Pontic area between the Cucuteni–Trypillian culture in the forest-steppe and north Pontic groups of the coastal steppe, including the site at Deriïvka (Reingruber and Rassamakin 2016). These close interactions were also maintained between the north Pontic and Khvalynsk populations, and it seems to have been driven by an interest in metal objects. In fact, the Khvalynsk centre of metalworking was formed under western influences, among which the Early Trypillian centre dominated (Kotova 2008)

The exchange systems in the north Pontic area during the Eneolithic included intercommunal exchange within likely related ethnolinguistic groups (such as the Sredni Stog internal exchange of natural resources, like flint materials); exchange with the nearest neighbours (such as prestigious exchange between Sredni Stog and the Trypillian, Kyiv–Cherkassy, Donets and Middle Don cultures, as well as northern Caucasus and Crimea); and long distance exchange, made far from friendly villages, probably created under the Khvalynsk–Novodanilovka network (Kotova 2008).

The revolution of herding, travel, and raiding—and thus the change in the steppe—had come with horseback riding, appearing ca. 4800 BC in early Khvalynsk, and spreading south- and eastward with Suvorovo–Novodanilovka elites. They came from the eastern steppe, and they were probably involved in raiding and trading with the north and west Pontic areas during the Trypillian B1 period, before and during the collapse of Old Europe (Anthony 2007).

At the end of this period, the system of interrelationships disappears: there are no late Sredni Stog pottery in Cucuteni–Trypillia; the pottery changes; there is no evidence for the production and distribution of flint artefacts of the old type; and new types of arrow- and spearheads with distinctive notched bases substitute the old projectile points in the region (Rassamakin 1999).

IV.3.4. Forest Zone

The first pottery appeared around the ancient Lake Saimaa basin ca. 5100 BC, followed by the Early Asbestos Ware (EAW) culture ca. 4700 BC, which used asbestos as a tempering material. This culture was the prevailing type of archaeological assemblage for several hundred years, but declined and disappeared around the early 4th millennium BC.

In mixed forest regions of the central Russian lowland plain to the Volga area and the Kama valley, Mesolithic–Neolithic hunter-gatherer groups like Lyalovo (ca. 5000–3650 BC) and Volosovo (ca. 3650–2300 BC) show late pricked and comb–stamped ceramic. The characteristic settlement shows partially sunken earth-houses or dugouts (*poluzemlyanki*), and vessels are simply formed, with a round or pointed base and imprint-decorated outer surfaces. Tools include harpoons made of flint, bone, and horn. Copper objects are rare findings, but bone or stone animal figures are typical and associated with forest fauna, such as bears, fish, beavers, etc. (Parzinger 2013).

In the southern area, near the north Pontic forest zone up to the Don River, this stage of Rudnyaya culture shows continuity in relation to the previous Late Neolithic period, and cultural interaction is observed with the eastern Baltic area and through the Western Dvina (Mazurkevich et al. 2009).

iv.3. Early Uralians

Two individuals of the 5th millennium BC, presumably from early Sredni Stog, show continuity with ancestry similar to the previous samples of the north Pontic area: one from Deriïvka (ca. 4630 BC), and one from Vovnihy (ca. 4430 BC) of hg. I2a1b1a2-CTS10057 (Mathieson et al. 2018). Another sample from Deriïvka (ca. 4870 BC) is a clear outlier, with fully Anatolian farmer-like ancestry—clustering closely with Balkan Neolithic and Chalcolithic samples—but shows haplogroup I2a1b1-M223, and thus probably continuity of the male population.

In the Balkans, Copper Age populations contain significantly more hunter-gatherer-related ancestry, contemporary with the 'resurgence' of hunter-gatherer ancestry in central Europe and Iberia, and consistent with changes in funerary rites ca. 4500 BC to extended supine burial, in contrast to the Early Neolithic tradition of flexed burials. An important population replacement is supported by the presence of mtDNA haplogroups H, HV, W, K, and T in twenty-eight Trypillian samples from the Verteba Cave, contrasting with typical pre-Eneolithic lineages (Wakabayashi et al. 2017). Trypillian samples of the Middle Eneolithic (see *§v.6. Late Uralians*) show mostly Anatolian-related ancestry (ca. 80%) with contribution of hunter-gatherer ancestry (ca. 20%) intermediate between WHG and EHG, consistent with the local population (Mathieson et al. 2018).

Based on the lack of individuals of R1a1a-M198 lineages during the 6th and 5th millennium BC—the most likely Early Uralic speakers—in the sampled populations from the Pontic–Caspian area, and their presence there and among Baltic hunter-gatherers during the Mesolithic, it is possible that communities of this lineage were at this time mainly part of the forest or forest-steppe regions from the Middle and Upper Dnieper basin, and spread to the south ("resurging" in the area) only after the Khvalynsk–Novodanilovka expansion.

This wide distribution of haplogroup R1a1-M459 in the eastern European forests is supported by an individual from Yuzhnyy Oleni Ostrov (ca. 6300 BC), of hg. R1a1-M459, reported as both outside and (tentatively) within the R1a1a-M198 tree (Haak et al. 2015); the individual from Khvalynsk (ca. 4600 BC), of hg. R1a1-M459 (xR1a1a1-M417), probably R1a1b-YP1272, like a later Maykop sample from the Northern Caucasus Piedmont (ca. 3230 BC); an individual from Serteya VIII (ca. 4000 BC), of hg. R1a-M420 (Chekunova et al. 2014); and a sample from Kudruküla, Estonia (ca. 3000 BC), of hg. R1a1b-YP1272 (Saag et al. 2017). Contacts between the Upper Dnieper–Upper Don forest cultures and those of the forest-steppe continued during the Neolithic (Mazurkevich et al. 2009), which justifies their eventual infiltration down the Dnieper during the so-called steppe 'hiatus'.

IV.4. Fertile Crescent

IV.4.1. Anatolia and the Levant

There is no perceptible break in cultural continuity between the beginning and the end of the Anatolian Chalcolithic. However, certain gaps and discontinuities observed in many regions and periods, usually attributed to lack of adequate research, coupled with relevant changes in local cultures, point to a shift of the previous east–west influence to (at least partially) a west–east direction of innovations in certain Anatolian sites (Schoop 2011).

In general, this period of the 6th millennium shows thus the existence of wide communication systems, with continuity of previous traditions but with the introduction of foreign decoration techniques. Shortly before 5500 BC, a number of changes can already be seen in the Fikirtepe groups around the Bosporus (mainly settled on its eastern part), which point to a connection with the Vinča culture in the Southern Balkan region. In the Lake District, 'vinčoid' pottery is observed postdating the Fikirtepe tradition: it belongs to the dark-faced monochrome group, but there is some decoration with motifs in the stab-and-drag technique. Similar material is found in neighbouring regions (Schoop 2011).

During the 5th millennium, in the Middle Chalcolithic, a period of significant cultural development emerges. Near the western coast, Ubaid influence is noticed in urban plans and in pottery typical of the Halaf/Ubaid transitional period. In the Cappadocian margin of the Anatolian Plateau, which showed monochrome pottery decorated with different techniques in the Early Chalcolithic, the site of Gelvery-Güzelyurt shows pottery with swirling designs, executed in a stab-and-drag technique, which represents Balkan influences in the 4th millennium BC (Schoop 2011).

To the north, Late Chalcolithic İkiztepe (ca. 4500–4000) shows striking parallels with early to middle 4th millennium BC assemblages from the southern Balkans. This culture shows increasingly strong typological connections with materials further inland. While pottery traits point to continuity of traditions, notable innovations in shapes and decoration point to a *koiné* that encompasses most of Anatolia, the northern Aegean, and the southern Balkans. This period, since the early 5th millennium BC, coincides with the evidence of the production and consumption of metals, either simple metal artefacts (flat axes, pins, awls) or as crucibles or slag (Schoop 2011).

In south-east Anatolia, the Halafian ‘heartland’ developed since the 6th millennium BC, from its previous small or very small communities to large settlements which represented regional centres in a two- or three-tiered settlement hierarchies, with sedentary farming as the main subsistence economy, although cattle maintained its relevance for this originally semi-nomadic culture based on pastoral herding (Özbal 2011).

Close contacts and interaction between Halaf and Ubaid from Southern Mesopotamia had already been ongoing for a millennium, and possibly a crisis caused by its demographic and geographical expansion led the culture to a different organisation system. From about 4700 BC, though, Ubaid influence is increased in northern Mesopotamia, across a broad east–west arc (Özbal 2011). Southern Mesopotamian communities seem to have moved northwards, given the sudden social and cultural change in certain sites, first in the northern border, then in the Upper Euphrates.

A transformation began which eventually led to the disappearance of the way of life of the Halaf communities: new material culture, with new types of domestic architecture, village arrangements, public buildings, pottery, and other daily life objects; new economy, with less varied and more agriculturally-orientated production system; and a new social structure with sedentary population, a society that ceased to be egalitarian, family and not clan as the basic social unit, and emerging elites. The hybridisation of the two cultures produced innovations that spread in a southern direction, too (Frangipane 2015).

Farther south, the Levant Late Chalcolithic shows burial customs, artefacts and motifs with an origin in earlier Neolithic traditions in Anatolia and northern Mesopotamia. Characteristic of this culture are the secondary burials in ossuaries with iconographic and geometric designs. Artistic expressions have been related to northern regions related to finds, ideas, and later religious concepts, such as the gods Inanna and Dumuzu. The knowledge and resources required to produce metallurgical artefacts in the Levant have also been hypothesised to come from the north (Harney et al. 2018).

IV.4.2. Caucasus and Mesopotamia

The Chalcolithic in the Caucasus begins with foreign contacts from eastern Anatolia and Mesopotamia through the Taurus Mountains, giving rise to a new social and economic network ranging from the south-eastern Caucasus to the Kuban region in the steppe. The Maikop culture is thus the dominant northern Caucasian tradition, known from its extremely wealthy tomb assemblages, and probably born out of an indigenous group with distant economic connections to the south. The pre-Maikop phase appears in sites like Nal'chik and Meshoko in the late 5th and early 4th millennium BC (Sagona 2017).

Characteristic features of the Maikop culture include the adoption of barrow burials, shifting settlements on elevated positions—on foothills overlooking a river valley, but avoiding rugged highlands—with short occupations, abundance of metalwork, and widespread connections with the Near East and Europe. The greatest concentration of settlements occurs in the north-west, around the Kuban River system. The eastern half of the northern Caucasus, judging by the hundreds of Pit-Grave burials, belonged to the steppe cultures. The spread of the Pit-Grave building tradition in pre-Maikop is likely related to the expansion of Khvalynsk settlers into the neighbouring region (see *§IV.2.3. Kurgans*), but the southern burials—including small, mud-brick burial chambers, possibly reflecting an idealised house—have also been linked to central Asian and northern Iranian influence, which would have been added to the exotic imports of turquoise, silver, gold, carnelian, lapis lazuli, and cotton (Sagona 2017).

The southern Caucasus Chalcolithic groups are distinguished from Neolithic cultures by a more flexible lifestyle, reflected in varying modes of occupation (from permanent villages to seasonal camps, from open plains to caves); a capacity to benefit from resources across a wide range of environmental zones, including at higher altitudes; diverse subsistence strategies, incorporating wine-making; external networks, based on a flow of commodities; and advancement of metallurgy (Sagona 2017).

The Chaff-Faced Ware horizon forms part of a tradition that reached from the north Syrian and Mesopotamian plains through the middle part of the Araxes Valley and Azerbaijan to north-western Iran, known in the Fertile Crescent as Amuq F. It is found in the first half of the 4th millennium, with Azerbaijan showing slightly earlier dates. This is a homogeneous culture that reflects standardisation and technological simplification. In the later periods of the culture (as well as in north-west Iran), the influence of the Ubaid tradition of Upper Mesopotamia can be seen in ornamentation (Sagona 2017).

Connections with the Neolithic, evident in the earlier period with circular dwellings furnished with a central hearth, disappear later on (after ca. 4300 BC) as small, multi-roomed rectangular structures appear, with an evolving social structure, heavy exploitation of tree fruits, and more complex wine production industry. Single or multiple pit–graves with barrow burials are the standard, with the deceased in a flexed position with no preference as to side, showing the start of the 'sacrificial' metals in assemblages, possibly to strengthen the kinship-related social status (Sagona 2017).

The Sioni horizon is a local, imprecisely defined culture based on ceramics found in south-eastern Caucasus and on the Iranian side of the middle Araxes Valley, as well as in easternmost Anatolia. Its early phase is dated ca. 4800–4000 BC, and its late stage ca. 4000–3200 BC. Sites are characterised by flat settlements with variable building tradition. It probably emerged as local communities moved away from the alluvial plain into the foothills, as they were able to exploit a wider range of resources and pastures. Pottery has relatively few forms and a limited range of ornamentation, and their lithic technology is difficult to reconstruct (Sagona 2017).

iv.4. Late Middle Easterners

Chalcolithic peoples from Hajji Firuz in north-western Iran (ca. 6000–5700 BC) and from Seh Gabi in eastern Iran (ca. 4800–3800 BC) can be modelled as a mixture of western Iran Neolithic with significant contributions from a CHG-like population (ca. 63%) and the Levant (ca. 20%), becoming thus more 'western', consistent with their shift in the PCA. In Anatolia, the low genetic diversity of early Middle Eastern farmers during the early Neolithic was broken by a wave of 'eastern' ancestry from Iran Chalcolithic (ca. 33%), which eventually reached south-eastern Europe before at least ca. 3800 BC. These migrants brought also J-M304 lineages—typical of Caucasus and eastern Iranian populations—to the late Neolithic central and western Anatolia (Lazaridis et al. 2016; Kilinc et al. 2016).

This 'eastern' ancestry may have been caused by interactions between central Anatolia and the Fertile Crescent in the late Pre-Pottery Neolithic B (Özdoğan 2008), a migration related to other interregional exchanges, or admixture among local populations. The Tepecik-Çiftlik site's presumed role as an obsidian hub, and its cultural links with the Levant, might have started already before the Pottery Neolithic (Kilinc et al. 2016).

Although traditionally associated with an east–west movement of peoples, it could well represent the opposite direction, thus including expanding Anatolian-speaking peoples through northern Anatolia, from the west to the central part. Later samples from Bronze Age south-western Anatolia (ca. 2800–1800 BC) show this 'eastern' contribution of CHG-related ancestry, but lacking steppe-related EHG and WHG ancestry (Lazaridis et al. 2016).

The Chalcolithic population from Areni in modern Armenia (ca. 4350–3500 BC) also shows similar components to neighbouring Anatolian and Iranian Chalcolithic samples, but with a different distribution: Anatolia Neolithic (ca. 52%), Iran Neolithic (ca. 30%) and EHG (c. 18%). This, coupled with the different haplogroup found, L1a1-M27 (formed ca. 15000 BC, TMRCA ca. 6100 BC), points to a different population in the southern Caucasus Piedmont (Lazaridis et al. 2016). The appearance of mtDNA hg. H2a1 and U4a (more typical of the Pontic–Caspian steppes) among these samples, as well as their position closer to steppe populations, speaks in favour of female exogamy.

Before the emergence of the classical Maikop culture, the three sampled Caucasus Eneolithic individuals of Darkveti-Meshoko from Unakozovskaya, in the north-west Caucasus Piedmont (ca. 4600–4300 BC), present a genetic profile similar to Iranian Chalcolithic samples, with predominant haplogroup J2a-M410, possibly both J2a1a1a2b2a3b1a-Y11200 (formed ca. 5900 BC, TMRCA ca. 5800 BC). This increased assimilation of Chalcolithic individuals from Iran, Anatolia, and Armenia is in accordance with the Neolithisation of the Caucasus, which started in the floodplains of the great rivers of the southern Caucasus in the 6th millennium BC, from where it spread to the western and north-western Caucasus during the 5th millennium BC (Wang et al. 2019).

Haplogroup J2a2-L581^{+}(formed ca. 14100 BC, TMRCA 13100) also appears in one sample from Seh Gabi (ca. 4700 BC), and hg. J2b-M12 in two samples from Hajji Firuz (ca. 6050–5850 BC), with hg. G2a1a-Z6553 (ca. 5750) and G1a1b-GG313^{+} (ca. 3900 BC) in Seh Gabi pointing to a mixture of these haplogroups since the sampled Iran Neolithic individuals, compatible with a migration wave of J2a2-L581 lineages connecting the northern and southern Caucasus regions ca. 5500–4500 BC (Wang et al. 2019). This haplogroup is also found later in Anatolian Bronze Age samples and in Old Hittites.

Samples of the Late Chalcolithic in the southern Levant, from the Peqi’in Cave (ca. 4500–3900 BC), attributed to the Ghassulian period (Figure 16), can be modelled as deriving ancestry from local Levant Neolithic peoples (ca. 57%), Iran Chalcolithic (ca. 26%), and Anatolian Neolithic (ca. 26%), suggesting the spread of Iranian agriculturalists into the Levant. They overlap in the PCA with a cluster containing Neolithic Levantine samples, shifted slightly toward Levant Bronze Age samples. Their prevalent Y-DNA haplogroup, probably in twelve of thirteen samples reported, is T1a1a1b2-CTS2214 (formed ca. 6700 BC, TMRCA ca. 6700 BC), with only one sample of E1b1b1b2-Z830 subclade, also suggesting an important population replacement in the region.

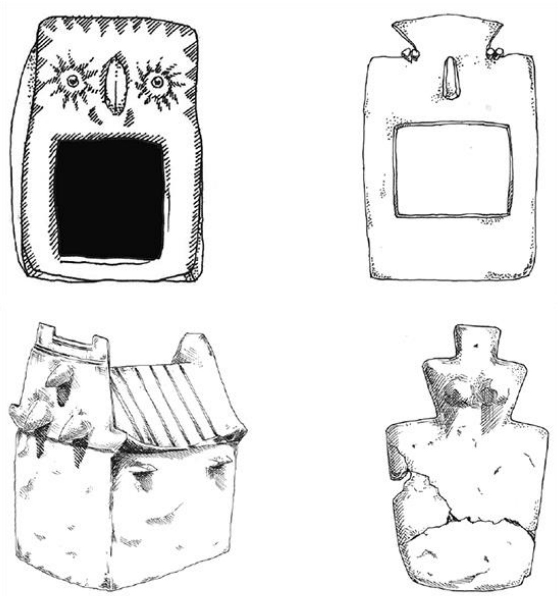

Figure 16. Ossuaries from the Peqi'in Cave. Image modified from Jaruf (2017), using figures adapted from Yannai and Porath 2011, and Gal et al. 2011.

IV.5. Africa

Towards the end of the African Humid Period there were some dry peaks due to fluctuations in rainfall and increasing dryness, with serious impacts on human settlements. Demographic modelling suggests a relative human population maximum in the central and western Sahara near the end of the AHP (between 4700–4300 BC), followed by a population collapse coinciding with the end of the AHP. This crisis is coincident with the emergence of the Ashakar-Skhirat ware along the Moroccan north-Atlantic coast, and also with the abrupt decrease of humidity and rainfall leading to sudden changes in vegetation, particularly the Gineo-Congolian taxa, in the western Sahara ca. 4500 BC (Martínez Sánchez et al. 2018).

The appearance of Ashakar-Skhirat ware parallels the expansion of cattle pastoralism in the Sahara Desert, which has been interpreted as an adaptive mechanism against the arid conditions after the end of the AHP. Pastoralism required frequent relocations in search of fresh wild grasses for livestock, resulting in the spread of this ceramic technology throughout central and northern Sahara during the late 6^{th} and 5^{th} millennium BC. Similar types of distribution have been linked to southward and westward dispersal of pastoral groups from the Sahara (Martínez Sánchez et al. 2018).

Megalithic stone monuments with different architectural features and various ceremonial purposes, which possess characteristics of social relevance and temporality as to be considered ‘places to be remembered’, also appear and diffuse at the end of the AHP (6^{th}-5^{th} millennium BC) and spread afterwards (di Lernia 2013). After ca. 4500 BC, herding spread south and east, and pastoralists built megalithic structures at Wadi Khashab in the Red Sea Hills, and established large cemeteries at Kadreo, Kadruka, and R12 in the Nile Valley. Elaborate mortuary traditions continued for more than a thousand years at sites like Jebel Moya, as agricultural lifeways and early states developed.

iv.5. Late Afrasians

Before 5500 BC, population curves for the eastern Sahara, the Atlas & Hoggar, and central Sahara follow broadly synchronous variation. After the population decline period ca. 5500–4500 BC, there are divergent responses: the eastern Sahara, extremely arid today, underwent a rapid population decline, with occupation shifted towards the Nile Valley, probably giving rise to the Hamito-Semitic isolation. The finding of hg. R1b1b2a2a-V1589/Y7771 and subclade R1b1b2a2a1-V69 in modern populations of the Arabian Peninsula may indicate its wide distribution in eastern Africa, just before the Semitic and Hamitic expansions.

To the north and west, the Atlas & Hoggar mountain region declined equally rapidly, possibly isolating the pre-Berber-speaking population (Brierley, Manning, and Maslin 2018). An important population replacement happened in north-west Africa between the Early Neolithic and Late Neolithic samples from Kelif el Boroud (ca. 3700 BC), with ancestry shifting (up to 50%) from Iberomaurusian to European Early Neolithic. Reported mtDNA haplogroups include K1, T2, and X2, proper of Anatolian and European Neolithic populations; and Y-DNA T-M184, observed in European Neolithic individuals. This is probably related to contacts between both sides of the Gibraltar strait at this time, before the Bell Beaker expansion (Fregel et al. 2018).

Central Sahara, on the other hand, had a much more gradual decline in population, attesting flexible and adaptive strategies that co-evolved with the drying environment, living in balance with the available pasture (Brierley, Manning, and Maslin 2018). The persistence and expansion of haplogroup R1b1b-V88 in this region dominated by modern Chadic speakers is thus most likely the result of less population pressure and continued expansion of Pre-Chadic peoples, contrasting with the harsh environment, faster life history, and haplogroup replacement experienced to the north and east.

Two Neolithic individuals from Takarkori in the central Green Sahara (radiocarbon-dated to the early 5th and mid–5th millennium BC, respectively) show a basal mtDNA haplogroup N that branched off immediately after the Palaeolithic sample Oase 1, and before all present-day N-derived mtDNAs. This finding could be explained as from a local subclade that branched off just after the differentiation from L3 within Africa, or as a back-migration after its expansion out of Africa (Vai et al. 2019).

V. Middle and Late Æneolithic

V.1. Africa and the Levant

At the end of the AHP, with increasingly arid conditions, mountain ranges like Tibesti, Tassili-n-Ajjer, and Ahaggar—forming a major topographic feature spanning more than 2,500 km. from southern Argelia to northern Chad—acted as important water towers in contrast to the surrounding plains, providing populations settled on the windward side with more persistent rain runoff. Because of that, some of the earliest direct evidence for the exploitation of domestic livestock, use of milk products, and the construction of cattle tumuli come from the heart of the central Sahara (Brierley, Manning, and Maslin 2018).

The emergence of rock art depicting livestock scenes and stone monuments with associated domestic animal remains in the middle Holocene attest to a highly formalised expression of a wider Saharan "cattle cult", with isotopic analysis of animal bones from the region demonstrating seasonal transhumance similar to strategies followed by modern traditional pastoralists (Brierley, Manning, and Maslin 2018).

In the Levant, discontinuity in archaeology with the previous period is marked by dramatic changes in settlement patterns, large-scale abandonment of sites, many fewer items with symbolic meaning, and shifts in burial practices, such as secondary burial in ossuaries, which disappear completely. This supports the view of profound cultural upheaval leading to the extinction of whole populations, associated with the collapse of the Chalcolithic culture in the region.

v.1. Early Semites

Population replacement is supported in genetics by the genetic discontinuity between the Chalcolithic and the Early Bronze Age period (Harney et al. 2018). Proto-Semites, who probably lived at the beginning of the 4th millennium still on the savannahs of the then still pale-green Sahara, migrated north after ca. 3900 BC, once the region reverted back to a desert climate (Lipiński 2001). Whether they migrated through the horn of Africa to Arabia or through the Nile to the Sinai before reaching the Levant is unclear, although the apparently closer relationship of Proto-Semitic to Proto-Berber, and the appearance of Semitic languages quite early in both the Syrian desert and the Levant, seem to support its initial diffusion through east Africa rather than Arabia.

The presence of haplogroup J1a2a1a2d2-Z1865 (formed ca. 5500 BC, TMRCA ca. 5200 BC) and its subclade J1a2a1a2d2b-Z1853 (TMRCA ca. 4900 BC) in modern south Arabian populations suggests an expansion of this subclade potentially from southern or northern Arabia in ancient times. Subclade J1a2a1a2d2b2-Z2331 (TMRCA ca. 3800 BC) is associated with modern Semitic populations widely distributed through the Middle East, with its oldest subclade J1a2a1a2d2b2a-Y15152 (TMRCA ca. 3800 BC) present today in modern Jewish populations. The presence of J1a2a1a2d2b2-Z2331 subclades later in Canaanites from Sidon (ca. 1750 BC) and in Levant BA from ‘Ain Ghazal (ca. 2100 BC) further supports the connection of this haplogroup with the expansion of Proto-Semitic.

The presence of haplogroup J1a2a1a2d2b2b2c-Z2329 (formed ca. 3600 BC, TMRCA ca. 3600 BC) in a Pre-Ptolemaic Egyptian individual (ca. 670

BC) (Schuenemann et al. 2017) suggests the widespread distribution of this haplogroup J1a2a-L620/Z2356 (formed ca. 16000 BC, TMRCA ca. 12700 BC) along the Levant, from the north to the Sinai Peninsula and beyond, as evidenced by its widespread presence in modern Arabic tribes.

The arrival of Proto-Semitic migrants might have caused the collapse of the related cultures Amratian (Naqada I, in Egypt) and Ghassulian (in the Levant) ca. 3500–3350 BC, both in turn possibly related to Minoans. The expansion of Semites from the Levant may have in turn caused the first split into a western and an eastern dialect, and the further expansion of the latter to the north and east across the Syrian steppes, into south-east Anatolia and southern Mesopotamia.

In northern Arabia, crop cultivation and other features traditionally used to define the Neolithic do not seem to have been practised until the arrival of the Bronze Age (ca. 3000–1200 BC), a situation that contrasts strongly with the Fertile Crescent, where sedentary communities were present since the Epipalaeolithic (Scerri et al. 2018). This significant cultural change also suggests a potential demic diffusion to the region.

V.2. The Caucasus

V.2.1. Chaff tempered ceramics

In the late 6th millennium BC, eastern Anatolia, the Upper Euphrates Valley, Syria, and northern Mesopotamia were involved in a system of interactions. It seems that this network of expanding influence in a south–north axis is repeated in the final phases of the Ubaid period, during the Chalcolithic, from ca. 4500 BC onward, in a process of transformation of the role, function, and meaning of the ceramics, with extreme simplification of decoration and formal standardisation (Sagona 2017).

The diffusion of chaff tempered ceramics in eastern Anatolia and the Caucasus has been thus linked by researchers to the presence (ca. 4250–3500 BC) of northern Mesopotamian groups involved in such economic activities as pastoralism and commerce (trade in metal ores or raw materials). The presence of “indigenous” sites distinguished by their continuation of local pottery suggests a complex system of complementary interactions between groups of differing origins and different cultures (Mesopotamian and Transcaucasian) that occupied different areas depending on their different economic activities (Sagona 2017).

The adoption of funerary customs such as elite tombs built with mudbricks but under funerary tumuli (from the north Caucasian tradition), and the presence of fortifications in the area, strengthen the increased Syro-Mesopotamian influence overlapping the cultural substratum of Late Chalcolithic communities of the Caucasus. The emergence of a regional centres and a stratified society with elite groups in northern Mesopotamian communities probably triggered the structural and organisational changes in the South Caucasian—and eventually eastern Anatolian—communities, to adapt themselves to the growing demand from the south. They show an increasing territorial mobility, pastoral specialisation, and the capacity to exploit ecologically different resources. Some findings point to the formation of small local elites imitating the Mesopotamian structure (Sagona 2017).

Before ca. 3500 BC, scarce Pre-Kura–Araxes settlements are found in northern areas. The culture shows little continuity with previous Chalcolithic cultures, and the Red-Black Burnished Ware displayed by the culture shows technological and cultural links to certain settlements of eastern Anatolia and the Upper Euphrates. The synchronous appearance of these sites suggests a common network of information, trade, and culture. On the other hand, the strong typological, functional, and ornamental similarities with the southern Caucasus suggests a connection with the southern Caucasian domestic model (Sagona 2017).

V.2.2. Maikop

The turn of the 4th millennium BC saw the development of various cultural traditions in south-east Anatolia, north-east Syria and north-west Iran; on the northern fringe, these traditions manifested themselves in the Maikop culture. In fact, the first high-status burials containing gold and gemstone jewellery (including carnelian, turquoise and lapis lazuli) appeared in the northern, rather than southern, centres ca. 4000–3750 BC. With regard to funeral rites and stylistic characteristics of jewellery pieces, these graves have many parallels with early Maikop burials (Sagona 2017).

Few settlements are known from the classical Maikop stage (ca. 3800–3000 BC), with few fortified central places and a majority of open areas composed by groups of small and ephemeral villages of ca. 1–2 ha, with house plans of varied shapes, not articulated through foundations or postholes. Hearths played an important role. Subsistence economy was most likely based on cattle breeding, probably including transhumance, as well as on other animal husbandry (mainly pigs) and probably agricultural means (Sagona 2017).

In the classic phase, Maikop circular pit–grave burials became larger, and showed symbolic features like a flat top (probably a cultic platform), had a stone gridle delineating its circumference, and a trend to seal smaller barrows under a ‘roof’, so as to create a cemetery-like structure (Figure 17). Red ochre was ceremonially sprinkeled on the deceased, placed in a flexed position on their right side, head pointing south (Sagona 2017).

Most Maikop burial assemblages and constructions do not share the magnificence of the wealthy barrows, and are simple, rectangular earthen pits beneath a shallow tumulus, although they share the same principles. Despite the abundant metalwork, there is little evidence of extractive mining or metallurgical craftsmanship. The society appears divided thus sharply in two levels, with few individuals being regarded as the ‘chieftains’ and buried with luxurious assemblages. They were probably a sign of the emergent elite ideology in the Caucasus, absent in the southern territories, as well as monuments affirming territoriality (due to their visibility) and veneration of ancestors (Sagona 2017).

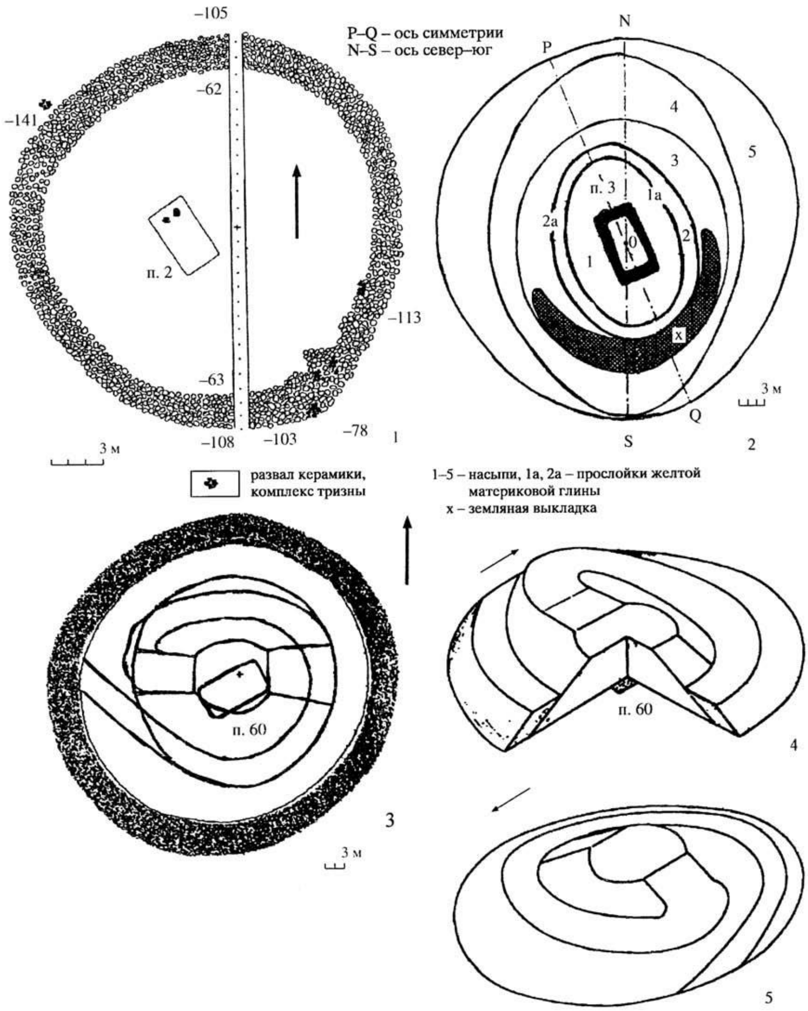

Figure 17. Kurgans of the Maikop type. 1 – kurgan II of the Sunzhenski cemetery; 2 – kurgan III of Brut, 3; 3 – Zamankul (plan and reconstruction of the mound). Modified from Korenevskiy (2012).

Four types of tomb chamber are distinguished (Sagona 2017):

- A rectangular, earthen pit with rounded corners, edged around the base with stones, and with a roof of timber logs.
- Rectangular or circular burial on the ground surface made of wooden planks or field-stones.

- Rectangular, one- or two-chambered tombs, built above ground with slabs of stone, with access through a porthole entrance. Ornamentation is rare. This type is typical of the megalithic tradition.
- Stone cist tombs built with slabs set into a pit (identical to the previous), with access through the roof.

In its late phase, Maikop metalwork diversified, with metalsmiths working gold, silver, and copper. The source of copper-nickel-based objects seem to lie in metal ores to the south of the Caucasus, while arsenical-copper objects—concentrated in the Kuban region—probably had a local origin. Typical Maikop pottery shows a limited range that emphasises rounded and simple profiles, like globular pots and jars, and hemispherical bowls and cups (Sagona 2017).

The Uruk expansion in Mesopotamia after about 3700 BC intensified during the late Uruk period (ca. 3350–3100 BC), and its expansion reached toward the gold, silver, and copper sources in the Caucasus Mountains. The Maikop culture of rich chieftains' graves with Mesopotamian ornaments probably developed from this trade network in the North Caucasus Piedmont. A western and probably also a later eastern southern trade routes have been proposed, through the shores of the Black and Caspian seas respectively (Anthony 2007).

Connections with the Near East are evident in the occasional cylindrical seals (Rollsiegel) in Maikop assemblages. It seems that a distinctive technique of making thin-walled jointless beads from gold was a regional technological development of Maikop culture goldsmiths. This was deeply rooted in the Near Eastern tradition of ritualisation of the production and use of jewellery pieces made of gold, silver and gemstones. The jewellery traditions of the Maikop culture had no successors in the Caucasus or the adjacent steppes. In the third millennium BC, the goldsmiths of Europe and Asia had to reinvent the technique of making thin-walled jointless gold beads from scratch (Trifonov et al. 2018).

To the north, the existence of steppe–Caucasian trade is supported by Maikop imports found in the north Pontic steppe from the Dniester to the Lower Volga in the east, but no Caucasian imports have been found in the Volga–Ural region. Late Maikop peoples, most likely speaking languages ancestral to modern Caucasian languages, probably interacted with individuals from Repin and late Khvalynsk cultures, and the contact was most direct on the lower Don. Late Maikop graves incorporated carved stone stelae like those of western Yamna. The trading of drugs, wool, and horses has been proposed as main steppe imports into Maikop (Anthony 2007).

v.2. Early Caucasians

The two Maikop samples from this period in the Northern Caucasus Piedmont show largely continuity with Caucasus Eneolithic samples, but with a clear additional contribution of Anatolian Neolithic-related (possibly AME) ancestry (ca. 15%) compared to them. Five Maikop outlier samples from the steppe (ca. 3600–3100 BC) represent a likely expansion of Maikop peoples to the area and their admixture with the previous Khvalynsk and local settlers, suggesting their acculturation in the region, evidenced by their admixture closest to ANE.

In terms of haplogroups, one sample from Baksanenok (ca. 3350 BC) is reported as within the K-M9 trunk, possibly L-M20. The acculturation of the North Caucasus region may also be inferred from haplogroups of outliers, which show one Q1b2b1b2-L933^{+} (formed ca. 13600 BC, TMRCA ca. 6600 BC) and another R1a1b-YP1272^{+}, in contrast to previous Eneolithic (J-M304) and later (L-M20) haplogroups (Wang et al. 2019). Both individuals were buried in the same kurgan in Sharakhalsun and with similar radiocarbon dates (ca. 3350-3105 BC), and a later individual attributed to the Yamna culture in the same site (ca. 2780 BC) also shows a typical Indo-Anatolian lineage R1b1a2-V1636. Another outlier shows hg. T1-L206.

Horse trade, including wheels, carts, and the possibility of a quicker transport of metals into Uruk, is proof of an indirect contact between steppe herders and Mesopotamia. The need of exported domesticated horses to be accompanied by experienced breeders and riders from the lower Don offers a solid framework to support the hypothesis of the presence of Late-Indo-European-speaking peoples in Mesopotamia, and thus allow for Indo-European borrowings in Sumerian (Sahala 2009-2013).

Nevertheless, the scarcity of proofs for wooden vehicles in the region before the first attested one in Sharakhalsun, as well as bioarchaeological investigations of common representations which point to an emphasis on cattle as driving force—instead of highlighting the means of transportation, as in the Yamna culture—seriously challenge the hypothesis of large-scale mobility in the piedmont and the Caucasus (Reinhold et al. 2017). The condition of Pre-North-West Indo-European (likely spoken by the late Repin culture expanding westward) as an Euphratic superstratum of Sumerian (Whittaker 2008, 2012) would require a more detailed explanation of internal and external cultural influence, and reasons for potential language replacement and expansion in Mesopotamia.

V.3. Anatolia

In the Late Chalcolithic (ca. 4250–3000 BC), the western cultural koiné characteristic of the previous period continues, at least in south-west Anatolia and along the southern and middle Aegean coast. Further to the east, cultural developments show a different trend, with influence from the Late Uruk pottery reaching ca. 3500 BC eastern Anatolian regions, including the Plateau. This influence coincides with the start of Transcaucasian contacts, too. Regional fragmentation is the rule, and the Black Sea coast shows no eastern influence. On the contrary, ring-shaped figurines—flat objects of stylised female shape made of silver, lead, or gold—connect the Plateau to the southern Balkans, which is seen as evidence of close contacts with the west Pontic area, particulary Bulgaria (Palumbi 2011)..

In Syrian and northern Mesopotamian regions, south-eastern Anatolia, and the Upper Euphrates, the period ca. 3500–3000 BC was associated thus with the formation of large and important regional centres, a general reorganisation of the craft production – with growing specialisation –, and the emergence of stratified societies and elite groups. Late Chalcolithic architecture evolves into settlements of huge dimension. Increasing social and economic complexity lead gradually into the Early Bronze Age (EBA), although nothing suggests the emergence in the area of proto-urban structures typical of the Upper Euphrates or northern Syria (Palumbi 2011).

The Ubaid or Uruk expansion is supposed to have affected wide regions in the Middle East, although the precise regional mechanisms are still unknown. For example, whereas the Upper Euphrates shows indigenous social complexity, the Upper Tigris Valley shows a resistance to foreign influence. South-eastern Anatolian and northern Mesopotamian populations interacted ca. 3500–3000 BC with settlements in the Upper Euphrates, Upper Tigris, and beyond in their quest to obtain raw materials. Uruk colonists seem to have expanded to the north. Although it had been presumed that early state systems were restricted to the southern Mesopotamian alluvium or Uruk-influenced sites to the north, different sites show that indigenous societies which whom Urukians interacted had independently evolved into complex administrative centres in south-eastern Anatolia, like Hamoukar, Tell Brak, or Arslantepe (Palumbi 2011).

V.3.1. Arslantepe

Two periods reveal the centrality of the Arslantepe site, located in the Malatya plain, as a place of cultural boundary in the network of interregional relations of the Middle East. The first is the Late Chalcolithic period, over the entire 4th millennium BC, when a very early hierarchical and politically centralised society developed on the site; and the second period refers to the 2nd and early 1st millennium BC, when Arslantepe was affected by the eastward expansion of the Hittite state (Frangipane, Manuelli, and Vignola 2017).

During the first half of the 4th millennium, Arslantepe had already developed a political system in which the elites had gained some control over staples, and developed well-established circuits for the centralisation and redistribution of foodstuffs, carried out in public ceremonial areas. The material culture of the site was local, although it seems to have been a powerful regional centre, whose leaders interacted with their Mesopotamian neighbours. The elites had their residence separated from the common houses, on top of a mound, close to temples, which indicates their social importance and the symbolic emphasis on their prestige and growing power. Their role as central authority included control over food and its redistribution in ceremonies and feasts (Frangipane, Manuelli, and Vignola 2017).

Around 3500–3400 BC, the main temples were abruptly abandoned, and a radical change occurred in the power system, which led to an extraordinary development of the Arslantepe society towards a stronger and more centralised structure. A monumental, imposing, tall building with very thick walls—although much smaller than the previous buildings—was built, without any cultic or religious features. This building and the courtyard, whose entrance was decorated with stamped lozenge motifs and wall paintings, constituted the core of the new public area. There seems to have been a throne room opened towards the courtyard, a place for audience, and also a private section for authorised persons (Frangipane, Manuelli, and Vignola 2017).

The public area may have been conceived for the leader to address the public and held audiences in a ceremonial environment, now without any cultic or religious connotations. On a corner, a temple with a floor plan identical to the audience building shows that cultic and religious rites were of restricted access, probably for people of high status. Authority was thus excercised without any religious mediation, and elites preserved the religious authority, detaching themselves still more from the rest of the population. Economic and administrative rooms were added, evidenced by intensive sealing and sophisticated accounting system. Interesting are certain scenes, like those of bulls pulling a cart or plough driven by a coachman (depicting a ploughing scene), and a transport of an eminent person on a threshing sledge car found on a cylinder seal (Frangipane, Manuelli, and Vignola 2017).

v.3. Early Anatolians

Anatolian has long been considered the first language to branch off of the Proto-Indo-European trunk, due to its peculiar archaisms (Trager and Smith 1950), even before the proposal of a Late Indo-European community from which all other known Indo-European languages branched out (Meid 1975; Kortlandt 1990; Lehmann 1992; Dunkel 1997; Melchert 1998; Adrados 1998; Ringe 2006; Mallory and Adams 2007; Beekes 2011). Based on the known Khvalynsk migrations of the previous period, and on the presence of a prehistoric geographic and genetic barrier in the Caucasus Mountains (Wang et al. 2019), the most likely route of expansion of Proto-Anatolians lies in the Balkans (Anthony 2007), which is supported by the presence of Balkan outliers with Steppe ancestry (see *§iv.2. Indo-Anatolians*).

The main question has turned thus to the when and how of the migration into Anatolia of Proto-Anatolian speakers. One important cue, based on its relevance for Suvorovo–Novodanilovka chieftains (see *§IV.2.2. Horses*), is horse domestication: it is found at Çadir in north-central Anatolia already in the early 4th millennium BC, continuing into the 3rd millennium (Arbuckle 2009), representing thus the earliest evidence of its presence in Anatolia, comfortably earlier than Late Chalcolithic remains of eastern Anatolia or the earliest representations of a wheeled vehicle by Sumerians ca. 3100 BC, probably pulled along by oxen (Sagona 2011).

Similarities between the Varna culture (lasting until ca. 4200 BC) and that of İkiztepe on the central coastal region of the Black Sea strongly imply close ties between the eastern Balkans and central Anatolia (see *§IV.4.1. Anatolia and the Levant*), with this population having been proposed as cultural predecessors of the Hittites (Bilgi 2001, 2005) based on its connection with Balkan Early Eneolithic pit grave cultures, including extended, supine inhumations with the use of ochre, as well as the use of ring-shaped idols

(Zimmermann 2007), and also craniometric features proper of south-eastern Europeans (Welton 2010). The lack of similar remains in western Anatolia may suggest an ancient maritime connection to continental Europe through the coasts of the Black Sea rather than by way of a land route (Özdoğan 2011). This is compatible with the Anatolian Chalcolithic sample of Barcõn, Marmara Region, north-west Anatolia (ca. 3800 BC) showing "eastern" contribution (see *§iv.4. Late Middle Easterners*), but no Steppe ancestry (Lazaridis et al. 2016).

The lack of relevant cultural or genetic connections in north-west Anatolia may also suggest the infiltration of small groups of Proto-Anatolian speakers who have not left much traces in other intermediate Balkan regions, either. In any case, the Sea of Marmara had become a true cultural barrier during the Chalcolithic, separating south-eastern Europe from Anatolia, as evidenced by the split of the "Balkano-Anatolian Culture Complex" by the turn of the 5th to the 4th millennium BC, at the end of the Vinça Period (Özdoğan 2011).

Based on the likely presence of Anatolian speakers ca. 2500 BC in south-eastern Anatolia, it is tempting to locate the arrival of pioneer Proto-Anatolian speakers in İkiztepe, north-central Anatolia, via the south-eastern Balkans—whether by land or sea—and their expansion southward into central Anatolia with the sociopolitical change at Arslantepe ca. 3500–3400 BC. The lack of genetic traces from the steppe on south-western and central Bronze Age samples (see *§vii.4. Aegeans and Anatolians* and *§viii.13. Assyrians and Hittites*) may suggest a low genetic impact of the Anatolian migration, or the replacement of this early population with eastern migrants, or both. Among the investigated eighteen ancient individuals from the Late Chalcolithic to the Early Bronze Age in Arslantepe, there is no evidence of a major genetic shift, although there is high heterogeneity compared to other Anatolians, and more Iran Neolithic-related ancestry (Skourtanioti et al. 2018).

V.4. Steppe package

V.4.1. Kurgan cultures

After the expansion of Suvorovo–Novodanilovka chieftains through south-eastern Europe, and the use of kurgan burials by Cernavodă I and related groups (first half of 4th millennium), there is a process of coexistence and acculturation in the north-west and west Pontic areas at the end of the Eneolithic, ca. 3600–2900 BC, where the first burial mounds indicate a lack of standardisation (Figure 18). This process is simultaneous with the evolution of Late Copper Age communities north of the Black Sea, such as Lower Mikhailovka, Trypillia C (including Usatovo), Late Kvityana, Late Deriïvka, Late Sredni Stog, post-Mariupol, and eastern cultures like Repin, Maikop, etc (Frînculeasa, Preda, and Heyd 2015).

In these late Eneolithic 'kurgan cultures', primary graves consisted usually of small mounds (only later became enlarged), were orientated to various directions, and individuals lied in a contracted position to the side or (continuing earlier periods) in an extended position. Grave pits were more oval than rectangular, and ochre was sparsely used (if at all). Both males and females were buried, and only rarely had they assemblages. The most prominent burials with inventories are those of Trypillia C2, Horodiștea–Foltești and particularly Baden–Coţofeni (later evolving into Usatovo) at the Lower Danube. These are mostly local developments, although there might have been some infiltration of local steppe peoples from the Lower Mikhailovka and Kvityana into the Lower Danube (Frînculeasa, Preda, and Heyd 2015).

Unlike Marija Gimbutas' claim of succeeding 'kurgan population waves' into south-eastern Europe, the Eneolithic period shows merely a long-term, low-level population interaction between similar steppe environments north and west of the Black Sea, continuing some of the cultural patterns left by Suvorovo–Novodanilovka chiefs ca. 4600–4000 BC, representing therefore local populations integrating 'eastern' burial customs in their own rituals

(Frînculeasa, Preda, and Heyd 2015). Which of these populations might have been direct cultural heirs of the Suvorovo migrants, and which showed mere remains of their earlier influence, is unclear.

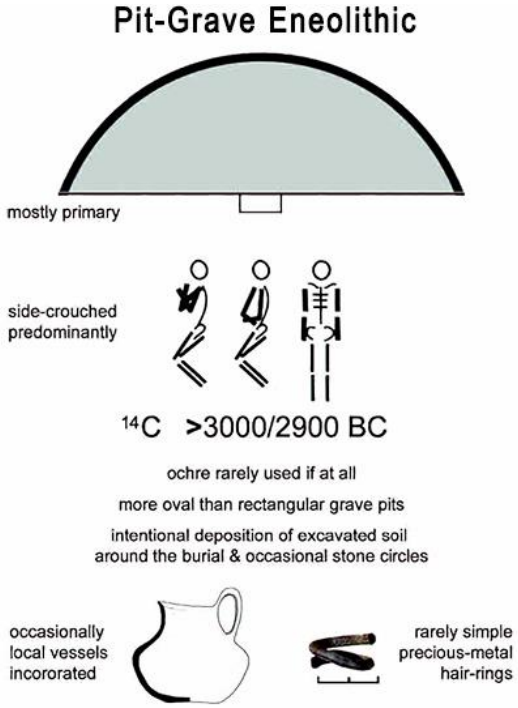

Figure 18. Burial schemes of pit graves found in the Lower Danube region during the Eneolithic. Modified from Frînculeasa, Preda, and Heyd (2015).

Precisely in these steppe areas north-west and west of the Black Sea are few pit–grave kurgans found ca. 3700–3000 BC, of variable shape and rituals, from the Prut–Siret–Plain to the south-west Balkans, including Horodiștea II, Gordinești-Cernavodă II, Foltești, Horodiștea-Foltești, and to the south into the Dobruja and the Eastern Thracian Plain in Cernavodă III and Ezero A1. Such simple, ‘steppe-related graves’ are also to be found to the west in cultures like Boleráz and Baden in the Carpathian Basin (Frînculeasa, Preda, and Heyd 2015).

There are thus similar cultural findings all over Europe since the mid–4th millennium, unifying regions that were previously separated in material culture, as well as in social, economic and ritual aspects: so the predecessor of the Baden complex, Cernavodă III–Boleráz, spread from the Lower Danube to the Bodensee in the northern Alps (beginning ca. 3700/3600 BC); and later, ca. 3350–2700 BC, the Globular Amphorae in north and north-east Carpathian Basin and central Europe, and the Baden culture from the Carpathian Basin to the Northern Alps. Included among these related cultures and ceramic groups are those of the whole Balkan Peninsula and Lower Danube, almost reaching north-west Anatolia; and also the Corded Ware culture (Single Grave and Battle Axe culture, and neighbouring East European groups in the first half up to the mid–3rd millennium BC), eventually connecting the Volga with the Rhein and Scandinavia (Frînculeasa, Preda, and Heyd 2015).

All these cultures are connected through a unifying pottery, fine ceramic—often drinking and eating ware—with identic shape (round to tappered bottom) and emblematic cord decoration (with mixed forms like the Cucuteni C-Ware), apart from prestige objects (viz. triangular silex spearhead and the European dagger idea), and symbolic aim and key elements of burial rituals (like individual graves, gender roles, and social attributes). Regional and cultural differences lie in technique/technology, specific subsistence economy, settlement patterns, and social organisation. It seems that these cultures were therefore united in certain essential social, spiritual, and religious aspects (Frînculeasa, Preda, and Heyd 2015).

Apart from this, it is also apparent that the expansion of Suvorovo chiefs must have set in motion the start of the “Secondary Products Revolution”, which becomes full-fledged in eastern Europe ca. 3600 BC, and includes traction, dairy farming, horse riding, and wool production (Figure 19). This revolution brought about changes in economic and social complexity, population growth, density pressure, expansion to secondary environments, deforestation and increasing pasture, and easier transport, greater mobility, regional specification or territorial competition. The new emphasis is thus on cattle, with a marked rise in its numbers, and a diminishing number of pigs (with a later, gradually rising number of goats and sheep), and it eventually affects all aspects of life, including social and spiritual beliefs (Sherratt 1981).

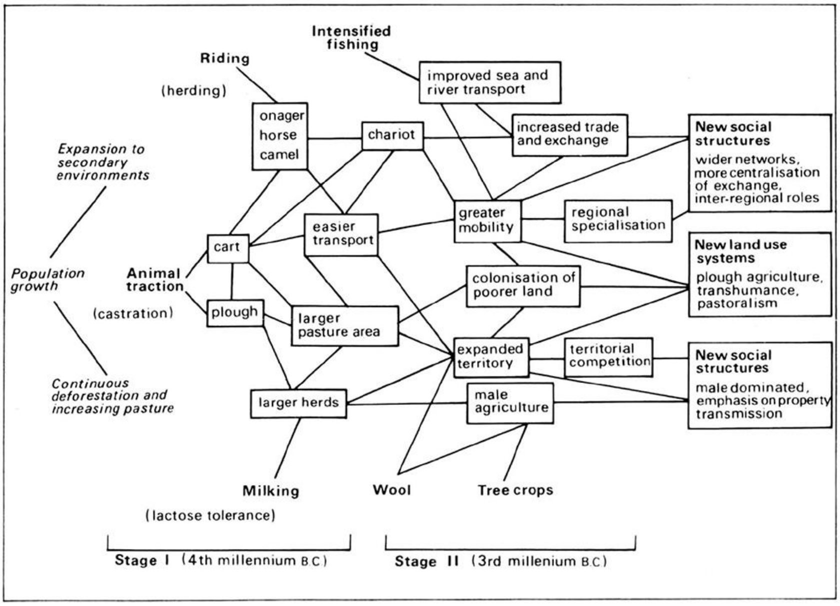

Figure 19. Original graph of the 'Interaction of the components of the secondary products complex through time', by Andrew (Sherratt 1981).

V.4.2. Corded ware

Corded ware refers to corded decoration of pottery assemblages, made with a cord, which has been proposed to be originally derived from twined hemp (the rope of which is used to control herds), hence related to cattle-herding cultures; or from wool cords, hence related to sheep and wool processing. Whichever the case, its spread over a great part of central Europe was mediated by the Globular Amphorae culture, which popularised the drinking vessels and their corded ornamentation (Bulatović 2014).

In the first horizon of Corded Ware culture, a cord is twisted, or wrapped around a stick, and then pressed directly onto the fresh surface of a vessel leaving a characteristic decoration (*Wickelschnur*). This technique appears as a non-native trait in the Early Eneolithic Bubanj–Salcuţa–Krivodol cultural complex, with no correlation in autochthonous Neolithic traditions, possibly from influence of the Suvorovo–Novodanilovka and north-west Pontic cultures, at the end of the 5th millennium BC (ca. 4200 BC). This is supported by the presence of horse-head sceptres in the Balkans, which become sporadic in the south and central Balkans beyond the Danube—like cord decoration and other steppe-related material culture, such as funerary rituals or ceramic shapes—which may point to their adoption as a symbol of power and prestige, at the same time as steppe influence causes a cultural unity of the region, reflected in tell-type settlements, similar ceramic forms, anthropomorphic and bone figurines, zoomorphic altars, among others (Bulatović 2014).

The spread of the 2nd Corded Ware horizon ca. 4000–3750 BC is clearly (and almost exclusively) identified with the Coţofeni group, especially Oltenia and Transylvania initially, and later Coţofeni-Kostolac towards the south, into the cultures of the Lower Danube and northern Bulgaria, together with pottery of the Cucuteni–Trypillian culture. These cultures are connected in turn with movements of the steppe-related Cernavodă I community in the Danube delta, to the south into Ezerovo (Bulatović 2014). The decoration is applied with a real cord, but ornaments are shorter and do not cover the whole girth, which is found only later in the classic central European corded ware.

The corded ware decoration was adopted widely during in the middle to second half of the 3rd millennium BC in the north-west and west Pontic areas, the Balkans, and the north and north-east Carpathian Basin. Only in the central Balkans were new steppe elements noticed during this period, which may point to a closer cultural relationship of this area with the Pontic–Caspian steppe. The Usatovo culture, settled in the territory of the Trypillian culture, eventually replaced the Coţofeni culture at the time of the expansion of the third horizon of the Corded Ware culture into Central Europe.

The third horizon of the Corded Ware culture appeared in the late Eneolithic / Early Bronze Age in areas to were Coţofeni and related cultures had expanded during the second horizon, including central (Vučedol, Bell

Beaker) and northern (Classical Corded Ware culture), as well as central and southern Balkans, Greece and the Peloponnese, including the Eastern Thracian Plain, and also a western area in the Adriatic coast (through a southern route from Bell Beaker or Vučedol). These ornamentations are often local innovations connected to previous regional Eneolithic cultures (Bulatović 2014).

There was a long-term connection between the north-west Pontic steppe area and the border of the forest zone up to the eastern Baltic area, centred on the Dniester–Buh limes (encompassing the Dniester, Dnieper, and Buh rivers). It also included the areas between the Vistula and the Dnieper (with the Lesser Poland area) – which topographically form a natural *continuum*.

V.5. Northern Europe

V.5.1. Funnel Beaker culture

The Funnel Beaker, Funnelbeaker or *Trichterbecher* (TRB) culture (ca. 4000–2800 BC) was spread through the North European Plains, to the north of the groups that formed the late LBK groups. Its characteristic pottery includes funnel-necked beakers, two-handled or four-handled amphorae, flasks, bowls, and flat clay disks, with limited ornamentation consisting of a series of stabs below the rim. Later, decoration of the vessel body with vertical incisions is common. Flint tools include (pointed or thin, butt-end, flat-trimmed) daggers, axes, round scrapers, transverse arrowheads, and knives. Flat hammer axes and club heads are made of ground stone, and amber heads and pendants are used as ornaments (Midgley 2004).

During the early period (ca. 4000–3500 BC), only small plots are cultivated, with cereal appearing late. Livestock—cattle, pig, and few sheep–goat—are more important than agriculture. Settlements with earthen long barrows are small and mobile, in the vicinity of lakes and streams or on the coast. Extensive swidden agriculture and ploughing appear ca. 3600 BC and replace wild resources in the diet. In this period (ca. 3600–3200 BC), a three-tier settlement pattern expands, organised around regional causewayed enclosured centres, surrounded by small communities (each with a settlement), a cluster of megalithic tombs, and bog deposits. During the final period (ca. 3200–2800 BC), habitation becomes concentrated in still larger settlements (Midgley 2004).

Initially, the burial rite consisted of non-monumental burials, including flat graves, a simple inhumation in the extended supine position, without a mound, which probably continued the Ertebølle tradition and expanded it through the Northern European Plains. The introduction of the new settlement pattern (ca. 3600 BC) coincides with the period of intense construction of megalithic tombs, which included only selected bones—with bodies skeletonised elsewhere—and elaborate sacrifices in the bogs. This period also coincides with the appearance of enclosures and changes in the landscape compatible with the deliberate creation of open areas, for both cereal cultivation and grazing (Midgley 2004).

Ditch systems, the so-called *causewayed enclosures*, are among the most impressive monumental constructions of Neolithic Europe. They comprise a succession of elongated single pits, possibly dug collectively by individual small groups, such as families. In the TRB North, causewayed enclosures are always accompanied by megalithic tombs, and their function may vary, possibly including a defensive role. Approximately every second generation, a burying and renewed digging phase is carried out, which—based on the settlement patterns and small size of farmyards—suggests that inhabitants from different farmyards convened at intervals in order to cooperate at particular celebrations (Müller 2014).

These structures appear scattered all over Europe, developing first in the Paris Basin connected with late Chaséen and the early Michelsberg cultures, which did not initially have grave fields as south-eastern Europe nor megalithic tombs as western Europe. The central German region (Baalberg) began their construction ca. 3800 BC at the latest, and they appear after a temporal and spatial gap—excluding west, south-east, and east TRB groups—in the TRB North group ca. 3600 BC (Müller 2014).

Megalithic tombs appear ca. 3650 BC and spread through the TRB area. They consist of the collection of matching boulders to form a corridor covered with a capstone and, in contrast to earlier stone cists, to leave an open access and thus form a chamber that may be re-entered recurrently. The construction needs a supportive mound, which may also serve as a ramp during the building process. A variable number of objects may be deposited in or in front of the grave chamber (Müller 2014).

V.5.2. Lublin–Volhynia

The late phase of the Malice culture showed intense contacts during the second part of the 5th millennium BC with Trypillia: on a moderate scale, Trypillian men seem to have sought their wives in the area of the Malice culture, and women moved to the Trypillian settlements. These women were probably responsible for the unidirectional transfer of material culture, i.e. the numerous imitations of the Malice ceramics, and the long-lasting (selective) traditions of Malice pottery passed down in their new environment (Kadrow 2016).

The Lublin–Volhynia Painted Ceramic Ware culture, which lasted a good part of the 4th millennium BC, is closely related to the Wyciąże–Złotniki group (starting ca. 4200/4100 BC), with which it coexisted until the mid–4th millennium BC, both in turn coexisting between the late 38th and early 35th centuries BC with early Funnel Beaker and early Baden influences. The later Wyciąże/Niedźwiedź materials, beginning in the mid–4th millennium BC, coexisted partially with the Lublin–Volhynian culture, and with the Funnelbeaker culture until ca. 3100 BC (Novak 2017).

These east-central European groups show some key elements in common (Wilk 2018):

- Concentration of graves in separate cemeteries;
- differentiation of burials with regard to sex (the principle of the 'left–right' side, different burial goods for males and females);

- stratification of graves with regard to the richness of their inventories (this mainly applied to copper artefacts);
- occurrence of indicators of the richest male burials (a copper dagger in Wyciąże, a copper battle axe, a small axe and a chisel in Książnice);
- allocation of a separate area for elite burials (the eastern burial area in Książnice, and the south-eastern and north-central part of the necropolis in Wyciąże), as well as one for egalitarian burials (the western area in Książnice, and the south-central and western part of the cemetery in Wyciąże).

These patterns of social and religious behaviours, partly due to the expansion of the steppe package, stemed probably from areas lying to the south, beyond the Carpathian Mountains. Similarities with the late Polgár groups and areas of the Tisza river include especially the different treatment of the deceased depending on their sex, age, and social rank. In the Lublin–Volhynia culture, there is an opposition male–female observed particularly in the consistent positioning of males on the right, and females on the left side, a ritual norm that divided the deceased from early childhood (Zakościelna 2010).

Nevertheless, differences in the size of cemeteries and orientation of burials, as well as in the details of the burial goods (smaller frequency of copper artefacts, particularly in prestigious, heavy items like battle axes, axes, and daggers) and local pottery used support that these influences were not caused by migrations from the south, but were rather due to processes of selective cultural transmission (Nowak 2014).

During the 4th millennium BC, the Danube (youngest Malice culture and classic Lublin–Volhynia culture) and Trypillian settlement complexes came into contact on the upper Dniester, and in the Styr and the Horyn rivers in Volhynia. This contact helped continue the previous forms of marital exchange, resulting in the further popularisation of the Danube culture in Trypillian settlements. It seems that the demand from Lublin–Volhynian groups favoured the expansion of flint working technology (such as trough-like retouch, or long flint blades) from Trypillian sources (Kadrow 2016).

These interactions continued in the mid–4th millennium, until the Funnel Beaker culture quickly drove out and replaced the Danube population in western Volhynia and the upper Dniester basin during its pre-classic and early classic phase. During this stage, even as an agrarian community, it has been described as closer to the sub-Neolithic groups than its predecessor, the LBK culture, with an observed archaeological "confusion" concerning wider areas beyond the Polish Lowlands. This is exemplified by the emergence of the Zedmar culture (Zedmar-type materials), the impact of Comb Ware culture or other cultural impacts on the Narva culture, changes in the Neman culture (or Pripyat–Neman culture and rise of the Neman culture), and in Poland the Linin-type materials (Adamczak, Kukawka, and Małecka-Kukawka 2016-2017).

During its classic phase, in the second half of the 4th millennium BC, Funnel Beaker migrants settled more intensively the upper Dniester basin up to the Hnyla Lypa river, and western Volhynia up to the Styr river, coexisting and interacting with Trypillian settlements for many generations (Kadrow 2016).

V.5.3. Forest Zone

After the deglaciation of the Scandinavian Ice Sheet, the Great Lake of Central Finland formed around 6500 BC, dominating the whole region at the time of the Holocene climatic optimum. Its waters dispersed into two basins: one of them formed Lake Saimaa, which continued to tilt in the southeast direction. Around 3845–2795 BC, Lake Saimaa eventually burst through its southern boundary, burrowing a 23–km-long valley and flooding towards Lake Ladoga along the River Vuoksi, the new outlet of Lake Saimaa. The Vuoksi breakthrough is considered a natural disaster on a massive scale (Oinonen et al. 2014).

Drastic changes to the shoreline occurred, with dried shallow lakes and rivers, lakes isolated from the main body of water, and thousands of square kilometres of emerged new land, creating a patchy habitat soon populated by pioneer flora (e.g. *Picea abies*, and spruce and Scots pine replacing mixed conifer-deciduous forests) and fauna adapted to the gradually cooling climate that increased the local biodiversity over the following 100–400 years. Lake Ladoga rose 1–2 m, altering the shoreline ecosystem and burying several settlements (Oinonen et al. 2014).

These environmental changes were coupled with cultural transitions of hunter-gatherer populations that lived in the area. The introduction of a completely new archaeological assemblage, the Typical Comb Ware culture (ca. 3800-3450 BC) heralds the appearance of Neolithic traits in the forest zone. It was a relatively uniform culture that covered a vast area ranging from the Urals to the Baltic Sea, and from Northern Ukraine to the Arctic Ocean, although in southern Finland and Karelia variants of the older types remained still in use. The rapid spread of the Typical Comb Ware culture was almost contemporaneous with the disappearance with the Early Asbestos Ware culture, and has been considered the most influential and innovative culture of eastern Fennoscandian prehistory, introducing pit houses with rectangular timber-frames, red-ochre graves, and exotic materials such as amber, flint and copper, rare in earlier periods. It coincided with the population maximum of Neolithic Fennoscandia, and with the increased salinity of the Baltic Sea and Holocene climatic optimum, which is linked to high productivity of terrestrial, lacustrine and marine ecosystems (Nordqvist and Mökkönen 2016).

The moose population explosion in southern Finland was due to the creation of huge areas rich in grazing lands for large ruminants, and came to an end one or two centuries after the Vuoksi breakthrough, when wetlands developed into old forests and spruce-dominated forests. The Typical Comb Ware culture, predominantly of maritime hunter-gatherers concentrated on seal hunting and fishing in the coastal areas, adapted to the new resources.

Change in subsistence strategies include the increase of moose remains from ca. 3% in the Early Asbestos to ca. 24% in the Typical Comb Ware period (especially significant in the Lake Saimaa region), falling back to ca. 5% in later periods. All this led to a population maximum in the region that lasted for approximately two centuries (ca. 3800–3600 BC), declining after 3600 BC with the change from open grassland into old forests (Nordqvist and Mökkönen 2016).

The disintegration of the Comb Ware phase began ca. 3500 BC, coinciding with the influence of the Volga–Kama region and the birth of several variants of Asbestos- and Organic-tempered Wares, although no break has been observed in cultural development (Nordqvist et al. 2012). These groups also maintained vast and varying intra- and interregional contact networks. During this period of 3500–3000 BC a shift to drier and cooler conditions is found in the steppes, with steppes expanding, and therefore also Yamna pastoralists and their cattle following them. The emergence of the poor Volosovo and Garino-Vor metallurgy in the 4th millennium BC (see *§VIII.15.1. Balanovo*) has been attributed to external influences from Yamna.

Between 3500–2000 BC an interruption in cultural continuity is found in the forest zone, coinciding with a major change in the environment, with selective felling and subsequent regeneration of forests in the Pit–Comb Ware area (Mazurkevich et al. 2009; Poska and Saarse 2002). This could have been caused by the complex movement of peoples in this period, as reflected by the interaction or "checkerboard of regional cultures covering the rolling hills and valleys of the forest steppe zone" (Anthony 2007), and a complex set of cultures is found in the east European forest zone, different from central European cultures (Czebreszuk and Szmyt 2004).

v.5. Northern Europeans

TRB samples from central Europe include: from the old Baalberge group, one individual from Esperstedt (ca. 3850 BC), of hg. I2-M438, and two from Quedlinburg (ca. 3650–3500 BC), one of hg. R1b1b-V88; one from the later

Bernburg culture (ca. 3200 BC) in Esperstedt, of hg. I2a1a2a1a1-Y3749; and one from a west TRB group in Sorsum (ca. 3200 BC). All of them show a typical ancestry composed of NWAN ancestry plus contributions of WHG ancestry, forming a close cluster with other Early Neolithic farmers from Europe (Haak et al. 2015), as well as with contemporary Iberian Middle Neolithic and Hungary Chalcolithic samples, although with lesser WHG contribution than the samples of the Michelsberg culture (ca. 4600–3000 BC) from Blätterhöhle (Gamba et al. 2014; Krause-Kyora et al. 2018).

An Early Neolithic TRB sample from Kvärlöv in the Skåne region also shows similar ancestry, with hunter-gatherer contribution either from WHG or Baltic hunter-gatherers, rather than SHG (Mittnik, Wang, et al. 2018). On the other hand, a female from Syltholm in Denmark (ca. 3700 BC), before the transition to the Neolithic, shows entirely WHG ancestry, without any significant trace of EHG or NWAN ancestry, suggesting that EHG did not reach southern Denmark in Prehistory, and that NWAN ancestry had not still reached this region (Jensen et al. 2018).

TRB communities responsible for the spread of agriculture to Poland have been proposed to be formed by indigenous northern European Mesolithic peoples who adopted farming locally rather than by incoming exogenous Danubian farmers from central Europe. However, post-LBK samples of the Lengyel culture from the Brześć Kujawski group (ca. 4500–4000 BC) and of the TRB culture from Kuyavia (ca. 3500 BC) cluster together with Early/Middle Neolithic European farmers, with one Brześć Kujawski outlier showing an intermediate position with WHG, and another clustering together with WHG. One sample from the Brześć Kujawski group shows hg. G2a2b2a1a1a-U1, and one TRB sample shows hg. C1a2b-Z38888, while mtDNA shows a mixture of farmer and hunter-gatherer lineages (Fernandes et al. 2018).

At the transition to the northern Middle Neolithic (ca. 3300 BC) there was an intensification of agriculture in Denmark and in western and central Sweden, accompanied by the erection of megaliths, with Middle Neolithic (MN) TRB samples from western Sweden being directly derived from Early Neolithic TRB. In eastern central Sweden, settlements became concentrated along the coast, shifting towards marine resources. This early Pitted Ware culture (PWC), contemporaneous with MN TRB, shows an admixture and position in the PCA intermediate between SHG and MN TRB. Both MN TRB and PWC groups show continuity with hg. I2-M438 lineages (Skoglund et al. 2012; Raghavan et al. 2014; Skoglund et al. 2014; Mittnik, Wang, et al. 2018).

In the eastern Baltic, samples from the Mesolithic Kunda and Early Neolithic Narva cultures in Latvia and Estonia had an ancestry intermediate between WHG (ca. 70%) and EHG (ca. 30%) show a dramatic shift with the introduction of the Middle Neolithic Comb Pit Ware culture, with more EHG-related ancestry: from 65–99% EHG (and 1–32% WHG), with two individuals showing 100% EHG (Mathieson et al. 2018; Mittnik, Wang, et al. 2018). This suggests that a westward migration of peoples accompanied cultural changes in the region.

Individuals from the Forest Zone were not found to have received genetic influx from Anatolian-farmer-related genes during the Mesolithic or Neolithic, and therefore an inner cultural diffusion of pottery, farming and metallurgy is assumed for the population of the Baltic and Dnieper Rapids (Jones et al. 2017). The presence of a R1b1-L754 (xR1b1a2-M269) lineage in a Middle Neolithic sample from the Baltic may support both the continuity of (a part of) male lineages in the region, and the arrival of these lineages (probably R1b1a1-P297) from the west.

V.6. North Pontic area

V.6.1. Late Sredni Stog

At the end of the 5th millennium BC, Trypillia ceramic imports appear at the Neolithic Dnieper sites. In the forest-steppe region, they occur on a number of sites belonging to the Kyiv–Cherkassy variant of the Dnieper–Donets community, and later imports reach into the forest zone, into the territory of the Pit–Comb Ware culture. Prestige objects begin to appear at this time on the north Pontic region, too, marking the beginning of the prestige exchange (Rassamakin 1999).

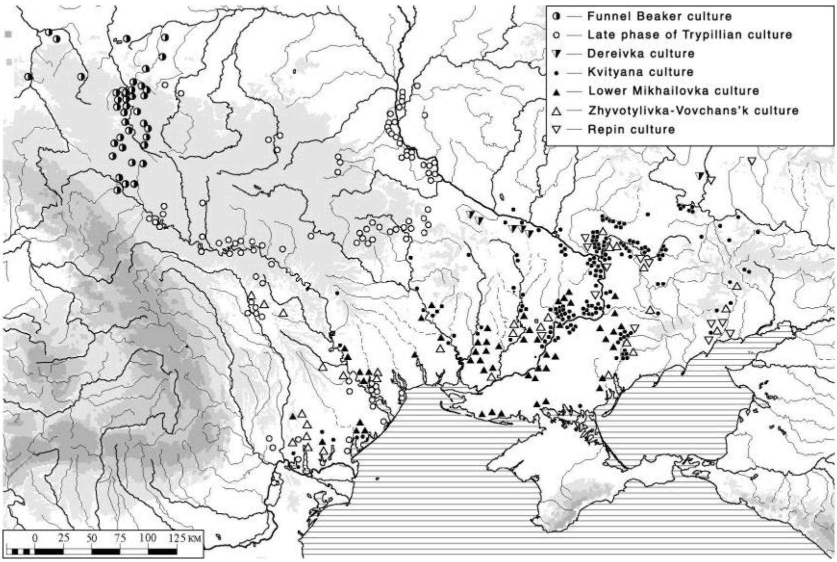

Figure 20. Late Eneolithic cultures of the north Pontic region. Image modified from Tolochko (1997).

After 4000 BC, different groups were formed in the steppes (Figure 20). In the west, distinct late Sredni Stog cultures appear, remaining in contact with Trypillian villagers, and some cultural assimilation seems to have happened east of the Dnieper ca. 3700–3500 BC. The Kvityana (also “post-Mariupol”) culture is characterised by supine burials and specific pottery, and encompasses the Dnieper steppe and forest-steppe region, the Azov region, and the Donets. Its emergence was probably related to the development of the

Lower Mikhailovka culture, and the culture is conservative and archaic in appearance, manifested in the burial rite involving a supine position, and in the pottery with no corded or caterpillar track decoration. Eventually, the Kvityana culture would expand to the south-west, with typical assemblages found in Usatovo territory (Rassamakin 1999).

Sredni Stog settlements appeared in the Middle and Lower Dnieper and Lower Don valleys and surrounds, with lifestyle based on restricted mobility, and orientated to valley resources. Their subsistence was varied, according to its distribution between the forest-steppes and the steppes, but a hunter-fisher-gatherer economy remained prevalent: people fished, hunted small and large game including wild horse, and kept some sheep-goats, cattle and pigs (as well as dogs). They also probably herded horses and there is evidence for control of the horse by bridles (Whittle 1996).

An important event in the history of population movements in this period was the appearance of Neolithic tribes of the Pit–Comb Ware culture in north-east Ukraine. Analogues of this culture have been found in the region of the Volga–Oka Rivers. The appearance of new ethnocultural groups in Ukraine resulted in an increasingly heterogeneous regional population, which differed in their cultural, religious, and anthropological traits (Telegin et al. 2015).

The Deriïvka culture, known from settlement materials in the Dnieper, at the sites of Deriïvka and Molyukhov Bugor, and distinctive pottery in Oleksandriia on the Oskol, is found in different forest-steppe regions in the Dnieper and the Donets basins, limiting to the south with Kvityana, and to the north with Pit–Comb ware cultures of the forest zone. Its pottery shows consistent features, such as a weak profile and slightly elongated proportions, with high, straight mouths, evenly cut off at the rim, and conical bases (Rassamakin 1999).

Deriïvka (ca. 4000–3000 BC) is on a promontory of the Omelnik river, a tributary of the Middle Dnieper, and represents a settlement of 60 by 40 m, including hearths, pits and two or more large rectangular structures with slightly earth-sunk floors (Figure 21). Other areas seem to have been given over to specific tasks, connected with pot use, bone tool manufacture and preparation of fishing gear and fish processing. Ducks and several species of fish show the importance of riverine resources. The abundance of horse remains could have come from both wild and managed animals, but scarce hints at the proportion of males may indicate they were domesticated.

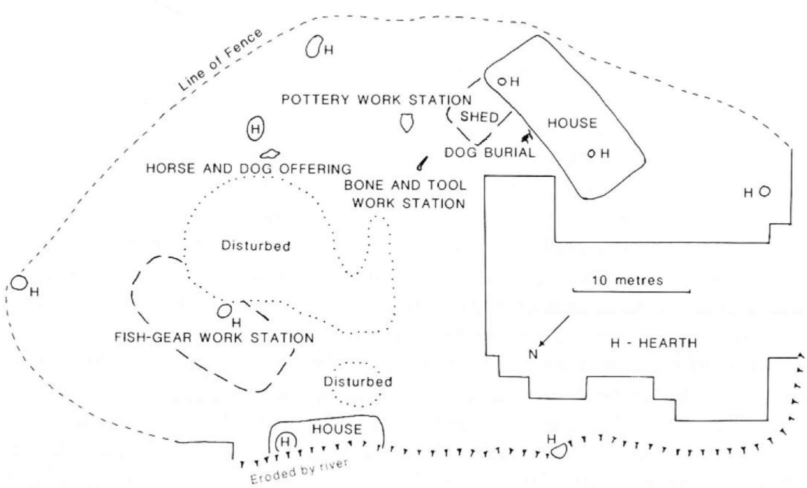

Figure 21. Simplified plan of the Sredni Stog occupation at Deriïvka. After Telegin and Mallory. Image modified from Whittle (1996).

Deriïvka shows a wide range of ceramics and anthropomorphic and zoomorphic figurines associated with Trypillia CI-CII, and ornamental corded compositions of Deriïvka ceramics are just like those from late Trypillia Usatovo, Gorodsk, and Tsviklovtsy (Rassamakin 1999).

The Molyukhov Bugor and Deriïvka sites from the Deriïvka culture show a clear reliance on equine products, mainly horse exploitation (ca. 15–50%), hunting (ca. 15–50%, mainly of deer and elk), fishing, and cattle breeding (ca. 15–40%). Nevertheless, the absence of ruminant dairy product residues suggests a relatively unsophisticated knowledge of ruminant domestication, which implies the presence of wild rather than domesticated horses. Agricultural tools and cereal impressions in pots suggest plant exploitation as a complementary activity (Mileto et al. 2017).

This primitive agriculture probably emerged as an imitation of Trypillian agriculture, based on the finding of numerous hoes, querns, and flat-bottomed vessels and flint tools similar to sickle blade elements. The fish and wild boar representations of the zoomorphic plastic art, apart from the high percentage of hunted fauna, support the high reliance on hunting and fishing as the main subsistence economy, depending on the ecological niche (Rassamakin 1999).

The Deriïvka culture emerged as the transformation of some part of the Neolithic forest-steppe tribes, since pointed base pottery is a characteristic feature of its assemblages. From the mid–5th millennium BC on, contacts with newcomers from Neolithic communities of pit–comb pottery is seen in the Dnieper–Don interfluve. This interaction is continued by Eneolithic communities, up to late materials (ca. 4000–3750 BC) with stroke and pit-comb complexes, material of Ksizovo type, and rhomb–pit pottery (Smolyaninov, Skorobogatov, and Surkov 2017).

There was local production of flat-bottomed basins (particularly at Deriïvka) and jugs (particularly at Molyukhov Bugor) within the specific Trypillian tradition. Corded decoration appeared first on cultures with a closer link to Trypillian cultures, and was thus prevalent among pottery from Molyukhov Bugor, in contrast to the scarce findings in Oleksandriia and Deriïvka, where they appear during later stages of their occupation (Rassamakin 1999).

Further up the Dnieper (mainly on its left bank) was the Pivikha culture, with its northern border reaching the Kyiv region, and with its imports reaching to the south into Mikhailovka. North of the Pivikha culture, Neolithic sites of the Dnieper–Donets culture still remain active in this period, with the forests on the left bank of the Dnieper showing sites of the Pit–Comb Ware culture, whose imports can be seen on the Deriïvka and Oleksandriia settlements (Rassamakin 1999).

The Lower Mikhailovka culture covers a wide area and period, showing a characteristic internal unity and consistent manifestations: analogous pottery in settlements and burials, interment ritual, and burial structure, with ditched cromlechs, an entry orientated to the southwest, mounds all made the same way, and a compound construction with clay overlying the black earth. It was located on the Dnieper–Danube steppe region, and chronologically it begins ca. 4000–3500 BC, with some overlapping of territory and culture with Kvityana (Rassamakin 1999).

The Mikhailovka I site reflects parallel adaptations with the north Pontic forest-steppe areas consisting of permanent settlements in river valleys with fortifications, and occasional farming west of the Don, evidenced also by occasional grain impressions in their vessels. Among domestic animals, mainly sheep and goat bones are found (and occasionally pigs), with only up to 7% of horse remains (used for secondary products rather than meat), and utilisation of wild resources, consistent with a sedentary way of life (Parzinger 2013; Mileto 2018).

V.6.2. Zhyvotylivka–Vovchans'k and Gordineşti

The Zhyvotylivka–Vovchans'k-type sties appear as burials cut into existing kurgans between the Prut and the Don. Their pottery belongs to forest-steppe (Kasperovo-Gordineşti) type, not to the steppe (Usatovo) variant. It appears to be a late, eastwards expanding culture, which was replaced eventually by Neolithic sites of the emergent Pit–Comb Ware culture, e.g. in the Samara tributary on the east bank of the Dnieper (Rassamakin 1999).

The period ca. 3500–3000 BC is characterised by a cultural break-up in the north Pontic area. Cultures from the previous period see their territories much reduced, or divided into smaller, more localised units. The Trypillia world continues to lead this area, but the settlement pattern is noticeably altered, the overall density of sites decrease dramatically, and the culture breaks down into individual groups with different burial traditions: in the Dniester region, Vykhvatinsk; in the steppe zone, Usatovo, which absorbed some features of the Lower Mikhailovka culture; in the Prut and Middle Dniester regions, Gordineşti (corresponding to Horodiștea on the Prut–Siret interfluve, and on the Lower Danube to Cernavodă III); Sofievka in the forest-steppes of the Middle Dnieper (Rassamakin 1999).

Trypillia increases its influence over Deriïvka, where corded decoration (“pre-Corded Ware”), plastic art, and bowls appear. The fate of Pivikha is not clear. To the south, Lower Mikhailovka remains intact on the Azov region and the Crimean steppes. To the north, the Kvityana culture survives in its initial core zone. The Dnieper–Buh group of sites emerges with mixed features between Trypillia, Lower Mikhailovka and Kvityana (Rassamakin 1999). All these terminal Eneolithic units developed gradually, probably as an adaptive response to climatic conditions over the course of the 4th millennium, and adopted a way of life similar to their EBA successors in the area (Harper et al. 2019).

A true Trypillian colonisation wave happened in what seems a mass exodus of Trypillian communities to the steppe (Manzura 2005). Gordineşti tribes expand to the south, into the zone of the Usatovo sites, and to the east and southeast, towards the Dnieper. The Zhyvotylivka–Vovchans’k burial assemblages are linked to this culture, and connected the forest-steppe Buh, Dniester, and Prut regions with the Lower Don and the northern Caucasus, where the late stage of the Maikop culture (the Novosvobodnaya sites) continued (Figure 22). Maikop cultural elements became more widespread in the steppe zone, and also Konstantinovka vessels appeared in Gorodsk settlements, probably with Zhyvotylivka–Vovchans’k as intermediaries (Rassamakin 1999).

The connection between Pre-Caucasian (Maikop) and Late Trypillian cultures that had moved to the left bank of the Dnieper points not only to Caucasian imports, but to a likely Caucasian immigration in a series of small shifts or ‘shuttle’ movements, possibly with the aim of exchange, trade, spoils of war, borrowing of technological devices, etc. This migration is linked to the creation of “bridge” communities, like the Zhyvotylivka-Vovchans’k cultural group, and the Late Trypillian Gordineşti group (Ivanova and Toschev 2015).

The expansion of Zhyvotylivka graves across the Pontic steppes, from the Carpathians to the Lower Don and the Kuban Basin clearly signals a rapid dissolution of former cultural borders, and the beginning of active movements of peoples, things and ideas over vast territories (Manzura 2016).

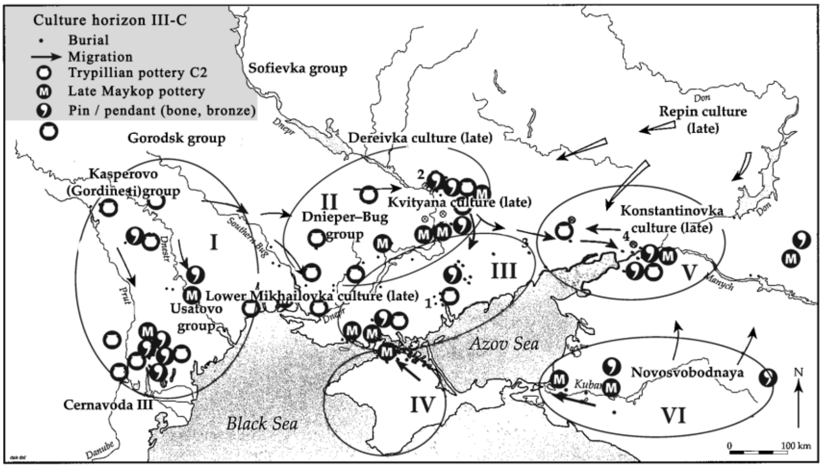

Figure 22. Disintegration, migration, and imports of the Azov–Black Sea region. First migration event (solid arrows): Gordineşti–Maikop expansion (groups: I – Bursuchensk; II – Zhyvotylivka; III – Vovchans'k; IV – Crimean; V – Lower Don; VI – pre-Kuban. Second migration event (hollow arrows): Repin expansion. After Rassamakin (1999), Demchenko (2016).

V.6.3. Globular Amphorae and Proto-Corded Ware

The easternmost area of the Funnel Beaker culture had become more Baden-like with the expansion of the Baden culture in its western area ca. 3300–2900 BC (with findings up to 2600 BC). On the east, the influence of the neighbouring Trypillian culture is seen from ca. 3000 BC, either from earlier (cf. Troyaniv, Koshilivtsy, Brînzeni, Zhvaniets, or Vychvatintsy) or later groups (cf. Gorodsk, Kasperivtsy, Sofievka, Horodiştea-Folteşti, Usatovo). In this period of reduction or concentration of settlements, vertical hierarchical relationships (central sites) were replaced by heterogeneous horizontal network links, eliminating the previous cultural boundaries, thus promoting the spread of foreign (Baden and Trypillian) stylistic influences (Kadrow 2018).

The later periods of shorter oscillations of more wet and drier sub-periods ca. 3700–3000 BC, and especially 2800–2200 BC, may have caused some of the population movements seen in Baden and younger Funnel Beaker culture phases, and older Corded Ware culture (CWC). Slash and burn techniques of agriculture—especially those practised by Trypillian and Funnel Beaker populations—must have intensified effects of natural growth of humidity (ca. 3400–2400), incrementing fluvial activities in west Ukrainian river valleys, and increasing deforestation processes (Kadrow 2016).

There is a trend during in the late 4th millennium to intensified expansion towards maximum inhabitation and agricultural use of all ecological zones, associated with favourable environmental conditions. The traditionally densely inhabited areas of Lesser Poland, the Carpathian foothills, Sandomierz Basin, Lublin Upland and Volhynian Upland, as well as those on the northern plains, are maintained, but there is a clear expansion towards less favourable areas, like the Carpathian Mountains and the Sudetes, with colonisation of the forest zone, especially Mazovia and central and north-eastern Poland (Kadrow 2016).

This reinforced pastoral tendencies in economy and caused changes in settlement patterns, with a reduction of great central settlements and the appearance of fortified settlement centres concentrated in some regions. Other parts of the population became increasingly specialised in stock breeding, leading a mobile way of life, favouring smaller mobile groups tied by kinship links instead of village-like communities, which may have favoured the initial expansion of a Proto-Corded Ware population in the area, among other groups. The brief phase of significant cooling ca. 2900–2850 BC may have favoured the initial, swift and synchronous migration of the group through northern Europe (Rassamakin 1999).

In the forest-steppe zone, herding and hunting activities intensified, while agricultural traditions were preserved, as shown by the Sofievka, Kasperivtsy, and Gorodsk groups. From the end of the 4th millennium BC, mobile parts of the late Trypillian populations moved to the steppe zone, absorbing more and more steppe elements: among others, cord ornamentation (in Vykhvatintsy, Troyaniv, and Gorodsk groups), pottery forms (Vykhvatintsy, which served as prototype for the Thuringian Apmphorae, dispersed along the Dniester river, too), flat burials with bodies in contracted position on the left or right side (Vykhvatintsy, reminding of Polgár culture different male-female position, and later Corded Ware burials, and also Lower Mikhailovka, under a mound without stone constructions). (Rassamakin 1999).

At the end of the Trypillia culture, its agricultural system collapsed completely. The cattle-centred economy of the agricultural Trypillia culture was probably carried into the steppes in the 4th millennium BC (Rassamakin 1999), and this is probably behind its adoption as main subsistence economy in Proto-Corded Ware groups, at the same time as west Yamna further specialised the trend that expanded with Repin.

The Globular Amphora culture (GAC), emerging in the same area as the Funnel Beaker culture but with a more mobile character, based on the scarcity of settlements found, shows a similar reliance on livestock (with decreasing relevance of cattle and increasing relevance of pigs), and characteristic pottery, with globular-shaped pots with two or four handles (see *§VI.3. Classical Corded Ware culture*).

GAC settlers on the north Pontic area, identified as the culture's eastern group, formed a strong long-distance structure for the circulation of cultural patterns, in which three subsystems or route foundations can be distinguished: the Volhynia, the Podolia, and the Siret (Moldavian) subsystems. These systems were used for about 500 years, from the 30th to the 25/24th centuries BC, and left Pontic elements assimilated by societies inhabiting the Lowlands on the Vistula river, such as adaptations of the funerary rite to the horse, and potentially the early reception of niche grave structures by the Złota culture (Klochko and Kośko 2009).

The expansion of Globular Amphora culture groups to the southeast, through the supposed cradle territories of the Corded Ware culture (Volhynia, Podolia, and upper Dniester river basin) likely destroyed the oldest, primary structures of the Proto-Corded Ware communities. This Proto-Corded Ware population found refuge and conditions for further development in south-eastern margin zone of the Funnel Beaker culture territories, penetrating at first the upper parts of the loess uplands like typical Funnel Beaker sites, but on the margins of their range, and also on areas avoided by Funnel Beaker settlement agglomerations (Kadrow 2016).

These close contacts between the Carpathians and the Dniester or Buh rivers with GAC included steppe cultural patterns traditionally identified with Yamna, but there might have been multiple sources of inspirations, such as CWC groups from the Vistula drainage basin and also CWC groups from the Carpathians, both of which are known to have settled in neighbouring regions for a long time. In turn, the origin of 'steppe' elements in the CWC may have been much more complex (see *§V.5.2. Lublin–Volhynia*).

Corded Ware settlements showed thus a continuation of subsistence strategies of Funnel Beaker, with cattle and sheep herding and cereal farming playing an important role, but also (in the first occupied sites covered with primeval forests) showing all possible subsistence strategies, like hunting and foraging. The deforestation caused by the Funnel Beaker culture in the eastern part of the Carpathian Foreland, creating opened local landscapes, allowed Corded Ware herdsmen to enter these territories and practise their way of pastoral economic activities without problem (Kadrow 2016).

v.6. Late Uralians

The finding of *Yersinia pestis* in two Funnel Beaker individuals from the Frälsegården passage grave in Sweden (ca. 2900 BC), basal to other Bronze Age strains, and not found in nearby Pitted Ware culture, suggests that Neolithic farming villages suffered epidemics before the arrival of steppe-derived populations. Their higher human and animal densities may have helped spread the disease, which seems to have expanded ca. 3700 BC in its basal strain, and then ca. 3300 BC in its typical Bronze Age strain associated with

Corded Ware and Yamna. This supports the spread of the disease prior to steppe migrations into Europe, but geographically associated with the steppe. Trypillian mega-settlements are thus best candidates for the emergence of the ancestors of plague lineages (Rascovan et al. 2018).

The connection of Trypillia with TRB in Sweden is probably to be found in the expansion of the Globular Amphorae culture and the mobility of its population, which likely helped spread the disease throughout northern Europe. The major genetic turnover that happened during the Neolithic demographic collapse, and the associated change in settlements and economic structures, particularly in Late Trypillian groups (abandoning of large villages and adoption of mobile herding), may be therefore explained by the spread of this deadly pandemic that benefits precisely from the agglomeration of big settlements (Rascovan et al. 2018). This population displacement probably set in motion a complex expansion of peoples in the north Pontic area, which ended with the migration of some groups—already associated with cattle-herding economy—to the north-west through the Volhynia–Podolia region, *pushed* by Late Trypillian groups.

The individual from Serteya VIII, in western Russia at the border with Belarus (ca. 4000 BC), of hg. R1a-M420 (Chekunova et al. 2014), and an EHG-like individual from Kudruküla, Estonia (ca. 3000 BC), of hg. R1a1b-YP1272 sample (Saag et al. 2017), both from Combed Ceramic-related groups, support the existence of R1a–dominated Neolithic groups in the eastern European forest zone during the 4th millennium BC, including the north Pontic forested areas.

Individuals from the north Pontic forest-steppe spanning the 4th millennium BC (classified as *Ukraine Eneolithic* samples) form a cline spanning from the Mesolithic/Neolithic cluster to the Northern Caucasus in the PCA, having a mixture of hunter-gatherer-, Steppe- and NWAN-related ancestry (Mathieson et al. 2018). This is compatible with the expansion of forest groups from the north (or resurgence of local hunter-gatherer populations of the forest-steppe) into areas previously occupied by Novodanilovka settlers of Steppe-like ancestry, and admixture with them through exogamy (Suppl. Graph. 6). The earliest one, from Oleksandriia (ca. 4000 BC) shows the highest contribution of Steppe ancestry—connected to north Pontic populations rather than the Don–Volga–Ural area[11]—while later samples from Deriïvka (ca. 3500 BC and 3100 BC) show more hunter-gatherer-related ancestry. This Steppe-related ancestry also found later in Corded Ware individuals may be more properly referred to as Forest-Steppe ancestry.

The sample from Oleksandriia is reported as of haplogroup R1a1a1-M417[12] (formed ca. 6600 BC, TMRCA ca. 3500 BC), which has an estimated expansion date ca. 3800 BC based on modern populations (Underhill et al. 2015), roughly coincident with the split of haplogroup R1a1a1b-Z645 (formed ca. 3500 BC, TMRCA ca. 3000 BC). Its isolated finding in the Middle Dnieper forest-steppe region, together with the known interaction of this area with forest cultures to the north, suggest a replacement of the previous Novodanilovka settlers with male migrants from northern forested areas, spreading Uralic languages with them into the north Pontic forest-steppe.

Copper Age Trypillian samples from the Verteba cave have been reported as having approximately 80% NWAN-related ancestry, with ca. 20% of hunter-gatherer-related ancestry (intermediate between WHG and EHG), consistent with their origin in early European Neolithic farmers admixing with hunter-gatherers from the region. Their prevalent Y-DNA haplogroup G2a2b2a-P303 (formed ca. 12400 BC, TMRCA ca. 9700 BC) further confirms their direct evolution from the first farmers from Anatolia (Mathieson et al. 2018). There is also a sample of haplogroup E-M96, also found in expanding

[11] The ancestry of the Oleksandriia individual can be modelled best as a mixture of Progress Eneolithic with local populations, which may include a combination of Varna-, Ukraine Neolithic-, or Comb Ware-related samples. The lack of Samara/Khvalynsk-related ancestry supports the origin of his ancestry as an admixture of locals from the North Pontic forest-steppe region with Suvorovo–Novodanilovka-like populations of Steppe ancestry.

[12] Tentative SNP calls with Yleaf from Wang et al. (2019) supplementary materials yield hg. R1a1a1-M417, without further subclade.

Neolithic farmers (see *§iii.2. Early European farmers*). At the mtDNA level, Trypillia shows typical Neolithic farmer haplogroups, with a closer connection with Funnel Beaker samples (Nikitin et al. 2017), which supports the described long-term exogamy practice with groups of the northern Carpathian area, taking Funnel Beaker as a proxy for them.

A late Trypillian outlier from the Verteba Cave (mean date ca. 3230 BC, compared to the others ca. 3700 BC), of hg. G2a2b2a1a1b1a1a1-L43 (formed ca. 2600 BC, TMRCA ca. 1600 BC), shows contribution of Steppe ancestry similar to the individual of Oleksandriia (Mathieson et al. 2017), clustering closely with the previous Suvorovo-related outliers (Wang et al. 2018). This sample, likely predating the expansion of late Repin/Yamna settlers in the area, supports the presence of Steppe ancestry in the north Pontic area driven by previous Novodanilovka settlers (see *§iv.2. Indo-Anatolians*). Novodanilovka-related peoples were eventually assimilated after their cultural demise by other groups expanding into the north Pontic forest-steppe and steppe areas, as evidenced by this male of a clear Neolithic Y-chromosome haplogroup but elevated Steppe ancestry. The same origin of Steppe ancestry is thus to be expected for Proto-Corded Ware populations of hg. R1a1a1-M417 stemming from the north Pontic forest-steppe area.

Samples of the Globular Amphora culture from sites in Kuyavia and Podolia (ca. 3400–2800 BC) form a tight cluster, showing thus high similarity over a large distance. Both groups have more hunter-gatherer-related ancestry than did Middle Neolithic groups from central Europe, representing thus a resurgence of this ancestry in central European farmers. They harbour mainly NWAN ancestry with WHG contributions (ca. 25%, similar to the level seen in Chalcolithic Iberian individuals), but no significant Steppe-related ancestry, representing thus a barrier to gene flow. This barrier to gene flow is also related to previous groups of the north Pontic steppe, which harbour hunter-gatherer-ancestry composed mainly of an EHG-related component (Mathieson et al. 2018). The greater similarity of GAC peoples to Middle Neolithic individuals from Hungary, Iberia, and Sweden, rather than geographically closer populations, supports their origin in north-central Europe rather than the east (Tassi et al. 2017).

The prevalent haplogroup in GAC samples from Kierzkowo (3100–2900 BC), Ilyatka (ca. 2900–2700 BC), and Koszyce (ca. 2880–2776 BC) I2a1b1a2b-Z161 (formed ca. 8500 BC, TMRCA ca. 7800 BC), found widespread across Europe, from Iberia Middle Neolithic and Chalcolithic to hunter-gatherers from the Iron Gates (ca. 6500–5700 BC). Its parent haplogroup I2a1b1a2-CTS10057 and sister clades are also found widely distributed between the Baltic and west Ukraine since the Mesolithic (see *§iii.5. Early Indo-Europeans and Uralians*).

The finding of subclade I2a1b1a2b1-L801 (formed ca. 7800 BC, TMRCA ca. 2000 BC) in most samples from Koszyce, Sandomierz, Mierzanowice, Wilczyce, and in samples of the Złota group (Schroeder et al. 2019), apart from late Corded Ware samples from Poland (Fernandes et al. 2018), supports precisely this subclade as the main lineage expanding with GAC settlers from east-central Europe, and the potential connection of the GAC population with the earliest Corded Ware groups (see *§VI.3.1. Genesis of the Corded Ware culture*). Their varied mtDNA lineages, H, J, K, U and W, support a mixture of hunter-gatherer and Neolithic populations (Tassi et al. 2017).

V.7. Don–Volga–Ural region

V.7.1. Late Khvalynsk–early Repin

To the east of the north Pontic area, the evolution of the early Khvalynsk–Novodanilovka cultural-historical area gave eventually way to different interconnected local cultures after ca. 4000 BC, whose main demographic base were the previous expanded patrilineally related clans, developing in close contact with each other, but also in contact with neighbouring emerging cultures. Their language is to be associated with an evolving Late Proto-Indo-European (Anthony 2007).

The Caspian steppes linked to the Lower Volga, the Lower Don, and the northern Caucasus region were characterised by the evolution of kurgan burials; the spread of catapult-shaped bone pins (later modernised as hammer-headed pins ca. 3000 BC in the early Yamna culture on the north Pontic area), developed in parallel in Repin and northern Caucasus areas; pottery assemblages similar to those expanded previously under the Khvalynsk–Novodanilovka period (i.e. similar to the one continued by Kvityana, but distinct e.g. from the innovative Deriïvka); etc. (Anthony 2007).

On the Lower Don, the Konstantinovka culture appeared as a continuation of the previous kurgan cultures with rich assemblages, distinct from the flat cemeteries of the Dnieper region. Characteristic of this culture is its orientation towards the Maikop culture, whose influence remains initially restricted to the Lower Don region (Rassamakin 1999).

The change of early to late Khvalynsk on the Lower Volga is defined by the Kara-Khuduk site in the Caspian region, and Razdorskoe on the Lower Don, and thus dated to ca. 3900–3800 BC, but it must have lasted at least until the expansion of the Repin culture. Pottery from this site includes incised ornament and rim form which mark its difference with the early Khvalynsk culture (although a similar rim fragment comes from the Khvalynsk cemetery), and connects this region to the Middle Eneolithic Pontic–Caspian steppes. The third stage of the Samara culture (marked by the Totsky-type grave goods, from Ivanovka), attested until the mid–4th millennium BC, can be included in the late Khvalynsk culture (Rassamakin 1999).

The early Repin culture (beginning ca. 3900/3800 BC) appeared in the region west of Khvalynsk, north of the Konstantinovka culture, and east of the Deriïvka and Kvityana cultures. It emerged on the territory of the previous Neolithic Lower Don culture, and continued the local tradition of pitted linear decoration, and clay bosses applied at the base of the neck. Settlements of the Repin type were few and short-lived, whereas the ritual of individual burials under kurgans became more widespread, replacing big soil burial grounds.

Settlements and burials point to a subsistence economy based on stockbreeding and nomadic or semi-nomadic way of life. The economic changes in Repin brought about a transformation in the social and spiritual sphere, too (Rassamakin 1999).

Its pottery is original, combining characteristic features of Eneolithic pottery, showing thus continuity in methods, technology, and morphology with neighbouring Volga–Ural (Khvalynsk – Samara) and Near Don (now inherited by Kvityana) areas, with demonstrated technical and technological continuity between Khvalynsk and Repin traditions (Vasilyeva 2002; Salugina 2005). Typologically, it comprises high vessels with profiled necks and spherical or flat bootms. Technologically, it included silt or clay containing silt, with an admixture of ground and shells and some organic solutions; vessels were made with the help of moulds, and their surface was smoothed and then decorated with comb stamps in different motifs (Rassamakin 1999).

V.7.2. Late Repin

V.7.2.1. Cattle-breeding and horseback riding

At the end of the 5th and during the 4th millennium, the steppe region was characterised by dry climatic conditions worsening gradually, with short-term but violent floods in the Volga–Ural region, and the peak of aridity happening during the late Repin / early Yamna period in the mid–4th millennium BC (Khokhlova et al. 2018). Forest in the river alleys receded markedly, and semi-arid landscapes appeared in the areas with the lowest rainfall to the south of the Pontic lowlands (see below Figure 25). Steppe grass-cover changed and pastoral productivity fell by ca. 50–60% in the whole region, which must have affected all cultures of the area, benefitting more specialised and mobile types of animal husbandry (Parzinger 2013).

In the fourth millennium, sheep–goat still dominated the domesticated animals of the north Pontic area (e.g. Mikhailovka I, Sredni Stog II, or Usatovo, all showing up to 60% of sheep–goat remains), and it probably also composed the majority of the diet (together with cattle) in the Don–Volga–Ural region.

Until 3500 BC, steppe populations were still largely hunters, gatherers and fishers who had herding as an adjunct to their foraging-centred economy (Anthony 2016). Unlike settlements to the west in the north Pontic area, cultivated cereals do not appear during the Eneolithic in the Don–Volga–Ural steppes, though.

The Repin culture, characterised by its cattle-breeding subsistence economy and semi-nomadic way of life, with much less reliance on hunting and fishing, must have emerged and spread benefitting from the expanding grasslands and retreating settlements of neighbouring cultures. Extensive use of broad, unsettled (or abandoned) steppe areas with little access to water was facilitated by highly mobile groups, no doubt thanks to horse-aided herding and wagons, without which the rapid adaptation and improved economic performance of this regional group would be unimaginable (Anthony 2016).

Wagons revolutionised the pastoral economy by providing bulk transport for tents, water, and supplies in combination with horseback riding, for which there is clear contemporary evidence in the Botai culture. Riding increased the number of animals a single herder could watch and control, and also improved a wagon-based mobile way of life (Anthony 2016). It is disputed whether wagons were also pulled by horses apart from bovines, though, because there is no direct evidence of the use of draft horses.

The widespread remains of burials and the rare finding of settlements, represented by seasonal camps of herders, starts in this period and continues into the late Repin / early Yamna stages. The eventual appearance of wagon parts in burials show a transition of a herding tool to a generalised symbol of a home in everyday life: by putting wheels (made of poplar especially for the occasion) in the corners of a burial, it turns into the last home on wheels for the dead. This also offers a potential explanation of how covered wagons—necessary for long travels—might have spread (Morgunova and Turetskij 2016).

All modern domestic horses investigated to date only show ca. 2.7% of Botai-related ancestry, with Przewalski's horses being feral descendants of Botai domesticates. This supports the existence of a different centre of domestication becoming the source of all modern domesticated horses, which incorporated minute amounts of Botai ancestry during their expansion. Ancient specimens from Russia, Romania and Georgia show this ancestry, suggesting its expansion to the east and south before ca. 2000 BC (Gaunitz et al. 2018). The most likely candidates for the expansion of the domesticated horse into Europe and Central Asia are therefore Yamna settlers from the Pontic–Caspian steppe.

The closest specimen found comes from Dunaujvarus, an East Bell Beaker site in Hungary, at the end of the 3rd millennium BC, which shows a contribution of ca. 39% of the branch ancestral to all horses, DOM2, apart from contributions form a source close to Iberian specimens. The Dunaujvarus branch is more archaic than the branch found in two roughly contemporary Sintashta sites, which suggests that the origin of both branches were domesticates spread with Yamna (Fages et al.).

The Dunaujvarus specimen also shows an archaic Y-chromosome lineage of horse domesticates, of haplotype Y-HT-3, shared with one of the Botai–Borly lineages, apart from specimens from Aldy Bel, Iron Age Estonia, Xiongnu, and Iron Age France, before further intense founder effects under a closely related lineage Y-HT-1 during succeeding periods; and it also shows an mtDNA line shared with Botai samples, with a sample from Lebyazhinka IV, and with different Eurasian domesticates. All this supports an origin of the expansion of DOM2 in late Repin–Yamna, and thus the presence of the ancestor of modern domesticated horses in late Khvalynsk–Repin (Wutke et al. 2018; Fages et al.).

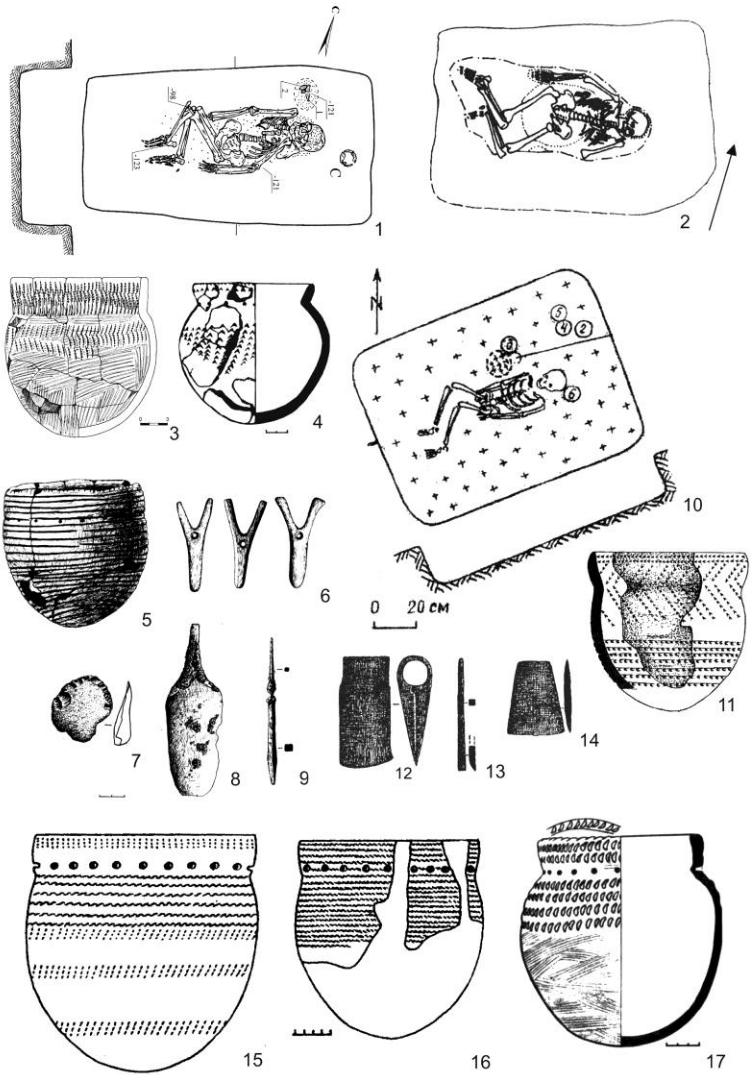

Figure 23. Materials of the Repin type: 1, 2, 10 burials under kurgans; 3–5, 11, 15–17 pottery; 6 bone; 7 stone; 8–9, 12–14 copper. From Morgunova (2015).

The genetic turnover identified in horses (Gaunitz et al. 2018) might be associated with the suitability of horses in Repin for long distance travel and warfare, rather than localised pastoral and hunting activity of Botai horses, possibly derived from earlier Khvalynsk domesticates. The likely long-term specialisation based on selective breeding in late Khvalynsk/early Repin is compatible with the existence of horse domestication in the Don–Volga–Ural area since the Khvalynsk–Novodanilovka period.

The adaptation of Yamna horses to other environments, as well as the gene flow over long distances, is suggested by weak geographic patterns among long-range similarities between Europe and East Asia (Zhang, Ni, et al. 2018), and by the rapid expansion and development of certain breeds since the estimated time of domestication (Yoon et al. 2018).

The late stage of the Repin culture, which showed its innovative corded decoration and bosses at the base of the neck (Figure 23), is the one associated with its expansionist trend, which must have begun probably after ca. 3500/3400 BC, and included settlers from the Middle Don migrating to the north into the Upper Don, southwest into the Dnieper region, and south, to the Lower Don and the Lower Volga (Rassamakin 1999).

V.7.2.2. Eastward expansion

In the Volga–Ural region, Repin features are found at transitory camps and burial mounds in the nearby Volga and Ural areas (Figure 24) during the Middle and Late Eneolithic (Morgunova 2015). These findings point to the Repin semi-nomadic culture diffusing into the Cis-Ural region with settlers. Morphometric studies have shown a potential infiltration from the Eneolithic Don–Volga steppes into the Volga Yamna population, while supporting homogeneity of Middle Volga populations during this period (Khokhlov 2016).

Other Middle Eneolithic regional groups like Khvalynsk, Atlantic, Toksk, and Turganik were possibly unified under the new expanding culture, at least in part through cultural diffusion, given the scattered Repin materials and settlements in the area before the synchronous emergence of early Yamna everywhere (Morgunova 2015). This continuity of the material culture—and probably in part of the population—in the eastern steppe could have been facilitated by the sharing of a common steppe habitat and close cultural ties since the Khvalynsk–Novodanilovka expansion, which might have smoothed the transition of local groups to the new steppe economy.

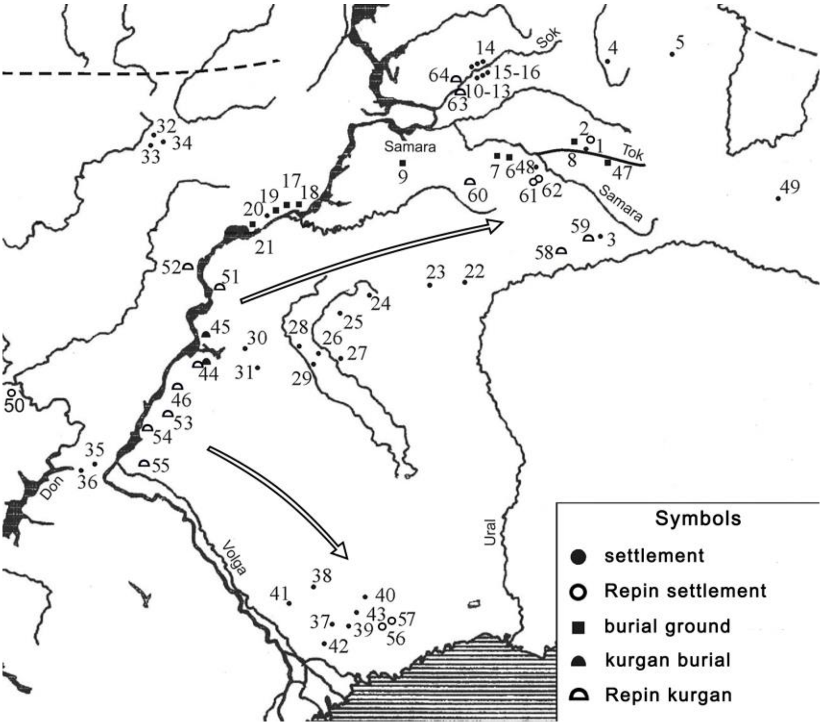

Figure 24. Eneolithic settlements (1–5, 7, 10–16, 20, 22–43, 48, 50), burial grounds (6, 8–9, 17–19, 21, 47, 49) and kurgans (44–46) of the steppe Ural-Volga region: 1 Ivanovka; 2 Turganik; 3 Kuzminki; 4 Mullino; 5 Davlekanovo; 6 Sjezheye (burial ground); 7 Vilovatoe; 8 Ivanovka; 9 Krivoluchye; 10–13 LebyazhinkaI-III-IV-V; 14 Gundorovka; 15–16 Bol. Rakovka I-II; 17–18 Khvalynsk I-II; 19 Lipoviy Ovrag; 20 Alekseevka; 21 Khlopkovskiy; 22 Kuznetsovo I; 23 Ozinki II; 24 Altata; 25 Monakhov I; 26 Oroshaemoe; 27 Rezvoe; 28 Varpholomeevka; 29 Vetelki; 30 Pshenichnoe; 31 Kumuska; 32 Inyasovo; 33 Shapkino VI; 34 Russkoe Truevo I; 35 Tsaritsa I-II; 36 Kamenka I; 37 Kurpezhe-Molla; 38 Istay; 39 Isekiy; 40 Koshalak; 41 Kara-Khuduk; 42 Kair-Shak VI; 43 Kombakte; 44 Berezhnovka I-II; 45 Rovnoe; 46 Politotdelskoe; 47 burial near s. Pushkino; 48 Elshanka; 49 Novoorsk; 50 Khutor Repin; 51 Shumeika; 52 Panitskoe 6b; 53 Skatova; 54 Bykovo I-II; 55 Verkhnegromnoe; 56 settlement Kyzyl-Khak; 57 settlement Kyzyl-Khak II; 58 Boldyrevo; 59 Gerasimova; 60 Orlovka; 61 Petrovka; 62 Skvortsovka; 63 Grachevka; 64 Lopatino I. Image modified from Morgunova (2015).

In the Middle Volga, regions which kept a traditional hunter-fisher economy even after the expansion of Khvalynsk–Novodanilovka witness the emergence of animal husbandry with cattle and sheep–goats and a productive economy, in combination with hunting and fishing, possibly influenced by the ‘push’ of the initial expansion of Repin. So e.g. in the Lebyazhinka site in the

Sok River (a tributary of the Samara river), with Lebyazhinka III (ca. 5200-4600 BC) compared to Lebyazhinka VI (ca. 4050–3700 BC), whose radiocarbon dates and specific domesticates, broadly related to the Middle and Lower Volga and to the North Caspian region, speak rather in favour of cultural diffusion of domestication to the region before the expansion of late Repin settlers (Korolev et al. 2018).

The presence of regional traits in pottery (a diversity also present in the west), and especially the maintenance of a mainly sheep-herding economy (ca. 65% sheep–goat and only 15% cattle in grave sacrifices) in the Don–Volga–Ural and in the north Caucasian–Caspian early Yamna groups (Anthony 2016), contrasting with the prevalence of cattle herding among Repin settlers and to the west of the Don River (later continued in the Catacomb culture) further supports a limited colonisation wave in the east.

V.7.2.3. Westward colonisation

To the west, demographic pressure and migration seems to have been the main cause of the demise of local cultures. In the north Pontic region, this expansion is considered a true "colonisation" (Suppl. Fig. 8): their demographic impact is seen in the dramatic reduction in territorial extent of Kvityana and Deriïvka cultures, as well as in expanding Repin burial assemblages, with settlements and temporary camps appearing in the Donets basin, in the eastern Azov region, and becoming widely distributed towards the Dnieper (Rassamakin 1999; Anthony 2013, 2007). The late phase of the Konstantinovka variant had continued on the Lower Don during the late Trypillian expansion, as evidenced by the sites of Konstantinovka and Razdorskoe, but with the expansion of Repin settlers the culture ceased to exist.

In the Kuban region, the local Novotitorovka culture emerged, preserving elements of the late Maikop culture. This culture features up to one in four graves with wagons or wagon parts (wooden wheel rims), possibly graves of blacksmiths, a custom common also in late north Pontic steppe cultures. Further connections of the north Pontic area with the Caucasus and of Maikop with the steppe are seen in the imports of arsenical bronzes from Caucasus mines, as well as in the characteristic burials in stone cists beneath grave mounds in the Kemi Oba culture of Crimea featuring Maikop elements (Parzinger 2013).

Contrasting with the characteristic adaptation of the Repin culture to a full pastoral economy, relying heavily on the exploitation of cattle and related secondary products, as well as on horse meat (up to 70% faunal remains in certain sites), north Pontic cultures had specialised throughout the 4th millennium BC in sedentary settlements relying mainly on wild animals, aquatic products, sheep–goat herding, and limited horse-related exploitation. The shift to cattle herding is not detected in the Mikahilovka site, for example, until the emergence of the Yamna culture ca. 3100 BC, a radical adoption of a unique subsistence economy influenced neither by climate nor by environment, which supports cultural belief and economic drivers of new settlers as the main factors (Mileto 2018; Chechushkov and Epimakhov 2018).

Eventually, the Pontic–Caspian steppes became unified under a common culture. The Repin expansion is rightfully considered by many researchers as the early stage of the Yamna culture, since it became culturally and chronologically associated to the synchronous appearance of the early Yamna horizon across the Pontic–Caspian steppes, from the Urals to the southern Buh, and this culture showed little connection to the cultures of the Azov–Black Sea steppes, which it eventually replaced ca. 3300–3000 BC (Figure 25).

All late Repin / early Yamna groups of the north Pontic area absorbed elements from pre-existing local Late Eneolithic formations, although there is a clear remarkably standardised, uniform burial ritual and material culture (see *§VI.1. Early Yamna culture*), opposed to the previous variability in the north Pontic area, which displayed e.g. cromlechs, orthostats, ditches, or sanctuaries in their burials. Similarly, in the Volga–Ural groups regional continuity is also apparent in pottery.

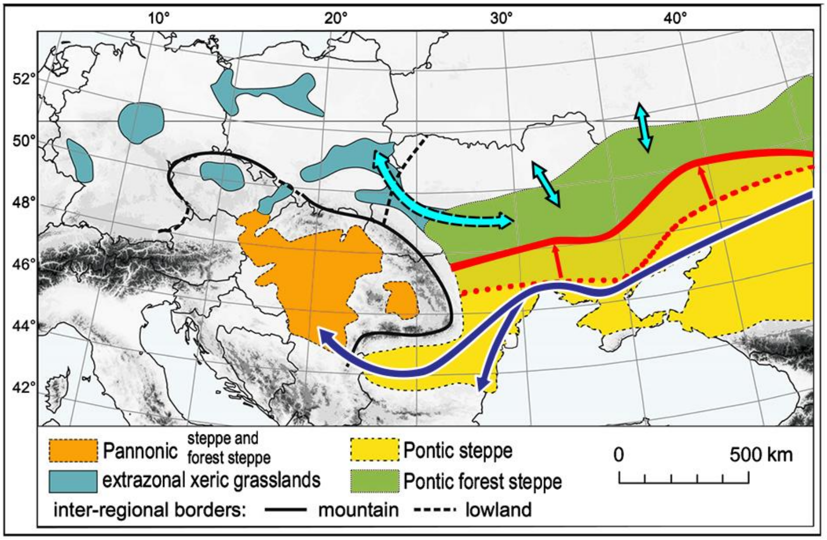

Figure 25. Expansion of the Neolithic north Pontic steppe area (dashed line) to the north during the 4th millennium BC (red arrows), and modern boundary (red line), according to Spiridonovoi and Alöshinskoi (1999). Arrows represent the most common connections and migration routes of steppe and forest-steppe populations. Modified from Kajtoch et al. (2016).

Earliest radiocarbon dates for the start of the early Yamna culture are ca. 3350/3300 BC in both the north Pontic and in the Volga–Ural regions, including the early graves with pottery of the Repin type, with the majority of dates in the north Pontic area lying in the span 3050–2300 BC, although chronologies vary widely in specific regions (Rassamakin and Nikolova 2008).

The earliest radiocarbon dated full-fledged Yamna-like kurgan burial appears precisely among kurgans of the Repin culture ca. 3300–3100 BC, in a region adjoining both the north Caucasian and Volga regions (Shishlina, van der Plicht, and Zazovskaya 2011). The burial ritual continues in part the previous early Khvalynsk tradition of the Volga–Ural area, but with modifications.

Individuals were buried lying on organic mats in grave pits beneath kurgans. Each kurgan contained only one to three individuals, rarely including children, and most graves include adult males, so the majority of the population was excluded from kurgan ceremonies, and we don’t know what happened with their bodies after death. Nevertheless, regional differences exist, and the Kuban–northern Caucasus region, for example, shows more children and female burials (Khokhlov 2016).

The survival of Repin traditions on the Lower Don and Middle Volga regions, which gave these early Yamna groups a more archaic appearance (in the so-called Gorodtsov type), further supports that migrations from this area were the origin of early Yamna settlers in the north Pontic area.

The western region shows the incorporation of foreign elements, such as the characteristic burials with wagons, assemblages including small hammer-shaped pins (rooted in earlier Repin pins, see above), and anthropomorphic stelae (a tradition proper of the earlier and contemporaneous Lower Don–Southern Buh steppe territories). These features are absent from the Volga and eastern regions, as are the impressive stratified kurgans, crammed with burials, typical of the Lower Don–Southern Buh territory.

v.7. Common Indo-Europeans

A Common or Classic Indo-European community (Mallory and Adams 2007; West 2007) must have developed during the period of close interaction between late Khvalynsk/early Repin cultures, before the expansion of late Repin/early Yamna caused the divergence evidenced in the Disintegrating Indo-European stage. Based on the ancestry found in Afanasevo individuals (Wang et al. 2019), the population from the late Eneolithic Don–Volga–Ural area probably had a quite homogeneous fully Steppe-like admixture (see above *§iv.2. Indo-Anatolians* and below *§vi.1. Disintegrating Indo-Europeans*) before the colonisation of the north Pontic area.

The split of R1b1a1b1-L23 (TMRCA ca. 4100 BC) into *western* R1b1a1b1a-L51 (TMRCA ca. 3700 BC) and *eastern* R1b1a1b1b-Z2103 lineages (TMRCA ca. 3600 BC, the same for R1b1a1b1b3-Z2106) probably happened early, most likely during the expansion of Khvalynsk clans in the early Eneolithic, which is supported by the disappearance of hg. R1b1a2-V1636 from the region (although it appears in one Yamna individual from the

Caucasus, see below *§vi.1. Disintegrating Indo-Europeans*), reinforcing in turn the concept of a unification of the Don–Volga–Ural region under a single Indo-Anatolian dialect, Common Indo-European, through demic diffusion.

The later successful expansion of R1b1a1b1-L23 subclades, with R1b1a1b1b-Z2103 slightly later than R1b1a1b1a-L51, as well as the prevalent R1b1a1b1b-Z2103 lineages found in eastern Yamna samples and Afanasevo, support the presence of R1b1a1b1a-L51 lineages mainly in the western Don–Volga area, possibly as the majority haplogroup of late Repin. The expansion of the late Repin culture (and later emergence of early Yamna) in the Volga–Ural region was probably then a cultural rather than demic diffusion over populations already genetically and culturally similar.

One Yamna sample from Lopatino II (ca. 3000 BC), possibly of haplogroup R1b1a1b1-L23 (Y410+, L51-)[+], may be thus intermediate between R1b1a1b1-L23 and subclade R1b1a1b1a-L51. The fact that Lopatino II is part of a late Repin kurgan site in the Samara region (see above Figure 24) points to some demic diffusion of Repin clans of R1b1a1b1a-L51 lineages to the east. Further R1b1a1b1a-L51 samples have been reported from central and south Asian sites (Narasimhan et al. 2018), although their actual haplogroups remain dubious. The majority of R1b1a1b1b-Z2103 lineages found to date in the Volga–Ural area, as well as their presence in the Balkans and among western Yamna settlers, points to its original presence probably among Repin settlers of the Middle Don region, too.

This extension of eastern lineages in the Don–Volga–Ural area and genetic homogeneity of the current samples do not let for the moment distinguish the ‘Northern’ Indo-European community—speaking the dialect ancestral to North-West Indo-European and Tocharian (Oettinger 1997, 2003; Adrados 1998; Mallory and Adams 2007; Mallory 2013; Beekes 2011)—from the ‘Southern’ or Graeco-Aryan one—speaking the dialect ancestral to Balkan and Indo-Iranian proto-languages (Adrados 1998; Mallory and Adams 2007; West 2007). The cultural division between a western Don–Volga early-to-late Repin culture opposed to an eastern Volga–Ural late Khvalynsk and Samaran cultures before the emergence of early Yamna may be tentatively used to identify a western community of ‘Northern’ dialect, and an eastern community of ‘Southern’ one, which is also consistent with the earlier separation of the Northern community and the continued innovations shown by the Southern group.

V.8. Inner Asia

The Kelteminar culture, located in modern Uzbekistan around the Kyzyl Kum desert, represents the colonisation of the Tugias forests and typical steppe close to river deltas and lakes, with a technical tradition derived from the local Mesolithic background. The early stage of the culture (ca. 7^{th}-6^{th} millennium BC), concentrated on the region of the Zeravshan Valley, shows several lithic production systems—including microblades, bladelets, and blades—with at least two techniques, the most common being controlled indirect percussion, the other being the bullet-shaped core method, but there is little evidence for pressure knapping techniques. Therefore, it was probably Mesolithic Ural groups in direct contact with this culture the ones who introduced the technique (Brunet 2012).

During the second stage (5^{th}–4^{th} millennium BC), a significant development of blade and bladelet production is seen, requiring more elaborated skills. Among the tools seen, the Kelteminar arrowhead and the horned trapeze show a wide distribution in parts of Central Asia (Kazakhstan, Russia, Uzbekistan, Turkmenistan, Northern Afghanistan), suggesting a symbolic value, and thus a way to define social identity. During that period, pressure knapping technique becomes prominent in blade production, with new relationships—evidenced by decoration in pottery—probably being developed in Chorasmia with agropastoral communities of southern Turkmenistan (Brunet 2012).

The Atbasar culture (ca. 5^{th}–4^{th} millennium BC) of the forest-steppe zone of Northern Kazakhstan also developed from the local Mesolithic microblade production using bullet-shaped cores as pressure knapping technique. The introduction of few regular blades and new formal tools can be seen during this period, such as points, trapezes, triangular arrowheads with a basal notch, bifacial pieces, and leaf-shaped bifacial points, possibly with different functional and socioeconomic contexts. This and the introduction of pottery with incised or combed decoration, and the domestic horse at the end of the period, suggest migrations in northern Kazakhstan at the same time as those seen among similar post-Mesolithic cultures of eastern Kazakhstan, Altai, and eastern Siberia (Brunet 2012).

The Botai-Tersek culture (ca. 3700–3000 BC) probably emerged from groups of Atbasar foragers in the steppes of northern Kazakhstan who developed a specialised economy as horse riders who hunted essentially horses. Their main diet consisted preferentially of horses, but it included also wild animals like large bovids, elks, deers, bears, etc. The small temporary settlements in the steppes, the evidence for herd-driving hunting techniques, as well as the management and transport of great quantities of horses, together with evidence for bitted and ridden horses prove the appearance of horseback riding ca. 3700–3500 in the northern Kazakh steppes (Brunet 2012).

The Hissar culture (ca. 7th–4th millennium BC) shows a continuation of Mesolithic material culture related to the *Yubetsu* tradition. As in the Atbasar culture, the introduction of new Neolithic components is seen in the late stage, with blade production using indirect percussion, flake production by direct percussion (hard hammer), and the presence of trapezes and polished axes, linked to domestic activities related to leather, skin, and woodworking (Brunet 2012).

v.8. Palaeosiberians

To the east, Neosiberians—from which contemporary Siberians derive—replaced the previous Ancient Palaeosiberian-like populations ca. 9000–2000 BC, restricting their AP-like ancestry to north-east Siberia, represented by an individual from Ol’skaya, Magadan (ca. 1000 BC), who closely resembles present-day Koryaks and Itelmens. In the Cis-Baikal area, thirteen Early Neolithic hunter-gatherers from Shamanka (ca. 5200–4200 BC) are representatives of AEA ancestry, closely related to individuals from the Devil's Gate Cave (ca. 6000–5500 BC). Among reported haplogroups, there are seven samples likely all N1a2-L666, and one C2a1a1a-F3918 (Sikora et al. 2018).

Cis-Baikal populations are replaced likely during the Late Neolithic (Moussa et al. 2016), with samples from Early Bronze Age (ca. 2200–1800 BC) evidencing an almost full population replacement with a resurgence of AP ancestry (up to 50%)—probably from a population migrating from the east and north—and influence from West Eurasian steppe ANE ancestry (ca. 10%) in the Altai region, represented by BA individuals from Afanasevo. Reported haplogroups are all Q1a2a-L712, with one Q1a2a1-L715 and one Q1a2a1c probably suggesting these subclades as those expanding in the EBA (de Barros Damgaard, Martiniano, et al. 2018).

AP ancestry is also found in modern Kets (ca. 40%), speaking a Yeniseian language, with genetic links to Palaeoeskimos, thus connecting Yeniseian genetically with Na-Dene-speaking peoples. The main reported haplogroup of Na-Dene peoples is Q1a2-M25 (ca. 90%), which suggests that its lineages expanded with ancestral Dene-Yeniseian speakers through north Eurasia, most likely during the Late Neolithic (Sikora et al. 2018). Yeniseians, on the other hand, belong to haplogroup Q1b1a-L54 (formed ca. 16100 BC, TMRCA ca. 14000 BC), which may point to the dispersal of certain Palaeosiberian languages with these particular lineages during the Palaeolithic (Huang et al. 2017).

It is unclear which lineage may have spread with AEA ancestry through northern Siberia, along the inner Asian Palaeolithic EHG–ANE–AEA cline, and when, although possibly some N1a1-Tat subclade (formed ca. 13900 BC, TMRCA ca. 9800 BC). In particular, the split into an eastern N1a1a2-Y23747 (TMRCA ca. 4500 BC), found among modern Japanese and Chinese, and a western N1a1a1-F1419 (TMRCA ca. 8800 BC), found among Khakassians and northern Indians, suggests a split around Lake Baikal.

Similarly, its subclade N1a1a1a-L708 (formed ca. 8800 BC, TMRCA ca. 5400 BC) shows a wide Northern Eurasian distribution in the regions east of the Urals. In particular, although basal N1a1a1a-L708 subclades can be found today around the Urals without a particular linguistic connection, its subclade N1a1a1a1a-L1026/L392 (formed ca. 4300 BC, TMRCA ca. 2900 BC) seems to represent expansions through Siberia from around Lake Baikal, often associated with Altaic-speaking peoples. This ancient Altaic connection is reflected in the finding of hg. N1a1a1a1a4-M2019 (formed ca. 4300 BC, TMRCA ca. 1700 BC) through Arctic populations, from Estonians to Tungusic speakers from Yakutia, from Chinese to Hungarians (see *§viii.21.1. Yukaghirs*).

Different expansions of these lineages include, among modern Northern Eurasian populations: N1a1a1a1a2-Z1936 (TMRCA ca. 2300 BC) connects N1a1a1a1a2a1c-Y13850 among peoples from the Trans-Urals region (see *§viii.17. Ugrians and Samoyeds*) with N1a1a1a1a2a-Z1934 in Palaeo-Arctic populations of the Cis-Urals (see *§viii.16.1. Saami and Laplandic peoples*), possibly through a Northern Eurasian forest–taiga route. SNP Y6058 (formed ca. 5300 BC, TMRCA ca. 2900 BC) connects hg. N1a1a1a1a3-Y16323 (TMRCA ca. 2900 BC) of Mongolic speakers and Chukchi of (see *§viii.21.2. Turkic peoples and Mongols*) with Mordvinic and later Balto-Finnic speakers of hg. N1a1a1a1a1-CTS10760 (TMRCA ca. 2100 BC), possibly through more southern forest-steppe–steppe routes of expansion, given the appearance of N1a1a1a1a1c-B479 among Tungusic speakers and Nenets (see *§viii.15. Mordvins and Mari-Permians* and *§viii.16.2. Baltic Finns*).

Late northern Siberian nomadic peoples close to the Arctic region are known to be easily subject to exogamy practices due to their mobility, and are thus associated with plurilingualism and eventual acculturation within few generations of admixture (Karafet et al. 2018). Therefore, it will remain unclear to what extent Palaeo-Laplandic from Lovozero (see *§viii.16. Saami* *and Baltic Finns*) or the language of northern nomadic peoples who adopted Mari-Permic, Ugric or Samoyedic languages remained related to Chukotko-Kamchatkan family thousands of years later, or spoke West Siberian languages like Yeniseian, or other Eurasiatic dialects.

Three samples from the west Siberian forest zone (ca. 6200–4000 BC) are representatives of a mixture of ancestry called "west Siberian hunter-gatherer" (WSHG) ancestry, made up of EHG (ca. 30%), ANE (ca. 50%), and AEA-related ancestry (ca. 20%). This ancestry was also present in the southern steppe and in Turan (BMAC), and formed ca. 80% of the ancestry of an early 3rd millennium BC agropastoralist from Dali, Kazakhstan, contributing to multiple outliers from 2nd millennium sites in Kazakhstan and Turan (Narasimhan et al. 2018).

The widespread presence of this ancestry in west Siberia is compatible with its association with hunter-gatherers of Kelteminar and other central Asian sub-Neolithic cultures (Narasimhan et al. 2018). The presence of an ancestral cline EHG–ANE–AEA ancestry in inner Asia is also supported by the west–to–east gradient formed in the PCA. This ancestral WSHG ancestry, separated from other ancient and present-day populations, is found in Botai (ca. 3600–3100 BC), Okunevo (ca. 2500–1800 BC), central steppe EMBA samples from Sjolpan (ca. 2550 BC), Takhirbai and Gregorievka (ca. 2150 BC), as well as Cis-Baikal EN and EBA populations (de Barros Damgaard, Martiniano, et al. 2018).

Of the three Botai samples published, one (ca. 3600–3100 BC) R1b1a1a-M73, while another (ca. 3300–3100 BC) shows haplogroup N-M231 (Narasimhan et al. 2018). Another individual of hg. R1b1a1-P297 is found in the Bol'shemysskaya culture (ca. 4500–3500 BC). The presence of R1b1a1-P297, and R1b1a1a-M73 in particular, is linked to the previous expansion of the North-Eastern Technocomplex, during the Early and Middle Mesolithic (see *§ii.1. Eurasians*), and thus likely associated with the creation of an ancestral Altaic-speaking population in inner Asia closely related to peoples with WSHG ancestry (see *§viii.21.1. Yukaghirs* and *§viii.21.2. Turkic peoples and Mongols*).

V.9. Afanasevo

Among late Repin settlers migrating to the east, one Trans-Uralian group was especially successful, developing the Afanasevo culture in the Altai region from ca. 3300 BC. The first to propose a common origin of Yamna and Afanasevo based on their shared material culture was I. N. Khlopin, and this hypothesis has been refined to a more archaic cultural phase (the Repin culture), based on archaeological remains, radiocarbon dates, and recently also ancient DNA (Morgunova 2014).

Before the emergence of Afanasevo, the region's most characteristic Eneolithic remains (ca. 4000–3250 BC) were geometrically ornamented pottery found in Botai, Kozhai I, Razboinichij Ostrov, etc. These remains are synchronous with the Repin culture, hence Eneolithisation of the west Siberian region lagged behind that of the Pontic–Caspian steppe, demonstrated also in the absolute lack of copperworking, and scarce, isolated finds of copper goods (such as an adze, and a knife with leaf-shaped blade), which show typological similarities with those of the Pontic–Caspian steppes (Morgunova 2014).

The appearance of Eneolithisation, including domestic animals, and metalworking in the Trans-Urals regions of western Altai and Tian Shan shows a close relationship of the whole process—typology, metal origin, and metalworking—to the early Yamna metallurgy in the Cis-Urals region (see *§VI.1.4. Volga–Ural region*). The appearance of intermediate materials in the territory of eastern and north-eastern Kazakhstan, showing syncretic decoration of Yamna and local Eneolithic cultures of comb-geometric pottery, strengthens the direct connection of the Volga–Cis-Urals area to the Altai precisely during this period (Morgunova 2014).

Burial similarities include the pose of the skeletons, the presence of organic bedding, the sprinkling of ochre, and the forms of the burial pits; differences include the use of stone constructions, and predominance of the south-western and western orientation of the dead (orientation to the east is exceptional). The deposition of pottery increases in relation to early Yamna, and it is marked by its heterogeneity, including its shape (tappered, ovoid, tall body, etc.), ornamental composition showing comb-like stamps, which was no longer typical of the steppe zone, but was common in the late Neolithic in the Urals (Morgunova 2014). Another strong parallel includes the earliest pictorial tradition of petroglyphs, the Yamna–Afanasevo tradition, characterised by the symbolic depiction of sun-headed men and animals (Novozhenov 2012).

Noteworthy features of the material culture are the pottery with swollen body and narrowed neck, which make it possible to assume its relation to late Repin ceramics. Also interesting is the technology used, including moulds, typical of Yamna dishes in the Urals. On the other hand, pottery is marked by considerable syncretism and heterogeneity (Figure 26). Metal is still rarely encountered, but those found show an origin in the Circum-Pontic and Maikop horizon, like those of the Don–Volga–Ural region (Morgunova 2014).

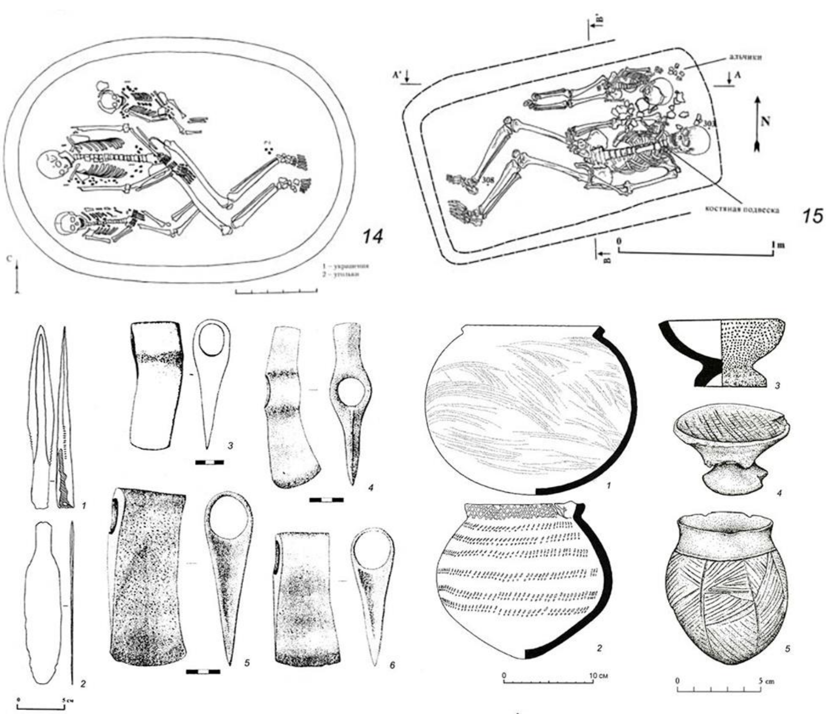

Figure 26. Materials of the Afanasevo type. Top: burial types (after Larin 2005); bottom left: copper products (after Kovaleva et al. 2010, Grushin et al. 2010); bottom right: pottery (after Polyakov 2010, Kovalev, Erdenebaatar 2010). From Morgunova (2014).

The predominant nutrition of buried skeletons is meat, and the main economic occupation of Afanasevo population is sheep and cattle breeding, not known previously in this territory. The presence of sheep, cattle, and horses, now predominant in the region, is typical of the Pontic–Caspian steppes (although the Botai also knew horse-riding before the appearance of Afanasevo). The appearance of Afanasevo must therefore be linked to an early, demographically strong migration wave of late Repin/early Yamna settlers from the Volga–Ural region, following steppe and forest-steppe environments favourable to cattle- and horse-breeding, and possibly in search for new metal deposits (Morgunova 2014).

Paradoxically, though, neighbouring Trans-Urals forest regions including the Botai culture of northern Kazakhstan received practically no influence from Yamna, in contrast to the neighbouring Volosovo–Garino Bor society, adopting metallurgy, productive farming (see *§VIII.15.1. Balanovo*), which suggests that migrants by-passed powerful cultures of combed geometric pottery. Nevertheless, the appearance of censers or 'incense burners' in the Altai ca. 2600–2000 BC, typical of the Catacomb and Poltavka cultures, suggests contacts of late Yamna groups with the region, possibly triggered by later waves of expansion into the Urals (Morgunova 2014).

Afanasevo coexisted with the Okunevo culture for ca. 100 years (ca. 2600–2500 BC), before being fully replaced by it. Okunevo developed for ca. 800 years, until about the 17th–15th centuries BC, when they were replaced by the expanding Fëdorovo culture. The different stages of the Okunevo culture have been radiocarbon dated, the Ujbat stage to the 26th–23rd c. BC, the Chernovaya stage to the 22nd–20th c., and the beginning of the Razliv period is dated ca. 19th–18th c. BC (Poljakov, Svjatko, and Stepanova 2018).

v.9. Pre-Tocharians

Tocharian shows peculiar archaisms and innovations compatible with a development isolated from other Late Indo-European dialects. Its strong differences with neighbouring Indo-Iranian and with other Late Proto-Indo-European dialects in general indicates an extensive period of linguistic separation from the common trunk. The early spread of a group from the late Repin culture into the Altai–Sayan region, emerging as the Afanasevo culture ca. 3300–3100 BC, is compatible with the described early isolation of the Pre-Tocharian group from a Late Indo-European-speaking Yamna community in contact in the Pontic–Caspian steppes (Anthony 2007).

Afanasevo individuals shows full Steppe-like ancestry, coincident with Steppe Eneolithic samples, without sizeable EEF contributions as found later in Yamna (Wang et al. 2019), which is compatible with its origin as an early offshoot from the Don–Volga region [13]. Most published samples from Afanasevo (ca. 3300–2500 BC), the supposed community of Pre-Tocharian speakers, are of haplogroup R1b1a1b1-L23, most probably R1b1a1b1b-Z2103 (Hollard et al. 2018), and many among them possibly of R1b1a1b1b3-Z2106 lineage (Narasimhan et al. 2018). Only three samples are of haplogroup Q-M242, all with a mean radiocarbon date later than 3000 BC, which implies their potential association with emerging Bronze Age cultures from Mongolia, or a resurge of previous populations (see *§viii.21.2. Turkic peoples and Mongols*).

Importantly, no Afanasevo-related ancestry is found in south Asia in the 3rd millennium BC, which discards any important migration through the Inner Asian Mountain Corridor in this period (Narasimhan et al. 2018).

---

[13] The apparent similarity of Afanasevo samples with Yamna individuals from the Kalmykia region between the Don and Volga rivers (among investigated Yamna samples), as well as the similarity in best fits obtained comparable to Yamna from Ukraine or the Caucasus, points to the expansion of Pre-Afanasevo peoples from the Don–Volga area rather than from the Volga–Ural region, suggesting therefore that they were indeed an early offshoot of late Repin.

VI. Early Chalcolithic

VI.1. Early Yamna culture

VI.1.1. North Pontic region

From about 3100 BC and for the next two to three centuries, GAC communities migrated from the Vistula River drainage basin into the area between the Carpathians and the Dnieper, more thoroughly than any of their central European predecessors: they crossed to the eastern bank of the Dnieper, they appeared in the Carpathian basin, and they came into close contact (probably 'face to face') with communities of the Yamna culture (Szmyt 2013).

GAC appeared into the forest-steppe and steppe zone west of the Dnieper ca. 3000–2900 BC, including areas between the Southern Buh and Sinyukha rivers, on the Inhul River, and also on the Dniester–Danube region. At the same time, the Trypillia culture was disintegrating into many regional groups in the forest-steppe and southern forest region between the Prut and the Dnieper (see *§V.6. North Pontic area*). Close interaction in this area is evidenced by mixed grave inventories in at least two parts of the north-western Pontic area, namely the Middle Dnieper and the Siret–Prut–Dniester area, with Yamna settlements showing atypical clay vessels more or less corresponding to GAC style (Szmyt 2013).

Nevertheless, even in the zone of greater migration exchange along the Prut, it is usually possible to draw a line separating the distribution of synchronous settlements, e.g. with GAC settlements occupying territories west of the area, between the Prut and Siret rivers, and Yamna occupying their eastern bank, between the Prut and Dniester. In the steppe zone, contacts in form of adopted pottery ornamentation by Yamna settlers are still less clear, which supports a clear differentiation of both groups (Szmyt 2013).

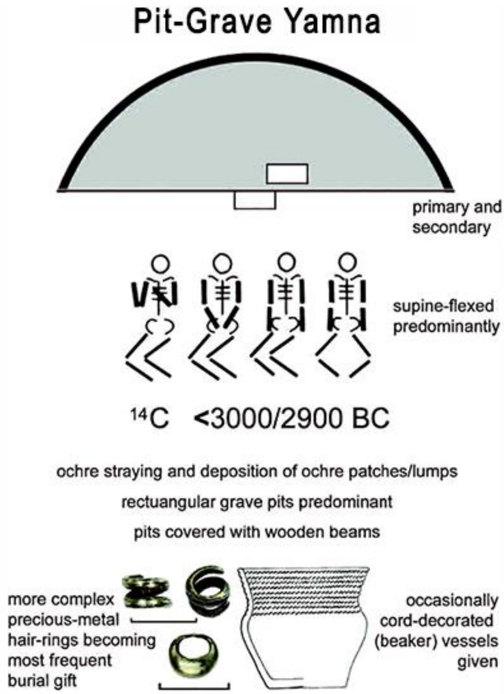

Figure 27. Burial schemes of pit graves found in the Lower Danube region during the Eneolithic according to Frînculeasa, Preda, and Heyd (2015).

After 3000–2900 BC, the majority of pit–graves west of the Black Sea belong to the domination and assimilation of peoples characterised by the Yamna funeral standard (Figure 27), in which the buried—both primary and secondary—were lying supine with the legs bent up in the knees, usually orientated on the west–east direction, in rectangular or sometimes chamber-like grave–pits covered by wooden beams. Poor inventories are the rule (contrasting with previous north Pontic steppe cultures, see IV.2.3. Kurgans), and spiral silver hair rings are the most defining items. Male burials are prevalent, and ochre staining or deposition of lumps is common. Pottery of local origin is rarer than before, and when it appears it is represented by cord-decorated beaker vessels, such as in Coţofeni III pottery ca. 3000–2800 BC (Frînculeasa, Preda, and Heyd 2015). During this late phase, Yamna appears firmly settled in the forest-steppe further north, where they were previously only occasionally found. Larger bands are therefore seen expanding in all directions (Suppl. Fig. 9).

Most Yamna burials in the west Pontic area have radiocarbon dates ca. 2880–2580 BC. Only a small proportion of sites at the Lower Danube shows later dates, with a dilution of the wider Pit-Grave phenomenon. This third stage of pit–graves shows a re-appearance of individuals buried contracted to the side or in extended body position as secondary burials in the mounds. This trend appeared perhaps under the influence of the Catacomb Grave culture or further to the east, or locally at the Lower Danube. This is a period when southeast and central European cultures like Coţofeni, Baden, Ezero A, Globular Amphora and TRB communities were transforming and splitting into successive archaeological cultures, such as Glina, Schneckenberg, Livezile, Makó/Kosihý–Čaka, Ezero B, or Corded Ware proper (Frînculeasa, Preda, and Heyd 2015).

The beginning of the western early Yamna complex is linked to the arrival of a novel set of deeply interlinked social, economic, and ideological innovations. Its five components (Figure 28) play the crucial roles, one due to the next (Frînculeasa, Preda, and Heyd 2015):

1. Subsistence economy based on specialised breeding and herding of cattle only, which leads to the increased use of secondary products in which milk and overall protein-enriched diet supplemented by game and fish (and very low ratio of starch and carbohydrates, as seen in

neglectable caries frequency) have an importance in subsequent changes in peoples' physical appearance and stature (with old anthropometric studies showing that they might have been some inches taller in average than their neighbours).

2. This new economy triggers a higher human mobility: the overall westward migration is a consequence of the ever-lasting search for green pastures for their stock. This mobility may have increased the exchange network, forwarding technical innovations like 'Caucasian metallurgy' of shaft–hole axes, tanged daggers, and previous metal hair rings.
3. Both the new economy and mobility triggered a novel way-of-life, with different land uses and understanding of territory. Peoples become true pastoralists leading a highly mobile way of life, and some segments become true nomads, which alters the social organisation and thus norms, morale, values, symbols and terms, altering the *Weltanschauung* and ideology, as well as religion, which become tradition.
4. A pit–grave under a kurgan becomes a standard in the Yamna custom-set, with its homogenisation reflecting the emerging unifying social norms. Its powerful symbolism is seen as a high landmark, the 'pyramids of the steppe', a monumental and dominant architectural element over ancestor graves (quasi-temples) in an otherwise flat and monotonous 'sea of grass', creating real or virtual ancestry and lineage, and being a sign of possession, and probably claiming territory, as well as delineating the oecumenes of pastoral groups, forming orientation points on the transhumance routes.
5. One key technological innovation made all this possible: the widespread acceptance of the transport complex of wheel and wagon, allowing herders to enter and exploit the deep waterless steppes (the largest part of the steppes) for their stock animals. It also allowed

pastoralists to live in these regions with their families for the longer part of the year, with all their possessions, without the need to keep a base-camp close to a water course.

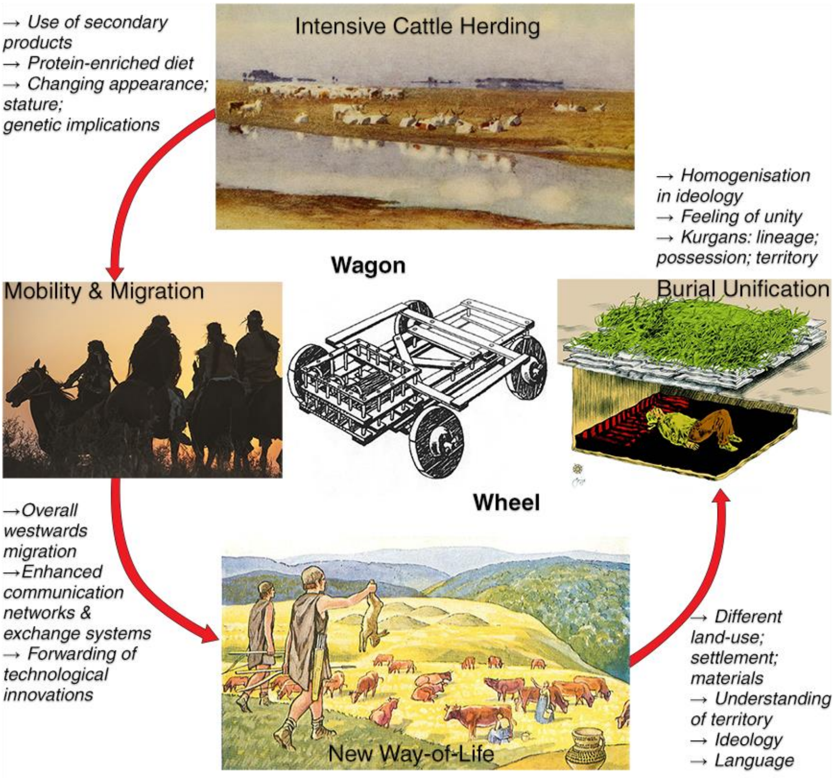

Figure 28. Scheme of interlinked socio-economic-ideological innovations forming the Yamnaya, modified from Frînculeasa, Preda, and Heyd (2015). Images used, from top to bottom and left to right: Cattle on the Puszta of Hrotobagy, by Adrian and Marianne Stokes (Wikimedia); still image from the documentary "Equus: Story of the Horse" (CBC); Bronzezeit keltische Hügelgräber, by Gerhard Beuthner (1930); reconstruction of primary burial (feature 2, Grave 1) of the Hajdúnánás-Tedej-Lyukashalom kurgan by Viktor Szinyei, modified from Pospieszny (2015). Center image: reconstruction of wagon after A.N. Gej (1993), from Novotitorovka wagon burial at Ostannii, kurgan I, burial 150.

VI.1.2. East-central European lowlands

Yamna settlements spread initially west- and southward into the Danube valley. A real current of immigration is noticed from ca. 2950 BC, being the first primary example of large-scale migration in later prehistory, with foreign people flooding over east and east-central European lowlands. More than 500 tumuli and more than 1000 graves have been already studied in this area (Heyd 2012).

A rapid decline in human activities peaked in Central Europe between 4000–3000 BC and recovered only after 3000 BC, accelerating after 2500 BC. This decline has been related to adaptation processes during climatic changes (Kolář et al. 2016; Gardner 2002) – which might have helped the expansion of Yamna settlers into scarcely populated areas closer to a more Atlantic-dominated climate zone.

The area recovered after 3000 BC with a more humid climate that favoured grassland productivity (Harrison and Heyd 2007), at the same time as the horse, the wheel, and pastoralist societies expanded into these areas. Their migration seems not to have been a traumatic event. There might have been local conflicts and raids, but there are signs of interaction with contemporary societies, as well as exchange of ideas, innovations and material culture (Heyd 2012).

The main settlement areas of west Yamna migrants were confined to the steppe habitat, and therefore Yamna settlers (initially) did not occupy, push away, or expel locally settled farming societies. West Yamna tumuli are radiocarbon dated ca. 3000–2500 BC (3100/2900–2500/2475 cal. BC), and contacts with other archaeological cultures confirm that they belong to the first half of the 4th millennium. Distinct from the close contacts between south-eastern European steppes and Pontic–Caspian steppes from earlier periods, it is quite likely that the “infiltration” of small Yamna migrants had begun in the decades, even centuries before the real current of immigration, i.e. at the end of the 4th millennium, as an extension of the north Pontic roaming area (Frînculeasa, Preda, and Heyd 2015).

The massive Yamna migration in south-east Europe is said to have been well organised, either in loose family alliances (the most likely scenario) or in clans, in any case with a clear leadership and structure (Heyd 2012). There was possibly more than one wave of migrations, with cultural differences noted north and south of the Balkans. At least one migration wave seems to have come from the north Pontic steppes, due to the presence of wagons (or parts of wagons) and stelae—characteristic of the Kemi-Oba and neighbouring zones of the Southern Buh–Lower Don steppe—in burial mound cemeteries of Yamna settlements (Kaiser and Winger 2015).

Important settlement areas included (Heyd 2011):

- The first large concentration of Yamna tumuli and burials appeared in the grass and bush-land typical of the steppe-like vegetation and environment, continuous from the north Pontic to the west Pontic area, up to the Dobruja (south of the Danube delta) and north-east Bulgaria.
- The second large concentration, the Tarnava-Rast group, appeared to the west in south-western Romania, on the plains and terraces divided by the lower Danube River. Migrants pushed west, appearing west of the Iron Gates in Jabuke, but the largest number of migrants ended up in the central Carpathian basin.
- Another province was formed by the Upper Thracian Plains south of the Varna Bay, in the Balkan uplands (Kovachevo-Troyanovo), within the region of the Ezero culture (Anthony 2007). It is more influenced by the Mediterranean, and tumuli are widespread, especially in the area between the Maritza and Tundza rivers.
- The Prut–Siret region of well-drained hill and flatlands show tumuli and burials backing onto the eastern Carpathians, in a number smaller than most other western *provinces*. More than distant nomadic settlements, these settlers formed part of a much wider, expanding Yamna group that was originally located further to the east and north-east. This is reflected by the gradually increasing number of tumuli and graves up to their source territories in the Dniester River and the north Pontic steppe

The westernmost group, third in size, lies in the Great Hungarian Plain or Great Alföld, in the central Carpathian Basin, a grassland plain mainly located north and east of the Danube, mainly east of the Tisza River. It covers 50,000 km^2 in Hungary, but reaches also neighbouring modern countries, e.g. Croatia, Serbia and Romania with the regions of Banat and Transylvania forming part of it. The core area of these lowlands is the Hungarian Puszta ('plain'), and Yamna tumuli and burials (Figure 29) are spread all over it, with the largest concentration located in the steppe areas neighbouring the Tisza River. There were originally around 40,000 kurgans in Hungary, but a more recent estimate suggests that there are today less than 2,000 left (Suppl. Fig. 10.A).

Figure 29. A kurgan stands out on a flat 'sea of grass' from the Great Alföld. Hegyes Mound, in the flood-free bank of the Kösely Stream (Nádudvar). Photo by Csaba Tóth, modified from (Tóth, Joó, and Barczi 2015).

Based on the distribution map of kurgans, burials are densest where there were no Boleráz or Baden occupations, although they partially overlapped. Boleráz–Baden groups represented settled, agriculturalist, indigenous groups, while Yamna formed small animal-keeping mobile groups. Where they appear at the same time, the kurgan is always situated on top of a settlement, indicating that they followed Baden and represented a somewhat higher social power and belief system. Apart from burials, no Yamna settlements are known in Hungary, so it is unknown whether they were situated close to the kurgans or somewhere else entirely (Horváth 2016).

Most kurgans are located on the plains, and a smaller portion appear in neighbouring hills and mountains, while in unfavourable areas of sand dunes (Nyírség Region, Danube–Tisza interfluve) kurgans are virtually absent. The highest density of mounds appear in alluvial and loess plains rich in active and abandoned river channels, usually on natural levees, sometimes concentrated along streams forming small or large clusters. Their distribution usually follows a curved line, and vertically mounds usually appear above a certain elevation corresponding to flood-free levees and small aeolian dunes (Tóth, Joó, and Barczi 2015).

In contrast to their compatriots around the Lower Danube and Moldavia, settlers from the Carpathian Basin applied reed mats, textiles, leather, and even furs (possibly even felt and carpets) for the pit walls and floors, and these have been documented outside the grave pit. These colourful decorations – despite the poorly furnished graves and generalized lack of accompanying grave gifts – must have played a distinct role in the Yamna society, as well as the importance of colour combinations and pattern as emplematic and symbolic signs based on associations. Burial chambers prepared in this way were covered with wooden beams, planks, or logs, reminiscent of the few cases in Bulgaria and Romania which show big stone slabs covering the grave pit. All of this is compatible with the importance of the *domus*-idea, as are additional wooden posts, stone frames, and fireplaces or hearths attached (Heyd 2011).

Sizeable concentrations of tumuli are found in steppe areas around the Middle and Upper Danube and its tributaries—such as the 8,000 km^2 wide Little Hungarian Plain (or Little Alföld)—as well as in neighbouring forest-steppe regions close to the Danube, representing a gradual adaptation of Yamna settlers to the forest-steppe region (Horváth et al. 2013; Horváth 2016). Some distant settlements to the west show strong hints of the Yamna culture, such as concentration of tumuli, elements of Yamna burial customs, anthropomorphic statue-stelae, and artefacts with eastern links or origins. These groups include, for example, the north/north-central Middle Elbe–Saale area of east Germany with steppe vegetations, in the shadow of the Harz mountains, or a stripe in the foreland along the east Carpathians and southeast Poland, the border between Romania, the Ukraine, and Poland (Heyd 2011).

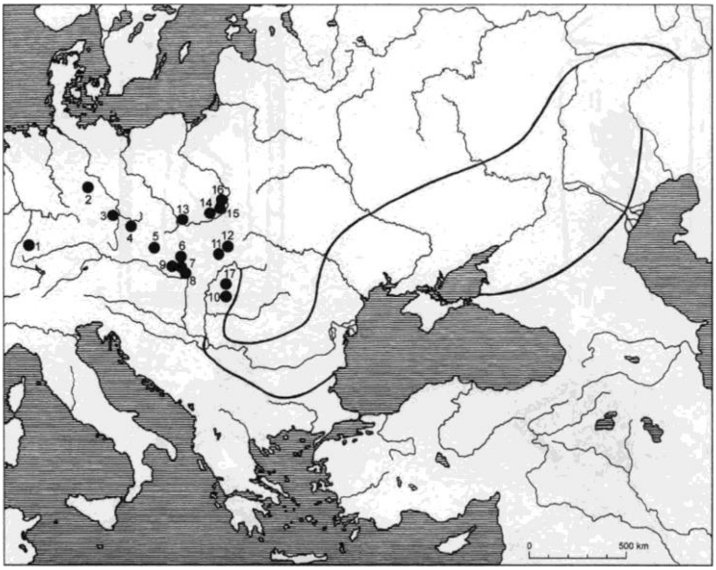

Figure 30. Distribution of artefacts and customs related to the Yamna culture (approximate border delineated up to the Tisza River), after Bátora (2006), fig. 15: 1 – Königshofen, 2 – Nohra, 3 – Kbely u Prahy, 4 – Cerhenice, 5 – Suchohrdly, 6 – Jelsovce, 7 – Nitra-Cermân, 8 – Nitra-Dolné Krskany, 9 – Sala, 10 – Kétegyháza, 11 – Kost'any, 12 – Lesné, 13 – Kietrz, 14 – Miemowo, 15 – Samborzec, 16 – Żuków, 17 – Püspökladány.

Many neighbouring regions with similar environment and landscape are thought to have been likely targets of that westward Yamna migration, although they have not yet yielded archaeological records, such as Black Sea shores of Bulgaria, East Thrace, modern Turkey, and northeast Greece south of the Rhodopes mountains. Interesting are the isolated findings of Yamna material culture in Corded Ware territory to the north (Bátora 2006), probably representing trade contacts or *vanguard* settlements (Figure 30) before the evolution into (and explosive expansion of) Bell Beakers.

An interesting finding is the discovery of a Yamna-like kurgan in Valencina de la Concepción, in southern Iberia (ca. 2875 BC), below which was the body of a man buried with a dagger and Yamna-like sandals, and decorated with red pigment just as Yamna dead were[14]. This suggests that the ideology, lifestyle and death rituals of the Yamna could run far ahead of migrants. The distribution of Yamna findings along the Danube, in central Germany, and up to Chalcolithic Iberia (Suppl. Fig. 10.B) before the emergence of East Bell Beakers—whose emergence happened roughly around the same areas (see below *§VII.7.2. East Bell Beaker group*)—suggests a complex framework of vanguard settlements and intense exchange contacts in central Europe.

Different from all these attested or supposed Yamna territories are some early samples of tumuli of mixed culture (e.g. those including cremation, or foreign material culture, or avoiding certain typical Yamna rites), which may point to Yamna influence on adjacent territories or local 'kurgan' cultures extant from the evolution of the previous Suvorovo–Novodanilovka expansion (see *§IV.2. Khvalynsk–Novodanilovka*).

Remains including a Coţofeni vessel from a Yamna grave in the Dniester (dating to the beginning of the Yamna migrations), and a typical Makó handled pot from Sofievka on the left side of the Dnieper (dating to the mid–3rd millennium) point to Yamna settlements closely connected to the core Yamna territory, thus considered an extension of their normal roaming area, and keeping a close contact among different groups (Heyd 2011).

Close contacts with adjacent cultures can also be seen in the Hungarian group, where for example herders from the Lizevile group in Transylvania seem to have used and economic model of transhumance, with livestock passing the winter and spring in the milder regions of the Great Hungarian Plain, as revealed by certain foreign tumuli in Yamna territory. Such regular visits increased the likelihood of these transhumant herders becoming integrated locally, and during the second quarter of the third millennium the internal coherence of the Yamna ideology had already diminished, which

[14] Comments by Volker Heyd (2019).

allowed other Lizevile and other herders to step in and take over locally, initially on a seasonal basis, and then permanently (Gerling et al. 2012).

VI.1.3. The Yamna package

The so-called "Yamna package"[15] (Figure 31) includes eleven components common to the initial western migrants (Harrison and Heyd 2007):

A) The social sphere:

1. The most important and visible is the round barrow as a personalised monument. Emblematic symbolic signs based on associations, using patterns and colourful decorations, often combining two or more different colours, apart from reed mats, textiles, leather, and even furs for the pit walls and floors, even outside the grave pit, and possibly felt and carpets. Burial chambers are then covered with wooden beams, planks, or logs. These are often combined in Bulgarian and Romanian groups with an anthropomorphic stela covering the grave pit (none are known from Serbia or Hungary). All this reinforces the importance of the *domus*-idea of the tumuli.
2. The single burial with a typical supine position on its back with flexed legs, usually upright (possibly to the side or in frog-position after a process of decay), often covered in red ochre, in a deep rectangular pit. The most common orientation of pits and skeletons is east–west, with heads in the west, but other directions are also attested.
3. Social position and gender are systematically marked. Most burials are of adult males, and their percentage is higher in primary graves (so probably very much a *masculine* society). The wooden wagon

[15] Package refers to the idea "that a recurring assemblage of well-defined artefacts and customs, visible in the archaeological record, matches an equivalent cluster of social habits, which identify a tightly-knit group. The term 'package' clarifies the idea that it is an arbitrary social choice to create insignia, and that their function is to make and maintain cultural boundaries with others who live in the same area. For this purpose, special clothes and dresses, or drinking and eating habits, are important. A cultural 'package' of this kind is an ideological statement, materialised in a special manner, so its transmission and adoption can be very rapid indeed." (Harrison and Heyd 2007)

marks an elevated social position in the north Pontic area; however, typical of west Yamna migrants are the poorly furnished graves and the general lack of accompanying grave gifts (with complete absence of weaponry and tools). The social expression in west Yamna is thus not manifested in grave goods, but firstly in the labour and communal exertion to erect a tumulus, and secondarily in the efforts to create a burial chamber, the new house of the dead.

4. The creation of a special status for craftsmen (especially metalworkers), especially widespread in the north Pontic region and western migrants. For the first time, metallurgists had a specific social status. The development of the so-called Circum-Pontic Metallurgical Province is also associated with the spread of Yamna—taking over the previous north Pontic industry (see *§IV.3.1. Metalworking*)—including the wide distribution of new methods of copper and arsenical bronze metallurgy, and a set of bronze objects.
5. Hoarding metal objects begins again in steppe cultures, with hoards of shaft–hole axes. Furthermore, the deposition of lumps of ochre in the graves and the fewer secondary burials cut into existing tumuli are typical of the Carpathian basin. This is useful when distinguishing Yamna burials of the Carpathian group from those on the lower Danube and the Prut.

B) The technological sphere:

6. Re-establishment of metallurgy of gold and copper, following a long decline after 3500 BC, but with a different technology of smelting, working and casting in two-piece stone moulds, or ‘Caucasian metallurgy’ (Sherratt 2004).
7. New weapon designs in copper: the single-edged shaft–hole axe, and the tanged metal dagger.

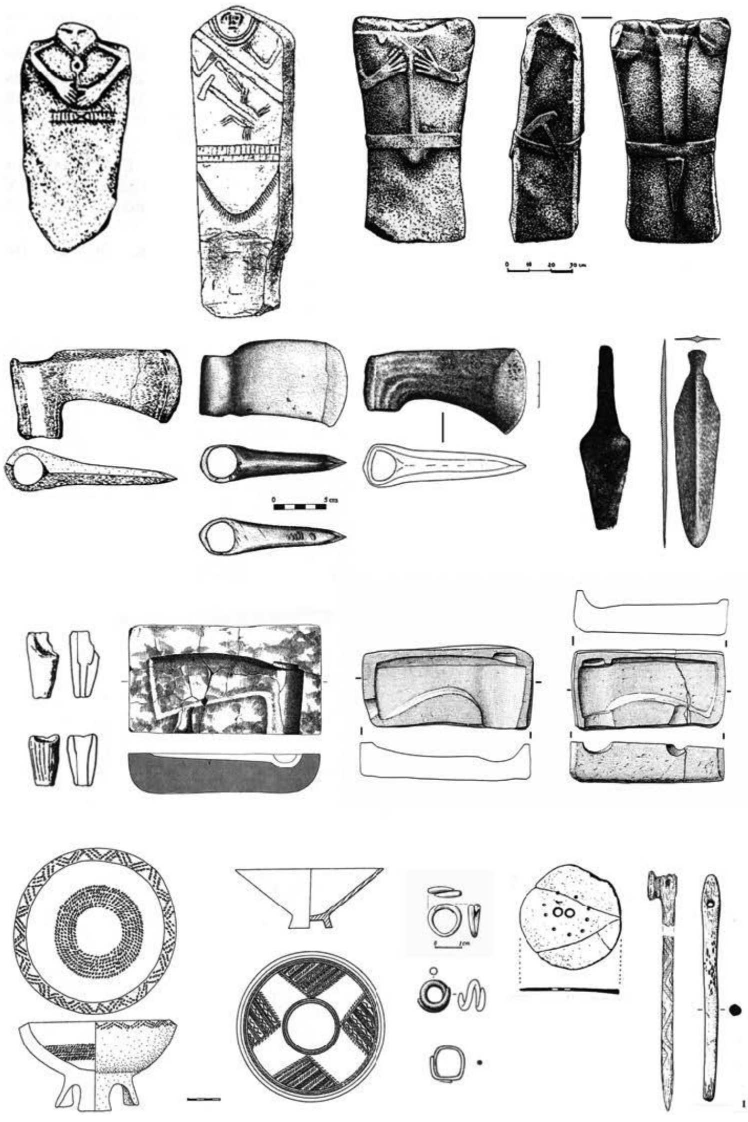

Figure 31. Examples of the western 'Yamna Package' material culture. Image modified from (Harrison and Heyd 2007).

C) The economic sphere:

8. The domesticated horse features importantly in a dedicated pastoral economy which raises herds of cattle, and perhaps flocks of sheep for wool. Domesticated horse is documented since the EBA on both sides

of the Carpathians from bone cheek-pieces, both as transport and as traction animals (Boroffka 2013).

9. Wooden wagons placed in graves as social markers; the westernmost example is the ox-pulled wagon grave of Placidol in northern Bulgaria.
10. The custom of using simple golden, electrum or silver hair rings, a distinctive bone toggle, and decorated bone discs, whose distribution covers all regions of western Yamna. Common adornments are also necklaces and chains of beads or perforated teeth.
11. Widespread use of cord decoration on pottery; the common cross-footed bowls copy models on the eastern Pontic steppes.

The use of pottery in western Yamna points to the import from neighbouring archaeological cultures, such as Coţofeni III vessels in Tarnava; Cernavodă II vessels in the lower Danube; Vučedol-like vessels in Romania and Bulgaria; and Makó and Lizevile-like vessels in Hungary. Most 'original' Yamna vessels include cord-impression techniques, and especially interesting is the classical beaker-like vessel widely distributed in the western regions, as well as the recurring decoration motif of triangles, fringes, or long triangles intermingled with each other, a specific decoration known from the north Pontic area (Heyd 2011).

Animals bones found next to the burial chamber, or part of the meals consumed during the ceremonies found around or on top of the graves, include dogs, sheep–goats, cattle, and horses (which hint at their relevance in the Yamna subsistence economy), and also hunted animals such as deer and birds (Heyd 2011). An important part of the industry related to pastoralism was the production of leather and wool. Examples are found, apart from western settlers, in Kalmykia, where wool and leather are widely used for the production of underlay, pillows, and clothes, with weaving skills showing up in good quality mats; or in Mikhailovka II-III, which shows a high level of leather production, as well as ceramic spindle whorls and weights. Based on scarce findings from Eneolithic steppe cultures, and on the analysis of Khvalynsk posttery ornamented with imprints of textile goods, Yamna findings likely show ultimately a great degree of continuity of an ancestral tradition (Morgunova and Turetskij 2016).

The interaction with previous cultures from south-east Europe may have been resolved in different ways, either violent confrontation, peaceful interaction, or neutral ignorance of each other. Since Yamna settlers occupied the steppe habitat, most economically important territories from neighbouring cultures would have been spared, at least initially, triggering mostly cultural interaction. However, communities derived from the small Suvorovo–Novodanilovka groups that settled the region may have entered into direct contact, which would have been resolved either violently or, perhaps, with rapid assimilation due to the similar economic/social background with comparable lifestyles (Heyd 2011).

Violence and raids must have been present with neighbouring cultures, though, and perhaps the building of a defence-like chain of hill forts along the south shore of the Danube by the Vučedol culture points to such contacts, although this is not the only interpretation possible. On a wider scale, the expansion of the Yamna culture begins a true horizon of transformation and cultural change in many European regions (Harrison and Heyd 2007).

VI.1.4. Volga–Ural region

Unlike western Yamna, where cattle dominates the diet and funerary rites, eastern Yamna in the Volga–Ural and in the northern Caucasian–northern Caspian steppes show a subsistence economy continuing the previous period, based on mainly sheep–goat and (less prominently) cattle, based on remains found in grave sacrifices (Shishlina 2008). The early Volga–Ural Yamna culture is represented by some settlements, small kurgans (ca. 20–25 m in diameter), and Repin-type pottery. The classical or developed phase is represented by the “unification of the funeral ritual, round bottomed pottery, the disappearance of settlements, and the prevalence of wheeled transport" (Morgunova 2002).

Differences between Yamna culture of the Volga–Ural interfluve and west Yamna groups are observed at both the social and economic levels. The traditional development of hereditary social strata in the Volga–Ural region was increasingly based on specific regional developments, such as the common interest in supply of metal objects and wooden products of cattle farming groups, which contributed to greater mobility of the nomadic pastoral population (Morgunova and Fayzullin 2018).

Such specialised production made it possible to raise the prestige of a given activity and individuals producing the necessary vehicles, tools, and weapons. The role of priests and producers (carpenters, blacksmiths) stands out by their unconventional burial rite: isolated skull burials and dismembered sacrifices the former, weapons and tools the latter, as in middle-aged men's burials accompanied by sets of tools for woodworking (axe, adze, big knife, gouge, pin, chisel) in some barrows of the Orenburg oblast. The lack of specific warrior burials points to the likely participation of the whole adult society in battles (Morgunova and Fayzullin 2018).

The construction of monumental kurgans with rich assemblages—such as those of Utevka I, Bodyrevo IV or Krasnosamarskoe IV, or the individual kurgans of Shumaevo II, Kalmytskaya Shishka, Dedurovskiy Mar—support the existence of ruling leaders among the elite, an aristocracy capable of: controlling competition (or supporting alliances) regarding territory, water resources, or raw materials; guiding the tribes; unifying their ritual and promoting the erection of sacred places; and enabling the expansion of homogeneous cultural elements through a huge territory. These elites probably concentrated economic–administrative, military, and religious functions under their charismatic leadership, which would become hereditary, evidenced by the presence of children burials among a majority of adult male elite burials (Morgunova and Fayzullin 2018).

The material culture of the Volga–Ural region (Figure 32) shows a clear connection with that of further eastern groups, including Afanasevo in the Altai region. This connection is evidenced by pieces of copper-containing sandstone from the southern Urals. A Yamna miner was buried in a mining pit ca. 3000 BC in the Kargaly copper ore field, located beyond the headwaters of the Samara River, in south-eastern Kazakhstan. Substantial deforestation near the ore field suggest large-scale copper-ore mining in the Kargaly area, with important mining and smelting operations during the early Yamna period (Parzinger 2013), incrementing in later periods (see *§VII.2.1. Poltavka* and *§VIII.18.1. Sintashta–Potapovka–Filatovka*).

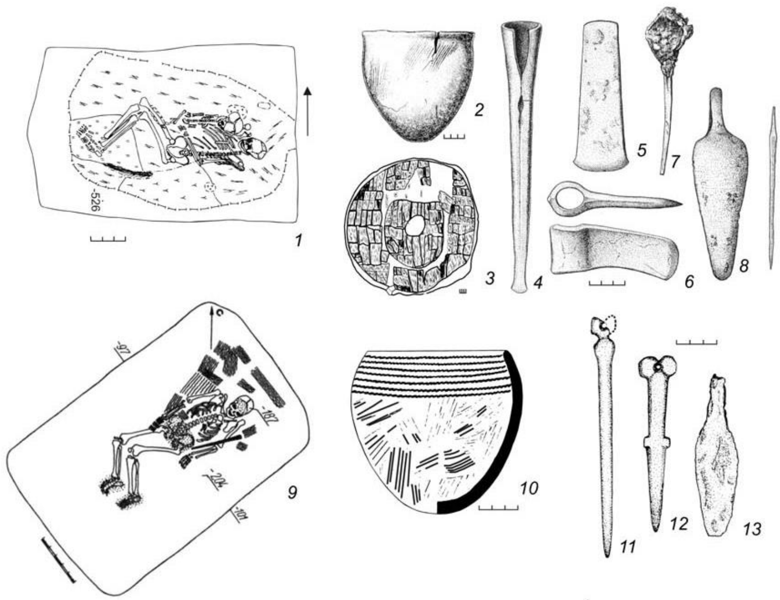

Figure 32. Material culture of Yamna on the Cis-Ural region (after Larin 2005). From Morgunova (2014). Compare with Afanasevo-type materials (see above).

vi.1. Disintegrating Indo-Europeans

Yamna samples had been described as being mainly composed of EHG:CHG ancestry (Jones et al. 2015; Lazaridis et al. 2016). Nevertheless, based on the ancestry of Afanasevo samples without EEF, and on later Yamna samples with EEF contributions, the late Repin expansion to the north Pontic area must have caused a mean EEF increase of ca. 15% to their typical Steppe ancestry inherited from the Khvalynsk–Novodanilovka expansion, varying from a minimum in the east (ca. 13%) to a maximum in the west in Hungary (ca. 17%), with intergroup differences not statistically significant (Suppl. Graph. 7). Further external contributions are found from a source related to Eneolithic Caucasus individuals in Yamna samples from the northern Caucasus (ca. 2900–2400 BC), and especially in a Yamna outlier from Ozera in the north Pontic area (ca. 40%), apart from later Catacomb samples from the same area (Wang et al. 2019), which support admixture with locals through exogamy.

The EEF ancestry found in Yamna points to a mix of NWAN (ca. 80%) and WHG (ca. 20%), and groups as distant from each other as Globular Amphora and Iberian Chalcolithic work as proximate surrogate populations for this kind of contribution (Wang et al. 2019). A similar ancestry may probably be found in Middle and Late Neolithic farmer groups from east-central Europe, such as Funnel Beaker and other post-LBK groups near the Balkans, and perhaps certain late Trypillian groups of the north Pontic forests, based on their close interaction with TRB—although samples from the Verteba cave have shown more EHG contribution (see *§v.6. Late Uralians*). EEF ancestry is also found elevated in Corded Ware samples, possibly up to 50% in certain groups (Wang et al. 2019), with a great part probably due to north Pontic-related Eneolithic interactions.

Compared to the Eneolithic Volga–Ural population, which had probably little or no EEF ancestry, the appearance of this ancestry in Yamna suggests thus an admixture of expanding late Repin groups from the Middle Don with Eneolithic populations of the north Pontic steppe and forest-steppe areas, which are also the likely source (or one of the main sources) of this ancestry found later in Corded Ware migrants. This admixture was probably driven by exogamy during the expansion of the late Repin strict patrilineal society, dominated by male elites, evidenced by the expansion of an overwhelming majority of R1b1a1b1-L23 lineages with Yamna. This is supported by the finding of late Sredni Stog samples as one of the best proxy populations (together with GAC and Iberia Chalcolithic samples) for the extra EEF ancestry found among Yamna peoples [16]. On the other hand, the homogenisation of this new EEF ancestry among all Yamna peoples—with no statistically significant differences between groups with the current number of samples—supports additional intense contacts and "internal exogamy" between Yamna clans of both western and eastern groups, and potentially also the expansion of 'admixed' late Repin settlers to the east.

The eastern Yamna or Volga–Ural–North Caucasian group includes the Volga–Ural variant between the Volga and Ural rivers (with Lower Volga, Middle Volga, and Ural regions), and the North Caucasus variant (right bank of the Volga River region, Kalmykia, and northern Caucasus steppes until the Terek River). Among the dialects spoken in this region was probably the ancestor of Indo-Iranian. Most reported Y-chromosome haplogroups of Yamna samples are from sites in Samara, Kalmykia, and northern Caucasus areas ca. 3100–2500 BC (Haak et al. 2015; Allentoft et al. 2015; Mathieson et al. 2015; Wang et al. 2019): sixteen out of eighteen are of haplogroup R1b1a1b1-L23, with further reported subclades mainly from the R1b1a1b1b-Z2103 trunk, except one sample from Lopatino II, in the R1b1a1b1a-L51 line (see *§v.7. Common Indo-Europeans*). A sample from Karagash in Kazakhstan, of subclade R1b1a1b1b3-Z2106 (de Barros Damgaard, Marchi, et al. 2018),

[16] In terms of specific groups, Yamna individuals may be modelled as from samples from the Northern Caucasus Piedmont and the Volga–Ural area, with good fits being Progress Eneolithic (ca. 40–50%)+ and Khvalynsk–Samara (ca. 35–40%)+, as well as variable contributions of 'western' populations (ca. 5–15%)+, with the best proxies for the latter being GAC, Trypillia, Ukraine Neolithic (or Mesolithic), or Varna samples. These 'western' proxies coincide with those of the late Sredni Stog population of the north Pontic area (being themselves also a good fit for Yamna groups)—who do not derive sizeable ancestry from Khvalynsk (see above *§v.6. Late Uralians*)—and are also found elevated in Corded Ware and derived groups (see below *§vi.3. Disintegrating Uralians*).

further supports the connection of eastern Yamna groups of the southern Urals with Afanasevo.

The western Yamna or Southern Buh–Lower Don group included the Don River variant (Lower Don from the Ilovlya River to the mouth of the Don River and valley of the Western Manych River); the Siverskyi Donets variant (right bank of the Siverskyi Donets River between modern Kharkiv and Luhansk cities); the Azov variant (steppe of the Northern Azov Sea coast); the Crimea variant; the Lower Dnieper variant (from the Orel River and the Inhulets River to the Black Sea coast) with the Bilozirka, Nikopol, Kryvyi Rih, Dnieper "Stone stream", Left Bank of the Dnieper, and Black Sea coast regions; the North-Western variant (steppe and forest-steppe borderland on the Middle Dnieper and to the west from it), and the South-Western Variant (between the Buh and Danube rivers).

Local groups of the north Pontic steppe include the Donetsk group, the Middle Dnieper group, the Lower Dnieper and the Azov–Crimea groups, and the Southern Buh group. The kurgans between the Dniester and the Prut Rivers received influences from the main neighbouring regions—such as EBA of central and south-east Europe, Globular Amphora, and Corded Ware, Foltești 2 and Coţofeni cultures—and two cultural-chronological variants are described: the Early Dniester variant, and the Late Budzhak variant (Rassamakin and Nikolova 2008).

Western Yamna and Danube groups probably spoke the ancestral language to both North-West Indo-European and Palaeo-Balkan languages. While there is scarce data on Y-chromosome haplogroups, based on later European samples it is very likely that these territories hosted R1b1a1b1a-L51 subclades—in particular R1b1a1b1a1a-L151 (TMRCA ca. 2800 BC)—whose lineages are found centuries later spreading with East Bell Beakers (see *§vii.7. North-West Indo-Europeans*), and were probably in the majority among Pre-North-West Indo-European-speakers. It is also likely that West Yamna hosted

R1b1a1b1b-Z2103 lineages, probably associated mainly with Palaeo-Balkan-speaking clans.

Two samples show I2a1b1a2a2a-L699 lineages (formed ca. 6800 BC, TMRCA ca. 4500 BC, one in Kalmykia and one in Bulgaria (an outlier with contributions from NWAN-related ancestry), which supports the presence of this lineage among certain Yamna clans (Mathieson et al. 2018). Similarly, the presence of R1b1a1b-M269 subclade R1b1a1b2-PF7562 among modern populations in the Balkans, Central Europe, Anatolia, and the Caucasus (Myres et al. 2011; Herrera et al. 2012), speaks in favour of clans of this lineage also expanding with late Repin/early Yamna settlers, or potentially of remnant populations of the earlier Suvorovo–Novodanilovka migrations who were part of (or pushed by) expanding Yamna settlers. The finding of hg. R1b1a2-V1636 in Sharakhalsun (ca. 2780 BC) may also suggest that this lineage expanded with Yamna, or alternatively that it belonged to a remnant population of Maikop in the Northern Caucasus Piedmont eventually integrated in Repin or Yamna (see above *§v.2. Early Caucasians*).

The migration of Yamna settlers into Hungary appears to be homogeneous at first, with early samples clustering closely to other west Yamna samples. Two late samples from Hungary show already increased EEF ancestry (ca. 10% more than Yamna, with a close source for this ancestry found probably in neighbouring Baden-like Hungarian samples), at the same time as Catacomb individuals also received further EEF-related contributions (probably from the north Pontic area), whereas a late Yamna sample shows no marked change, and Poltavka shows even less EEF ancestry than preceding eastern groups (Wang et al. 2018). This evolution ca. 3100–2500 BC suggests an initial homogeneous expansion, where Yamna clans either kept close contacts with other steppe clans or displayed little exogamy practices with the local groups they encountered; and a later gradual regional isolation, including interaction and admixture with different local groups.

VI.2. The Transformation of Europe

The so-called "Transformation of Europe" should probably be described as continuing the expansion of the 'steppe package' into western Europe, with expanding European cultures (such as northern European Globular Amphora or Corded Ware cultures, Balkan cultures like Makó/Kosihý–Čaka /Somogyvár) which share common traits (Heyd 2011):

- An essential individualisation in burial ritual, up to individual graves: in wide parts from north-west and west Europe this is associated with the megalithic world, and—still in collective graves—the appearance of individualising marks and personal possessions.
- Mound building as personal memorial over individual graves.
- Gender separation, not only in specific rituals, but also in gender-specific offerings.
- Monumental anthropomorphic stone stelae, appearing first during the Middle Eneolithic in Lower Mikhailovka I, but later widespread in a transect from east to west Europe, from the Kemi-Oba group (succeeding Lower Mikhailovka around Crimea) to Iberia, and being especially relevant in northern Italy and southern France.
- Internationalisation of certain goods, visible e.g. in the Grand Pressigny daggers.
- Symbolic prestige and status objects, also represented in stelae, like copper Remedello daggers and double spirals.
- Assignment of value to flint items according to the raw material they are made of (viz. valorisation of axes made of banded flint in GAC, flints for production of axes in CWC, spread of blade daggers of Grand Pressigny flint in western Europe, etc.).
- Differences in technological advances in the Final Eneolithic become smaller between regions and within them (compared with the production of sophisticated tools by specialised craftsmen in earlier phases).

Reasons for this transformation—as evidenced by the steppe origin of these cultural traits—lie in the reaction of central and western Europe to the expanding economic innovations from the south-east (during the second half of the 4th millennium), associated with the further expansion of the "Secondary Products Revolution", which involves the introduction of the wheel and wagon, plough, sheep wool, and probably also alcoholic beverages, first for the elites, then also to the whole agrarian population. Another reason could have been the influence of Aegean EBA cultures and their intensifying networks of communication, exchange, and even commerce (Heyd 2011).

However, the most important reason for this successful widespread adoption over almost all Europe (especially regarding late influences) must have been the irruption of thousands of Yamna migrants after 3100/3000 BC into the Carpathian Basin, which triggered a 'domino effect' in northern and central Europe, expanding further with CWC, GAC, Baden, and other central and west European cultures in contact with the new immigrants. For example, flint daggers – replacing copper daggers in the mid–4th millennium – reached the whole Balkans, the Aegean and Anatolia in the first quarter of the 3rd millennium (Heyd 2011).

VI.2.1. Tumuli

Western Yamna tumuli were not the first to be erected in their settlement areas (see *§V.4. Steppe package*), but they represent the first real wave of standardised tumulus construction. In neighbouring cultures, sometimes from distant regions, round personalised tumuli emerge. Five areas can be listed around the actual Yamna distribution (Heyd 2011):

- East Banat and west/south-west Transylvania. Tumuli are small and low, stones are used in their construction, and culturally they belong to late Coţofeni and successive cultures such as Lizevile in the west, Șoimuș in the south-west. In other parts of Transylvania, tumuli are constructed as well.

- East-Slovakian burial mounds are ca. 350 tumuli found in the Carpathians of east Slovakia, showing an amalgam of an inner Carpathian culture and Corded Ware tradition originating from the north of the Carpathians, which dates them rather to the mid–3rd millennium, although some poorly equipped ones may be earlier.
- Dalmatia and the east Adriatic coast: a large tumulus province extending all along the Dalmatian coast into its hinterland, reaching into Bosnia and probably Albania, as well as North Italy and Apulia. These are part of the Adriatic province of the Vučedol culture.
- Transdanubia, south-west Slovakia, and the Austrian Burgenland show some coherent cluster of tumuli with other Yamna links, such as a copper dagger, and a hair spiral. Neighbouring the Little Hungarian Plain, culturally it belongs to Makó/Kosihý–Čaka, Vučedol, and early Somogyvár.
- The largest continuous tumulus zone, as in the case of the cord decoration, is the distribution area of the Corded Ware and Single Grave cultures of central and north-central Europe. These are small tumuli, probably receiving the idea through Austria and Moravia, through the northern Carpathians into Poland (the origin of the A-horizon, see *§VI.3.3. East-Central Europe and Globular Amphora*), or more likely south-east Poland through contacts with the rivers San, Prut and Dniester, and the Yamna there.

VI.2.2. Anthropomorphic stelae

Large anthropomorphic stone stelae seem to have first appeared in the Mikhailovka I culture in the second half of the 4th millennium. Mikhailovka I areas were replaced by the Usatovo culture (related to Trypillia), but its culture continued in the Kemi-Oba culture of Crimea. Carved stone stelae appear to have expanded in frequency and elaboration in both territories, and in part of the north Pontic steppes, after about 3300 BC (Anthony 2007).

Strikingly similar stone stelae appeared later in the Caucasus, Troy, and also in central and western Europe, and with special frequency in the Swiss Alps and in the Provence, with examples also in the Iberian Peninsula and northern Germany. A maritime route for some of these cultural expansions has been proposed, which would justify e.g. its early presence in Troy (Anthony 2007).

VI.2.3. Associated cultures

Mainly associated with funerary customs in the Yamna horizon, the use of other carved anthropomorphic stones seems to herald the influence of the Yamna culture in Europe. The first wave of the warrior ideology starts around the mid–4th millennium, probably coinciding with the expansion of late Repin / east Yamna settlers.

Rich single graves, daggers, flint and copper halberds, or anthropomorphic stelae are part of the new Mediterranean trends. Thus, pre-Beaker Italy shows the Gaudo culture (ca 3300 BC), the Remedello and Spilamberto culture (ca. 3400/3300 BC), and the potentially slightly earlier Rinaldone culture. *Statues-menhirs* appear in southern France, and Italian influence is felt in the Alps and south-eastern France in the late 4th millennium, and later in cultures of macro-villages appear in southern Iberia (Jeunesse 2015).

The building of tumuli, the enhancement of gender distinctions, and the internationalisation of special objects made of rare materials as status indicators are seen slightly later. This influence was seen in the Corded Ware/Single Grave culture in central and eastern Europe in the east, Vučedol in the western Balkans, Makó/Kosihý–Čaka/Somogyvár in the Carpathian Basin and even the early Bell Beaker culture in south-western Europe around 2700/2600 BC (Harrison and Heyd 2007). Stone stelae and figurines might have also been used quite differently, or for different purposes, in certain local cultures (Robb 2009; Díaz-Guardamino 2014).

Radiocarbon dates from the north Pontic steppe show the late presence of steppe material cultures in the Carpathian EBA (ca. 2500 BC), in the

Makó/Kosihý–Čaka/Somogyvár–Vinkovci, late Vučedol, and others like Schneckenberg-Glina III, Csepel, or Early Nagyrév. These cultures have been argued to form a cultural unity, and it is proposed that such influence may have come from Yamna settlers on the left bank of the Tisza River (Rassamakin and Nikolova 2008).

The appearance of the Classical Corded Ware culture from the Rhine to the Danube ca. 3000–2750 BC, apart from all these reasons, was facilitated by the previous expansion of the similar Globular Amphora culture, which must have worked as a catalyser, not only because of its similar regional expansion, but also because of its structural similarities with later Bronze Age stages. Globular Amphora was itself rooted in the previous TRB tradition, in the same region (Heyd 2011).

Another common Late Copper Age trait were the sets of weaponry that became associated with individual graves: the battle axe and flint dagger for the Corded Ware; copper shaft–hole axes for Makó, Vučedol, and related groups; and the bow and arrow and copper dagger for the users of Bell Beakers. This weaponry and its symbolism define the idealised image of the Late Copper Age warrior (Heyd 2011).

Signs of this transformation in south-west Europe, from Iberia through Atlantic façade to the Rhine delta, include scattered perforated battle axes of various styles in northern Iberia (3000–2500 BC), and daggers of flint and copper in collective tombs of central Portugal, the Algarve, and Andalusia (3000–2700 BC). The demographic or economic pressure of Yamna migrants must have been responsible for the events in southern and west-central Iberia that led to the creation of macro-villages, i.e. the migration from villages and hamlets into enormous settlements, with their satellites, outlying forts, and cemeteries of megalithic collective tombs (Heyd 2011).

In the end, supra-regional cultures superseding smaller, regional-based cultures of the earlier Copper Age represented a cultural phenomenon that united wide regions of Europe. Influenced by these European trends was born the Proto-Beaker package in west Iberia, expanding quickly into Central Europe, probably triggering cultural adoption, and accompanied only by minor population movements, if at all (Heyd 2011).

vi.2. Late European farmers

Three individuals from the Remedello culture, probably all of haplogroup I2a1a1a1-Y3992⁺ (formed ca. 9400 BC, TMRCA ca. 6700 BC), and from Ötzi the Iceman, of haplogroup G2a2a1a2a1a-L166 (ca. 3500–3100 BC), all of northern Italy, show a high affinity with Chalcolithic samples from central Anatolia at Kumtepe. This affinity is higher between them than with earlier Anatolian Neolithic populations, which is against the interpretation of Remedello's ancestry representing a relict population stemming from Neolithic farmers (Hofmanova et al. 2016).

Because of their shared drift with CHG ancestry independent of steppe expansions, and because Kumtepe predates the northern Italian group by some 1,000 years, it has been proposed that they represent a more recent, yet undescribed, gene flow process from Anatolia into Europe. This Anatolian region shows a continued 'eastern' migration found in Anatolian Chalcolithic samples (Kilinc et al. 2016; Lazaridis et al. 2017).

Three Baden samples (ca. 3600–2850 BC) show no contribution of Steppe ancestry (Lipson et al. 2017), with one hg. G2a2b2a1a1c1a-Z1903 (formed ca. 6000 BC, TMRCA ca. 2400 BC), which—together with the genetic picture of Globular Amphora (see *§vi.3. Disintegrating Uralians*)—supports the cultural rather than demic diffusion of concepts related to the Yamna culture during the "Transformation of Europe".

Later cultures emerging in the Balkans near Yamna show contributions from the steppe, though: two of three samples of the Vučedol culture (ca. 2800–2700 BC) show Steppe-related ancestry over a mainly Balkan Chalcolithic population, with one sample from the Vučedol Tell of G2a2a1a2a-Z6488 lineage, and another from Beli Manastir–Popova Zemlja, Croatia (margins of the Vučedol area) of R1b1a2a2-Z2103 subclade (Mathieson et al.

2018). This supports the interpretation of (at least some) Balkan LCA cultures as a mixture of local and steppe populations.

VI.3. Classical Corded Ware culture

VI.3.1. Genesis of the Corded Ware culture

The origin of the Classical Corded Ware culture has been traditionally placed near the Volhynia–Podolia region, related to findings of Lesser Poland, Kuyavia, and adjacent regions of Ukraine and Slovakia, probably ca. 3000/2900 BC, and quite likely directly influenced by the *push* of the Yamna explosive migration to the west, but (at least initially) neither related nor in contact with it (Kristiansen 1989; Anthony 2007; Włodarczak 2008; Kadrow 2008).

The westward expansion of the Yamna culture along the Danube River, south of the Carpathian Mountains and along the upper Tisza River, put this culture in close contact with other “kurgan” cultural systems, south and north of the Carpathians. The Lesser Poland region found itself thus in close contact with communities characterised by new principles of social organisation and a new funeral rite. Around 2800 BC, these changes became evident in different regions of Poland, with the most numerous examples being documented in south-eastern Poland and Kuyavia (Włodarczak 2017).

The new Corded Ware material culture has no straightforward analogies in the world of the Pontic–Caspian steppe communities, though. To the north of the Carpathians, including the first examples of Złota and early Corded Ware, no graves indicating their relationship with communities of the steppe zone have been found. On the contrary, the funerary rites always display a local, central European nature (Włodarczak 2017).

Nevertheless, individual elements typical of the steppe do appear, emphasising the individual, maintaining specific rules of orientation and sharing features like the flexed position of the corpse and the deposition of drinking vessels, weapons, and other specific types of objects as grave goods.

The connection of the Corded Ware culture with Yamna or Bell Beaker and Balkan EBA groups occurs therefore through both the spread of a Yamna package, and the earlier spread of the so-called ‘steppe package’ (see *§V.4. Steppe package*).

The nature of economic activities of the different communities was variable depending on the environment, with coastal zones of the Baltic Sea, forests and lakeside zones showing an important role of hunting and fishing. However, while natural conditions determined the particular local adaptations, the overall economic structure remained usually dominated husbandry, including herds of bovine and sheep–goat. Even in zones with fertile soils, exploited agriculturally for hundreds or thousands of years prior to their arrival, there was a clear turn towards husbandry, which proved especially attractive to para-Neolithic communities of the not so fertile lands (Włodarczak 2017).

Animals were used for meat consumption, milk, wool, and also as pack animals. The importance of transportation is seen in the well-established roads at the time, and in the ease in travelling long distances. Palynological, zooarchaeological, and geological data, including some features of the material culture (like extensive circulation and short-term encampments along microregions, e.g. river beds) point to a mobile way of life associated with husbandry (Kadrow 2004). The mobility of Corded Ware settlers relied primarily on short-distance shifts, probably repeated multiple times, and was thus a continuation of a model from an earlier period of the Globular Amphora culture (Kośko and Szmyt 2004).

Regarding the impact of animal traction and the wagon, they are present in the archaeological record at least since 3400 BC, but they do not play any visible role in Corded Ware burial rituals, very much in contrast to the previous periods. Finds of horse bones are exceptional discoveries (Pospieszny 2015), unlike in the period before 3000 BC, and no evidence is found for an increased relevance of horse domestication during or in connection with the Corded

Ware culture There is thus no evidence for a widespread use of horseback riding (Włodarczak 2017).

The theories regarding the significant role of the horse in the economic, cultural, or even ethnic changes taking place in this culture are not confirmed Horse bones are not deposited in graves in any form, unlike commonly encountered bones of bovine, goats/sheep, and dog. Burials of horses would only appear later, during the Trzciniec culture (Włodarczak 2017). The economic importance of the domesticated horse was negligible, even lower significance than among Globular Amphora culture communities (Krośko and Szmyt 2004).

All this notwithstanding, the Corded Ware culture brings about a clear change in the structure of networks, a significant widening of scales, connecting formerly distant regions, with common practices and symbols widely exchanged and integrated into the local habits and discourses. This supra-regional network is the result of an increase in mobility, and probably an expansion of patrilineally-related clans (Włodarczak 2017).

VI.3.2. Single Grave

Some of the earliest radiocarbon-dated groups associated with the Corded Ware culture come from new single graves from Jutland in Denmark and Northern Germany, ca. 2900 BC. This Early Single Grave culture is associated with the appearance of individual graves (some time after the decline of megalithic constructions), composed of a small round barrow and a new gender-differentiated burial practice emphasising male individuals orientated west–east (with regional exceptions), combined with the internment with new local battle–axe types (Figure 33): A-Axe, boat-shaped battle–axes with an elongated rib on the upper surface (Furholt 2014).

Figure 33. Neolithic boat axe of the Single Grave culture, from Boberow. Photo by Wolfgang Sauber. Image from Wikimedia Commons.

A ‘Corded Ware package’, appearing ca. 2900 BC, and available at least partially on many burials, included artefacts such as objects for consumption of drinks (clay beakers or similar vessels) or equipment needed for battle or hunting (stone axe-hammer, flint knife, flint archery accessories such as bow or arrowheads), and less often ornaments made out of bone, copper and amber, as well as tools made of bone or flint (Figure 34). They are therefore an affirmation of battle, hunting and feasting, as well as libations (Włodarczak 2017). However, it is not until ca. 2700 BC when the pure A-Horizon of the Corded Ware group is seen in the region, unifying culturally the ‘core Corded Ware province’ formed by Jutland and Northern Germany, the Netherlands, Saale, Bohemia, Austria and the Upper Danube regions (Furholt 2014).

In central Europe, mounds had a diameter of 10–20 m and a height of 1.5–2.5 m, with an additional circular groove surrounding the centrally placed grave. The pit was often supplemented by a wooden structure, usually in the form of a box (in some cases by stone structures), and thanks to these additional structures the pit gained the form of a chamber with walls and a roof, “the house of the deceased”, where grave goods were also deposited (Włodarczak 2017).

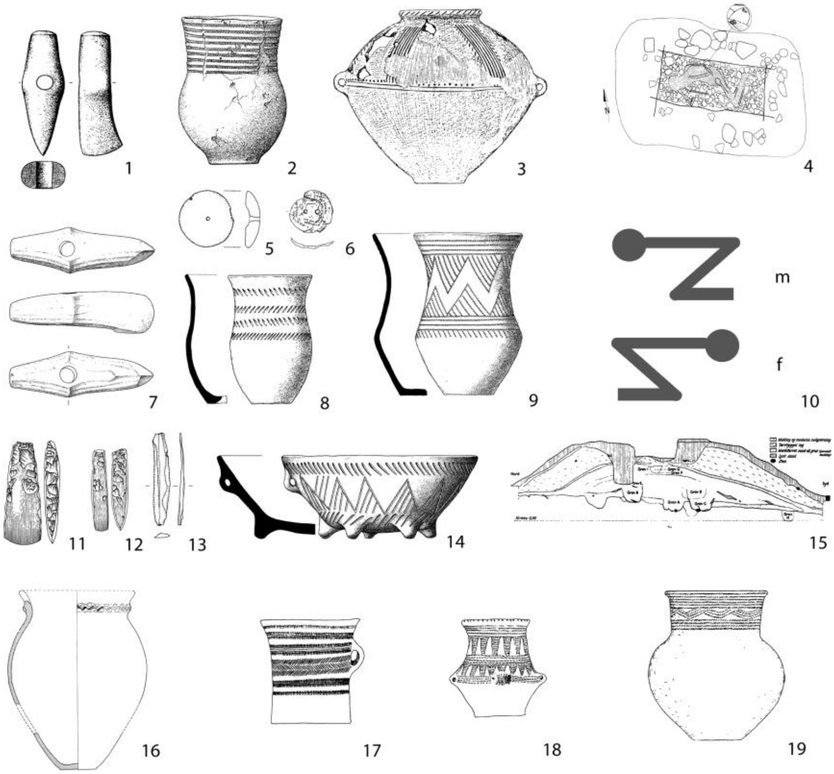

Figure 34. The "Corded Ware package", i.e. elements with a supra-regional distribution: 1. Battle–axe (Type A); 2. Corded beaker (type A); 3. 'Strichbündelamphora'; 4. Single burials below barrows (15), Gender-specific deposition rules (10); 5. Amber ornament disc (all Hübner 2005); 6. Bone ornament disk; 7. Facetted battle–axe; 8. Herringbone-ornamented beaker; 9. Triangle-ornamented beaker (all Dresely 2004); 11. (flint) axe; 12. (flint) chisel; 13. flint blade (all Hü bner 2005); 14. Bowl (Dresely 2004); 16. Short-wave-moulded 'Wellenleisten-'storage vessel (Strahm 1971); 17. Straight-walled vessel; 18. Amphora (both Matthias 1968); 19. Short-necked beaker (Włodarczak 2006). Image modified from Furholt (2014).

Single burials dominated, and the deceased were laid to rest in a foetal position on their side, with men usually on their right, women usually on their left, both looking to the south. The right to the single burial and to the 'grave goods set' (including vessels and weapons) was granted mostly to males (men, and sometimes children, believed to be an inheritance of warrior status), with females showing only some of the objects, and sometimes other more exotic ones, and being a majority among double and collective burials (Czebreszuk and Szmyt 2011).

All these burial traits distinguished the Corded Ware kurgans from previous GAC or Baden traditions: the spread of single burials, on the one hand, and the emergence of a complete set of new features, on the other, like the specifics of the grave structure, arrangement of the body of the deceased, and the type of grave goods, all of which point to a new ideology, partially based on local central-eastern European groups (see *§V.5.2. Lublin–Volhynia*).

Differences can still be seen in some of the older groups, though, so no strict funerary norms existed (Furholt 2014):

- In southern Sweden the prevailing orientation is north-east–south-west, and south–north; contrary to the supposed rule, male individuals are regularly deposited on their left and females on their right side.
- In the Danish Isles and north-eastern Germany, the Final Neolithic / Single Grave Period is characterised by a majority of megalithic graves, with only some single graves from typical barrows. In south Germany, west–east and collective burials prevail, while in Switzerland no graves are found.
- In Kuyavia (south-eastern Poland), Hesse (Germany), or the Baltic, west–east orientation and gender differentiation cannot be proven statistically.

Interesting is the presence of copper-rich burial inventories (some of which are imported from Yamna or Yamna-related cultures), in contrast to neighbouring cultures in the same region (Heyd 2004): for example, central European CWC burials do not show signs of metalworker burials, while west Yamna and later Bell Beaker or Makó/Kosihý–Čaka show a higher specialisation in metallurgy (and still there are proportionally, in comparison with south-eastern Europe, not many metalworking sites).

On the other hand, graves of silex workers and silex commerce is everywhere to be seen associated with the expansion of the culture and its daggers (flint daggers had replaced the earlier, Eneolithic prestige copper daggers from ca. 3600 BC onwards), including west France (with Grand Pressigny type), north Italy (Monte Lessini) and to the north, west of the Rhein (with Bavarian Plattenhornstein type). This exchange network is also seen in the widespread findings of axes from Silesia, or amber from the Baltic region (Heyd 2004).

The presence of semi-products in burials (e.g. flint flakes for arrowhead production), used in activities related to flint acquisition and processing, suggests that this daily routine activity (and not those of metallurgy or blacksmithing) became accented in the Corded Ware culture's funeral ritual (Heyd 2004).

All this points to the continuation in metal-poor central European Corded Ware groups ca. 2900–2500 BC, from an earlier tradition from copper-rich groups, such as those close to the north Pontic steppe (see *§V.6. North Pontic area*). There was, however, a traditional centre of metallurgy around the Podolia and Volhynia regions from ca. 4000 BC (possibly around a large deposit of virgin copper in Volhynia). This centre had potential connections to the Carpathian-Danube circle, based e.g. on the production of "willow–leaf "-shaped jewellery and other types of jewellery, Bytyń-type flat axes with flanges (and later Stublo-type axes from the Vučedol tradition), etc. which eventually served the Corded Ware culture when it occupied the region (Klochko 2013).

The necessity of horizontal social mobility and exchange drove a change in settlement pattern in Central Europe, from a domination of villages to a domination of farmsteads and small hamlets, which took place at the latest around 2800 BC, reflecting a profound change of identity and ideology (Müller et al. 2009): from collective to individual; from the village community to the core family; from regional political organisation to the dispersed identity of far-distant social units (Harrison and Heyd 2007).

As an example, a typical CWC site at Wattendorf-Motzenstein could have at any given time a mean of 4 huts with ca. 20 inhabitants, with each household representing an independent economic unit. Investigation of the activities of the site shows that its inhabitants (Müller et al. 2009):

- undertook intensive cereal and pulse cultivation with a household-orientated processing regime;
- produced essential stone, bone, and ceramic tools in the household;
- used a common area for cultivation, with each household needing ca. 1.5 ha of arable land, and the whole settlement around 9 ha to cover the population needs;
- carried out stockbreeding of cattle, sheep, goat, pig, and horse, and practised hunting;
- collected the necessary raw materials within a distance of less than 20 km;
- occasionally took part in longer-distance expeditions for the acquirement of raw materials;
- planned the settlement layout, with huts arranged along constructed pathways;
- celebrated ritual activities centred on a pinnacle dolomite rock where millstones, broken sherds, and animal bones were deposited under the visual sign of a wooden post, and used miniature wheels and axes for ritual activities amongst everyday life, and within the household.

VI.3.3. East-Central Europe and Globular Amphora

The oldest Corded Ware vessels (the A-Amphorae, which define the “A-Horizon” or “pan-European horizon” of the CWC) come probably from the Złota (or a related) group in Lesser Poland, where a mixed archaeological culture connecting Funnel Beaker, Baden, Globular Amphora and Corded Ware appears ca. 2900–2800 BC. The origins of cord decorations are probably to be found in steppe cultures of the Dniester region, possibly in the Usatovo culture, although it may have appeared under pressure from the Coţofeni culture in the southern parts of the north Carpathian mountains (Furholt 2014).

No cultural (typological) break is seen between earlier Globular Amphorae and the first Corded Ware Amphorae, but rather a *continuum* of traits and characteristics among the recovered vessels (Figure 35). This strengthens the connection of Corded Ware with the Globular Amphora culture. The A-horizon expanded thus probably from Lesser Poland ca. 2800–2700 BC, as seen in the synchronous appearance in local contexts of Poland and neighbouring countries. Compared to the earlier periods, the range of forms used narrowed and was mostly limited to amphorae, beakers, and pots, with large storage vessels no longer used. A pot with a standardised, S-shaped profile, decorated with plastic bands (or various kinds of imprints) became the predominant vessel (Furholt 2014).

Figure 35. Examples of pottery of the Złota culture, showing similarities with Globular Amphorae and Baden cultures of east-central Europe. After Włodarczak (2008).

The first burial mounds associated with Corded Ware, and some of the known settlements of Lesser Poland and the lowland can also be dated to this period. The kurgan-related funeral ritual is associated with Złota cultural communities: single burial graves, along with the habit of interring the deceased in multiple burial graves, but emphasising their individual character by careful deposition of the body and personal nature of the grave goods (Włodarczak 2017).

Additionally, grave goods from Złota groups also display a transitional nature, with materials and stylistics belonging to an older system (e.g. amber products); and others correlated to the 'new world', such as flint products made of the raw materials typical of Lesser Poland's CWC, copper ornaments, stone shaft–hole axes, bone and shell ornaments, and characteristic forms of vessels like beakers and amphoras. Military goods, which would become prevalent in later periods, are present in a moderate number, compatible with their lesser importance (Włodarczak 2017). Interestingly, numerous amber products are found in graves associated with the Globular Amphora culture and Złota groups, but its importance diminished in barrows of the Corded Ware culture, only to increase again during the Bell Beaker period.

Catacomb graves, with an entrance pit and a more extensive niche, and a narrow corridor leading to a vault with interments and grave goods, are also found in this old period (ca. 2900–2800 BC) in three large burial grounds, Grodzisko I, Grodzisko II, and Nad Wawrem, in the vicinity of Sandomierz (Figure 36). Limestone lumbs were used for the construction of a barricade at the entrance of a catacomb, and for making a kind of lining on the floor where the deceased were then laid. There are individual cases of application of ochre and deformation of skulls. These graves were the standard form of burial in south-eastern Poland, and are known in greater number on the left bank of the Vistula River, as well as on the Lublin Upland and western part of Volhynia Upland, and loess uplands within the Subcarpathian zone. Their rich assemblages– including large group of features with metal items – distinguish these communities from others in Central Europe (Włodarczak 2017).

The Złota culture depicts thus the most likely transitional picture between local Late Eneolithic GAC groups and the emerging Final Eneolithic Corded Ware culture, with the development of an original funerary rite, unique material culture, and multi-directional, long-distance contacts: e.g. the import of amber from the north, vessels imported from Baden-related communities, catacomb graves probably connected with areas of eastern Europe (Włodarczak 2017).

Figure 36. Original drawing of burial no. 325 from cemetery "Grodzisko I" at Złota. 1920s. (archive of State Archaeological Museum in Warsaw). Modified from Włodarczak (2017).

One of the regions with most kurgan findings known is the uplands of south-eastern Poland, probably from an old phase of the culture ca. 2800–2600

BC. This region includes the western Lesser Poland loess uplands, the Carpathian foothills and adjacent Sandomierz Basin, as well as the western edge of the Volhynian Upland, Lublin Upland, and Roztocze. Kurgans were an expression of egalitarianism, but it did not apply to the entire group, only to a specific part; furthermore, kurgan burials of women are rare, and the rich assemblage of one of them suggests that only special women were honoured that way (Włodarczak 2017). In other regions of central Europe, like the territory formed by Central Germany, Moravia, or the Polish Lowlands, there is a small presence of kurgans, which may point to a permanently present but not commonly followed burial rite.

In Lesser Poland, during the first 300 years of its existence, the Corded Ware culture developed among the settlements of the agrarian Baden and Globular Amphora cultures, without mixing (Włodarczak 2001), among a complex regional picture that had formed during the 4th millennium (Zastawny 2015; Wilk 2016).

Settlements show a tendency to smaller sites with short-term occupation, which does not constitute a radical change in the settlement model, but rather a continuation of a trend that began earlier during the late TRB and GAC periods in the Polish Lowlands (Włodarczak 2017). Corded Ware settlements in Lesser Poland show the following characteristics (Czebreszuk and Szmyt 2008):

- They mark a turning point in the history of ancient settlement structures of the Polish Plain. The trend to minimal, mobile settlements (with smaller concentration of ceramics, and fewer elements making use of earthen constructions, such as pits, hearths or postholes) as points of expansion, also attested in GAC settlements (which show more variability in size and finds), acquires its maximum value in the CWC. Later during the BA would the number of settlements grow again.

- It is supposed that in northern Poland more settlements (camps) existed. They were unstable, and only used for a short time, so they left few traces. It is difficult, therefore, to consider such territories as ‘scarcely’ settled.
- CWC-camps were founded on unstructured (usually sand) soil, in exposed sites like river- and sea-coasts. They preferred settled sites, i.e. those already changed through anthropogenic activity.
- Settlements and burials were located in the same zones, usually in the immediate neighbourhood. In some cases, it is difficult to differentiate settlement from burial fields, since both types of remains are mixed.

The main defining trait of the oldest CWC groups (in the Polish Plain and the Upper Vistula basin) are therefore small kinship groups marked by migrations, with relatively short breaks, building of small encampments of a temporary nature whose relicts are extremely difficult to identify. Enduring markers of such migrations were graves, at first isolated at a marked distance from one another, and which did not form cemetery complexes (Czebreszuk and Szmyt 2011). Intergroup links had to be strong, as evidenced by cooperative behaviours determined for different activities: construction of graves, long distance expeditions, exchange, exploitation of natural resources, military conflicts.

In the Kuyavian area, there were no stable spatial barriers separating settlements of the different societies coexisting during the Corded Ware expansion (TRB–Baden, GAC, CWC): the same territory was used by groups of completely different traditions. The long duration of that phenomenon shows the lasting awareness of a separate identity of individual societies grounded in their symbolic behaviour and kinship-based social organisation (Szmyt 2008).

Cohabitation of GAC and CWC is documented in the Polish Lowlands and in the upper Vistula basin (ca. 2800–2600/2500 BC), but in other regions such as Mittleelbe–Saale the emergence of CWC ca. 2800–2700 BC meant the end of the GAC in the area. Both GAC and CWC were supra-regional structures with certain mutual elements of material culture and social behaviour (ritual end economic). Differences included (Szmyt 2008):

- Settlement: semi-settled existence with cemetery complexes playing a stabilising role for GAC; CWC did not possess a stable settlement network, and showed an economy based on mobility (or semi-nomadism) related to animal husbandry.
- Ritual: most CWC burials are single or double, while GAC contains more multiple burials; both show mounds over graves, with GAC mounds being larger, and CWC mounds surrounded by a small ditch with a palisade.
- Corded pottery: technology, morphology, and ornamentation, such as impressions of a ‘double’ cord in CWC.
- Other objects (flint, stone, bone, tools, weapons) and their means of production.

Flint axes, however, point to mutual traits between the two cultures, although weaponry and tools deposited as grave assemblages include for GAC one flint axe (sometimes more), whereas for CWC it includes a stone axe–hammer, flint knife, and archery accessories (Szmyt 2008).

Social organisation (inferred from burials and materials): CWC shows a status of men as dominant, monopolising rites and social activity as ‘heads of family’, in relations between neighbouring families, and in decision-making councils at a higher level, i.e. (supra-)regional contacts with other bodies in other parts of the CWC population. The Corded Ware culture has been described as a ‘Big Man system’, with a warrior elite class (associated with symbolic prestige symbols), with age classes, and composed of family-bound lineages and clans (Strahm 2002). In this sense, the Corded Ware society was a continuation of societies born out of the “Transformation of Europe”.

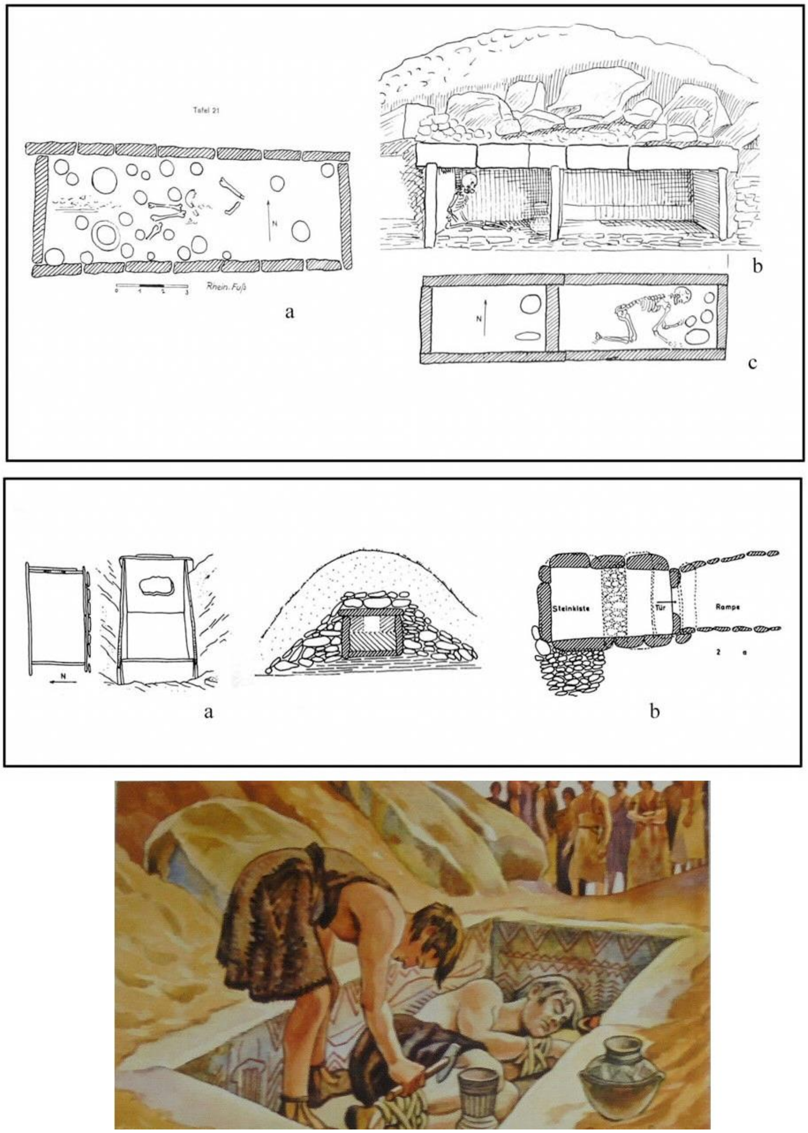

Figure 37. Tumuli of Central Europe during the Corded Ware period. 1a – Farnstädt I; 1b,c – Farnstädt II; 2a – Allstedt, Mallerbacher Feld; 2b – Lißdorf (after Behrends). Modified from Korenevskiy (2012). Bottom image: scene reconstruction from the Jungsteinzeit Bilderreihe by Gerhard Beuthner (1930).

There was a double cultural-social principle of the individual's identity in CWC: kinship (status gained at birth over small migratory kinship groups) and social identity gained through the individual's life. Social organisation in GAC was based on bigger kinship groups (made of at least several families), with rituals giving significance to ‘sacred’ places as territorial markers for their peoples, with cyclical dispersal and concentration of relation groups, where ancestor graves (Figure 37) would have been extremely important for social stability (Czebreszuk and Szmyt 2011).

One interesting trait of CWC funerary rites is the importance of the dog, which is buried together with a human, sometimes in an entrance pit to a catacomb tomb, or even in a separate burial. This is distinct from the sacrificial burials of the previous GAC, and reflects probably the interment of a friend, or of an animal part of the ‘inventory’ of the deceased. Burials of dogs are also found sporadically in other CWC groups in Europe (Włodarczak 2017).

In terms of pottery, three areas of regional influences can be distinguished: in south-eastern Poland, beakers display characteristics of the Middle Dnieper culture’s forms; in western Pomorze, Great Poland, and Kuyavia, flower-pot-shaped beakers appear with the traits typical of Single Grave culture; in Śląsk, vessels typical of Lusatian, Czech, and Moravian Corded Ware culture are present. These groups may in turn be related to “archaic” manifestations, such as materials from the Złota culture from the Sandomierz Upland, the Rzucewo culture from Pomorze, or the pottery of the forest zone of Mazovia, Masuria, and Podlasia (Włodarczak 2017).

VI.3.4. Circum-Baltic Late Neolithic

The TRB culture is supposed to have reached the Upper Bug ca. 3850/3700 BC, and soon afterwards (ca. 3600/3500 BC) it appeared in the Buh–Dniester frontier, reaching the drainage of the Horyn River, and the Taiga region possibly from the Upper Pripyat. After 3200/3100 BC, TRB colonisers are substituted by GAC societies, with the main process taking place ca. 2950–2350 BC, and reaching as far as Smolensk (ca. 2500 BC). During this time, it seems that some communities returned back to the Vistula–Dnieper region (Klochko and Końko 1998).

Among the so-called para- or sub-Neolithic traditions surviving into the 3rd millennium in the Forest Zone, the following are important for the development of the Corded Ware culture in the region:

The late stage of the Narva culture, part of the post-Narva phenomenon (dated ca. 4000/3750–3000/2750 BC) shows a highly diversified culture, with syncretic entities such as the Zedmar type, a synthesis of Nava (initially dominant) and Neman (eventually dominant). Other examples include the Šventoji and the Usvyaty cultures, the latter (ca. 3600–2600 BC) with TRB and GAC influences. In the opinion of many scholars, this phase is primarily marked by exogenous influences from the north (from the circle of Pit–Comb Pottery groups) and from central Europe (Funnel Beaker culture, GAC, and CWC). The impact of central European groups is most clearly intelligible in the south-western portion of the culture's range.

The late stage of the Neman culture (ca. 2800–1800 BC) is marked by its evident interaction with GAC and CWC settlers, especially in their area of contact, the drainage basin of the Neman and the Upper Pripyat. Earlier dates of the culture are recorded in Lesser Poland from the mid–4th millennium.

The late stage of the Prick-Comb Pottery culture is represented by the late stage of the Dnieper–Donets culture at the end of the 4th / beginning of the 3rd millennium—expanded from the forest-steppe region on the Dnieper area to the forest zone into part of Volhynia and Polesia (where the last remnants are found)—and the Upper Dnieper culture—possibly a variety of the Dnieper–Donets culture, surviving up to 3500–2500 BC, with its decline paralleled by the expansion of the Middle Dnieper culture.

There is a particularly conspicuous presence of comb ware in the materials of the Late Neolithic Zhizhitska culture (ca. 2450–2200 BC) in the Upper Dvina drainage.

The colonising Neolithic waves are continued by the Circum-Baltic Corded Ware culture, closely related to the traditions of the Single Grave culture and similar traditions of the Northern European Lowlands. After ca. 2900 BC, certain cultural systems with ‘corded’ traits—genetically related to the catchment area of the south-western Baltic—appear in the drainages of the Neman, Dvina, Upper Dnieper, and even the Volga. These communities are considered the vector of Neolithisation in the Forest Zone.

It is not clear how these ‘western’ influences affected the Yamna culture to the south, which is identifiable in the forest-steppe zone up to the Dnieper–Inhulets line. For example, in the Yampil Barrow complex between the Buh and Prut rivers, including part of the Podolia region, influences of cultures are seen in the kurgans and their graves, with Kvityana, late Trypillia (Gordinești or Zhyvotylovka-Volchans’k), GAC, early and middle Yamna, Corded Ware, and Catacomb traits succeeding each other (sometimes with obvious cultural influences between each other, in this period (Włodarczak 2017). Movements in the opposite direction, deep into Corded Ware territory, are also seen by groups of Comb-like decoration, reaching up to the Vistula and Oder (Klochko and Kośko 1998).

Burial customs of Corded Ware settlers in the eastern Baltic (from Lithuania, Latvia, Estonia, and western Belarus) include single graves or small cemeteries for up to 10 individuals, but larger cemeteries are unknown. Interment in a flexed position is common, and grave goods consist of battle–axes, flint axes, and large bladed knives, bone pins and wild boar tusks, with pottery appearing rarely. The absence of barrows, common in Central European CWC and to the south near the Pontic–Caspian area, sets this group apart from others (Piličiauskas et al. 2018).

Organic residue analysis demonstrates that a range of ruminant products, including milk, was preferentially processed in the CWC beakers, representing a radical change with respect to previous sub-Neolithic cultures. Flint blades were probably used for processing meat (Piličiauskas et al. 2018). Corded Ware individuals represent thus a transition from a mainly hunter-gatherer economy to agropastoralists in the Circum-Baltic region, although usually maintaining a mixed economy with a significant role of hunting, fishing, and gathering.

The Pamariu (Rzucewo) culture developed on the south-eastern shorelines of the Baltic, from a basic substratum in the populations of the Narva and Neman cultures, unified after ca. 2800 BC under the TRB, GAC, and CWC cultures, from Gdańsk to the Courland Lagoon (Szmyt 2010). The arrival of the Corded Ware culture in the region has been described as a process of infiltration of small groups in the local culture medium, due to the scarce research areas available to date. Even taking into account the scarcity of findings, there are some similarities in Baltic graves with the grave-set in Lesser Poland, including battle axes, flint artefacts, or crouched position of the body. The most striking finding of this region is probably the presence of permanent settlements within the coastal zone, the relevance of fishing and hunting (especially of marine mammals) for the economy's structure, and the acquisition of amber. There were both large, permanent settlements, situated in the upper zones of surrounding terrain, and short-term campsites located on floodplains (Włodarczak 2017)

One of the best studied sites is Suchacz, in East Prussia, where traces of 16 houses were discovered, consisting of post-frame buildings with sunken floors, typical of the Baltic coastal area (Figure 38). The location of other sites and the nature of dwellings (with occasional traces of structural repairs) point to permanent inhabitation. Permanent and short-term settlements alike were engaged in amber workshops, which continued a Final Eneolithic tradition. The only known large settlements among Corded Ware groups are found in the eastern Baltic, associated with the acquisition of amber. Domestic animals included mainly cattle and pigs, with goat–sheep being less represented than in other CWC groups. There is no confirmed agricultural activity (Włodarczak 2017).

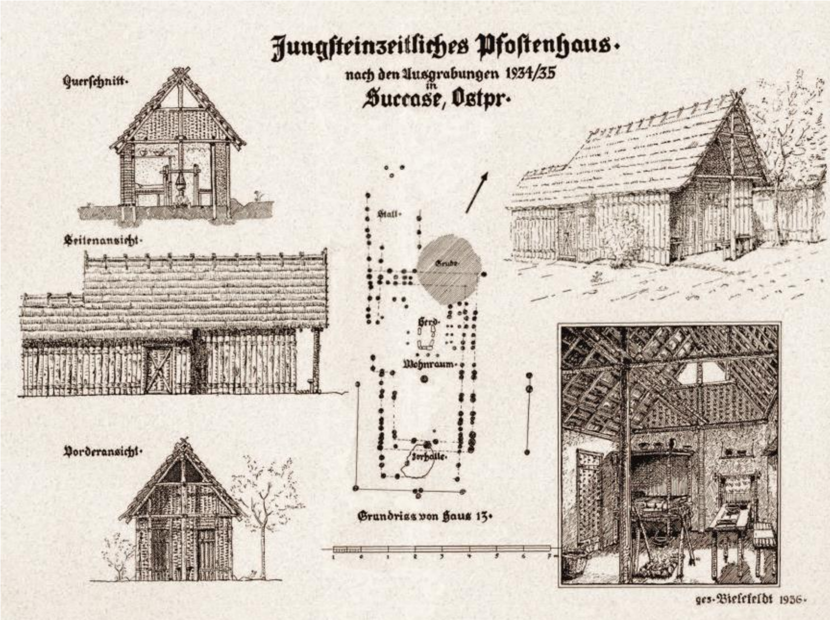

Figure 38. House no. 13 from Suchacz and attempts at its reconstruction, according to Ehrlich (1935). Modified from Włodarczak (2017).

The earliest Corded Ware in Finland is dated to ca. 2900–2800 BC, but the scarce data on the earliest sites preclude a proper estimation of mechanisms through which this culture appeared. There is a clear interaction sphere between the areas surrounding the eastern Gulf of Finland, reaching from Estonia to the areas of present-day Finland and the Karelian Isthmus in Russia, evidenced e.g. by the sharp-butted axes, derived from the Estonian Karlova axe (Nordqvist 2018).

VI.3.5. Contacts with Yamna

Proposed Yamna – Corded Ware cultural contacts are based on certain late 'Yamna–Catacomb' traits in the Baltic drainage basin, such as pit- and catacomb/niche-graves or 'Pontic' traits of funerary structures; production patterns typical of the Donets Basin and Caucasus centres of metallurgy and glass-making; and single finds of insignia-type forms, like Catacomb-type axes (or local imitations), or fluted maces. Other occasional finds include isolated 'Pontic' ritual, settlement, or funerary features (Klochko 2013).

In the Neolithic of the Vistula drainage, there are no prototypes (genetic inspirations) of ‘Yamna’ designs of grave chambers or single burials underneath barrows that appear in the early stages of CWC development. On the Lowlands, these are deep, straight-walled excavations 0.85–1.0 m deep, dated to 2850–2700 BC. On the Old Uplands of Lesser Poland—where niche chambers dominate—there is a Yamna-like chamber from a feature located underneath a barrow at Koniusza I ca. 2500 BC (Włodarczak 2008). These and similar isolated structures are elements of an exogenous funerary tradition, genetically related to the Yamna culture, likely spread towards the Vistula following left-bank tributaries of the Dniester towards the Bug drainage (Klochko 2013).

Yamna peoples entered the forest-steppe zone to the north of their territory ca. 2700 BC, with their presence being confirmed ca. 2550/2500 BC in the right bank of the Middle Dnieper drainage, and it may be accepted that they did the same in the Dniester–Prut interfluve. Contacts with the GAC population is well documented in terms of GAC cultural remains in Yamna settlements, as well as the use of ochre in certain GAC graves of the area after 2700 BC. The appearance of Corded Ware groups in the region between the Upper Vistula and the Dniester, before 2700 BC, must have culminated with the eastern expansion of Corded Ware peoples that caused the emergence of the Middle Dnieper group, and the decline of the eastern GAC societies (Szmyt 2013).

In the Baltic drainage, ‘Yamna’ features—leaving aside funerary patterns which are also common to the Złota culture—are thus catacomb cultures from Kraków–Sandomierz (ca. 2700/2600 BC) and Grzęda Sokalska (Roztocze, after ca. 2600 BC), the latter showing closer affinities with forms from Black Sea steppes, suggesting direct contacts of the Inhul group through the Buh drainage (Włodarczak 2008). This assumed route is also supported by the high share of Middle Dnieper culture patterns in the style of Grzęda Sokalska pottery, recorded on both the Bug and lower Vistula rivers.

vi.3. Disintegrating Uralians

The expansion of Proto-Corded Ware peoples was likely not related to the Złota group, given the common ancestry that sampled individuals show with other Globular Amphora samples. Nevertheless, the five individuals sampled from Książnice (ca. 2900–2630) show evidence of an additional gene flow, most likely from an eastern source, related to Steppe (ca. 10%) or EHG ancestry (ca. 8%), which supports contacts through exogamy of this group with Corded Ware, likely during the period of intense GAC–Trypillia–CWC interactions (Schroeder et al. 2019). The only reported paternal lineage from the Złota group is I2a1b1a2b1-L801 in an individual from Wilczyce, which supports the common genetic stock between GAC and Złota, different from Corded Ware peoples, and thus the spread of steppe features proper of the Yamna culture among neighbouring, non-Indo-European populations.

Corded Ware peoples have been described as deriving as much as 75% of their ancestry from a source close to Yamna samples from the Pontic–Caspian region (Allentoft et al. 2015; Haak et al. 2015; Mathieson et al. 2015). However, this shared Steppe ancestry is formed by different layers of admixture, which made both groups eventually converge genetically. The greatest similarity comes from the Steppe ancestry found in Eneolithic peoples from the forest zone (from which Proto-Corded Ware peoples likely derive), acquired through admixture with previous Novodanilovka settlers in the north Pontic forest-steppe region (see *§iv.2. Indo-Anatolians*).

Corded Ware samples published to date have additional EEF ancestry (between 30–50%) with similar values found in late Sredni Stog samples (Wang et al. 2019), as evidenced also in the continuity of both populations in their PCA cluster. In the Volga–Ural area, EEF contribution was probably minimal during the Eneolithic (based on Afanasevo samples), while the ca. 15% found in Yamna was probably due to the admixture of late Repin / early Yamna settlers with late Sredni Stog and other north Pontic groups (see *§vi.1. Disintegrating Indo-Europeans*). A good fit for the ancestry found in early

Corded Ware individuals is the Sredni Stog individual from Oleksandriia (ca. 80–90%)+ and additional 'local' sources of WHG or EEF ancestry. These differences of CWC individuals with Yamna are more clearly evidenced by the different Y-chromosome bottlenecks undergone in the Khvalynsk/Repin/Yamna communities, predominantly of hg. R1b1a1b-M269, and in the Sredni Stog/Corded Ware groups, with a majority of hg. R1a1a1-M417 lineages.

Among early individuals, one sample from Obłaczkowo (ca. 2700 BC) shows hg. R1b1-L754; samples from Brandúsek (ca. 2900–2200 BC) include two of hg. R1a1a1-M417, and one of hg. I2a1b1b-Y6098 (Olalde et al. 2018); and samples from Jagodno (ca. 2800 BC) show possibly hg. G and J/I (Gworys et al. 2013). Two individuals of the Single Grave culture from Tiefbrunn (ca. 2900–2600 BC) are of hg. R1a1a1-M417, and one from Bergrheinfeld (ca. 2650 BC) of hg. R1a1a1-M417, possibly xR1a1a1b-Z645 (Allentoft et al. 2015).

Individuals from of the Battle Axe group include Baltic Late Neolithic samples: two individuals from Ardu and one from Kursi, Estonia, of hg. R1a1a1b-Z645; one from Kunila (ca. 2450 BC) of hg. R1a1a1b1-Z283, and another from Ardu (ca. 2700 BC); one from Gyvakarai, Lithuania (ca. 2550 BC) of hg. R1a1a1b1a3-Y2395, i.e. pre-R1a1a1b1a3a-Z284 (Saag et al. 2017; Mittnik, Wang, et al. 2018). An individual from Kyndelöse, Denmark (ca. 2500 BC) shows hg. R1a1a1b1a3a-Z284+, and another from Viby, Sweden (ca. 2550 BC) also shows R1a1a1b-Z645 (Allentoft et al. 2015).

R1a1a1-M417 lineages, in particular R1a1a1b-Z645 (formed ca. 3500 BC, TMRCA ca. 3000 BC), most likely expanded with Corded Ware peoples, with an eastern subclade R1a1a1b2-Z93 (TMRCA ca. 2700 BC) probably expanding with Middle Dnieper and Abashevo, and a western subclade R1a1a1b1-Z283 (TMRCA ca. 2900 BC) expanding explosively with all other European groups (although Single Grave samples show a higher diversity), as evidenced by the similar times of split and TMRCA of R1a1a1b1a-Z282 subclades (TMRCA ca. 2900 BC): R1a1a1b1a-M458 (TMRCA ca. 2700 BC) probably to the west and north; R1a1a1b1a2-Z280 (TMRCA ca. 2600 BC) probably to the north and east, accompanying in part R1a1a1b2-Z93 subclades; and R1a1a1b1a3a-Z289/Z284 (TRMCA ca. 2700 BC) to the north, particularly among Battle Axe peoples.

The presence of a potential R1a1a1-M417 (xR1a1a1b-Z645) sample in Bergrheinfeld and later ones from Esperstedt (see *§vii.1. Western and Eastern Uralians*), all of Single Grave groups, coupled with the initial variability of subclades in early east-central European individuals, may suggest that the early expansion of the Single Grave culture did not undergo the Y-chromosome bottleneck through R1a1a1b-Z645 lineages common in Battle Axe or eastern groups. This is also supported by the prevalent presence of R1a1a1-M417 (xR1a1a1b-Z645) lineages among modern western Europeans, in spite of this subclade spreading from the steppes. Alternatively, these subclades may represent an early wave of Corded Ware groups, before the expansion of the unifying A-horizon, which would not have affected central and central-west Europe as intensely as the east.

The time of potential expansion of R1a1a1-M417 (formed ca. 6600 BC, TMRCA ca. 3500 BC), approximately coinciding with the formation and TMRCA of R1a1a1b-Z645 lineages, in turn close to the expansion of mainly European R1a1a1b1a-Z282 subclades, and mainly eastern R1a1a1b2-Z93 subclades, also supports this division. In fact, the common TMRCA for R1a1a1b1-Z283 and R1a1a1b1a-Z282 suggests an expansion at nearly the same time as peoples of Corded Ware cultures are supposed to have migrated east- and westward, reaching the Middle Elbe–Saale region about 2750 BC. The common TMRCA of 2700 BC for modern Asian lineages gives support to a later successful expansion into Asia centred on the eastern part of the Pontic–Caspian steppes (see *§viii.18.1. Late Indo-Iranians*).

The estimated split of Proto-Uralic into Finno-Ugric and Samoyedic The linguistic estimates for a split of Proto-Uralic into Finno-Ugric and Samoyedic ca. 3000 BC, and of Finno-Ugric into Finno-Permic and Ugric ca. 2500 BC (Janhunen 2009; Kortlandt 2019) fit the known expansion of Proto-Corded Ware first from the north Pontic forest-steppe into east-central Europe (ca. 3000 BC), and then the expansion of Classical Corded Ware into the Baltic (ca. 2800 BC) and to the east into the Volga–Kama region (ca. 2700 BC) with continued contacts of Battle Axe with Abashevo through Fatyanovo reflected in the strong similarity of Finno-Ugric to Proto-Uralic (Kallio 2015).

Among Baltic Late Neolithic individuals, three early samples (ca. 3200–2600 BC) stand out because of their close cluster with the Yamna population: one from Zvejnieki in Latvia, and one from Plinkaigalis; with a slightly later one from Gyvakarai, of hg. R1a1a1b1a3-Y2395, who clusters in an intermediate position between the two outliers and other Corded Ware samples. These outliers are described as forming a clade with Yamna, due to their reduced NWAN ancestry (Mittnik, Wang, et al. 2018), although their EEF-related admixture is ca. 20% or higher (Mathieson et al. 2018). This reduction in NWAN and EEF ancestry—and closer cluster with Yamna—is probably also due to their additional EHG admixture (bringing them closer to Khvalynsk samples, far from the mainly WHG-driven EEF ancestry of Corded Ware), evidenced in the ‘northern’ shift of this samples on the PCA (Suppl. Graph. 8).

The wide cluster formed by the available West and East Baltic Bronze Age samples, as well as East Baltic and Finland Iron Age samples, which encompass Baltic CWC as intermediate with other Corded Ware samples, confirms the nature of their ancestry as stemming from the admixture of Sredni Stog/Early Corded Ware with WHG:EHG populations from sub-Neolithic populations from the Baltic, rather than through direct exogamy with Yamna groups (see below *§viii.16. Saami and Baltic Finns*).

An additional potential source of similarities of certain CWC groups with Yamna may stem from the shared female population of the north Pontic region, supported by the statistically significant association of mtDNA between (especially west) Yamna and Baltic Corded Ware samples, in contrast to other

Corded Ware groups (Juras et al. 2018). The close traditional connection between the north Pontic area and the eastern Baltic through the Buh–Dnieper–Dniester corridor (Klochko and Kośko 2009), including the Volhynian–Podolian Upland and Polesian Lowland, could have facilitated exogamy with late Sredni Stog or closely related populations, which were also the source of gene flow into Yamna during the colonisation of the north Pontic area by expanding late Repin settlers. In particular, Zvejnieki shows mtDNA hg. U5a1b, associated previously with the north Pontic Neolithic and Maikop, and later with Corded Ware- and Yamna-derived groups (Mathieson et al. 2018; Olalde et al. 2018; Wang et al. 2019).

Exogamy has been argued to be an extended practice among Corded Ware peoples, with many adult women being of non-local origin, based on a recent work on diet and mobility (Sjogren, Price, and Kristiansen 2016), and mtDNA has been documented to be more varied among Corded Ware females than men (Lazaridis et al. 2014). The nature of these Baltic Late Neolithic samples as outliers among Corded Ware peoples is further supported by the close cluster formed between late Sredni Stog individuals and most Corded Ware groups sampled to date, including those of Germany, Poland—where the culture is supposed to have emerged—and the later samples from Sintashta, Potapovka, Andronovo, or Srubna, which suggest a similar genetic picture in the as yet unsampled Middle Dnieper, Fatyanovo–Balanovo and Abashevo cultures. Despite this homogeneity, two Corded Ware outliers from Single Grave and Battle Axe groups cluster closely to EEF and Comb Ware-like populations respectively, showing how admixture easily changes with exogamy.

Analysis of ancient samples has revealed that the plague was a prehistoric disease endemic to the Eurasian steppes, and a European pandemic may have been linked to the expansion of both Yamna and Corded Ware peoples, because they connected vast areas in east-central Europe in a relatively short period. One of the earliest known strains is found outside of the steppe in the Baltic, in the Northern European Plains, and in Croatia in the 3rd millennium

BC (Rasmussen et al. 2015; Andrades Valtueña et al. 2017). Nevertheless, the early finding of a European strain linked to Neolithic populations suggests that an earlier epidemic was probably a source of radical population decline of agricultural groups of central Europe and southern Scandinavia (Müller and Diachenko 2019) before the steppe-associated expansions (see *§v.6. Late Uralians*).

This contemporary population reduction in Europe, coupled with an already smaller population density to the north of the loess belt—contrasting with the greater population size of south-eastern Europe (Müller and Diachenko 2019)—may have provided a disadvantage of central-eastern European lands, and a necessary 'pull' trend for the migration and expansion of Corded Ware (Anthony and Brown 2017). The spread along sparsely populated areas, as well as continuous contacts between clans facilitated by their mobile economy, may have allowed for the genetic homogeneity seen among Corded Ware peoples from west to east, in spite of the proposed generalised practice of exogamy.

VI.4. Middle East

VI.4.1. Maikop–Novosvobodnaya

Shortly after the advent of the Kura–Araxes complex in the mid–4th millennium, the western Caucasus developed its own tradition of dolmens, or megalithic buildings for the dead, as early as 3250 BC. They are often associated with the megalithic traditions of western Europe, and seen thus as a global phenomenon, although they were restricted in this region to a small area in the north-eastern Pontic coast. Dolmens were built of well-squared, heavy stone slabs, placed on their edges and fitted together with precision, positioned to maximise the sunlight on the façade; most facing southwards, some eastwards. Most dolmens were used for multiple interments, and included men and women, young and old, and funerary provisions (Sagona 2017).

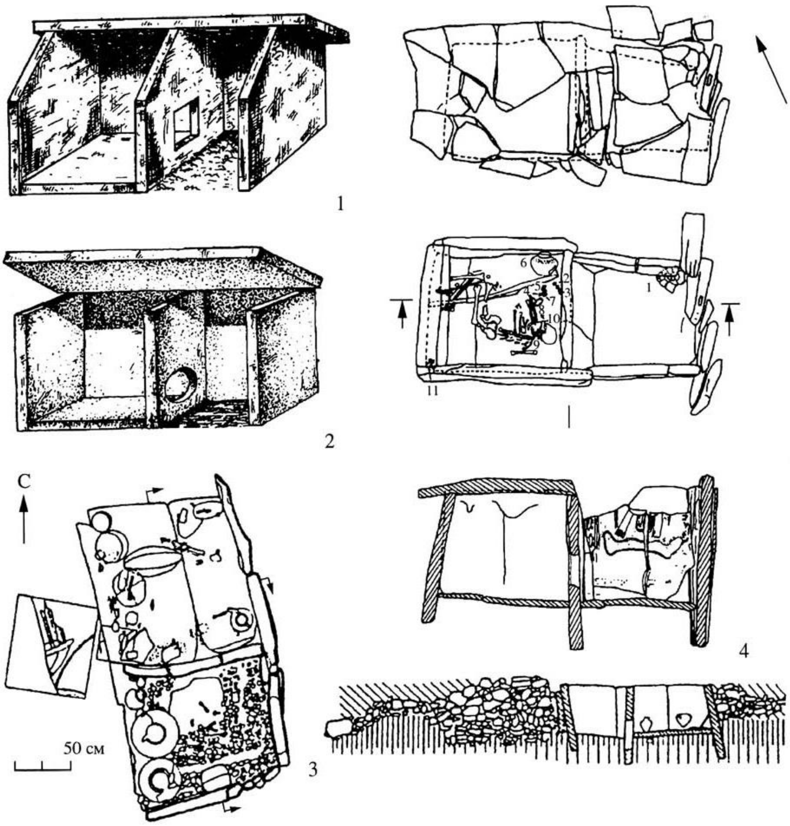

Figure 39. Tombs of the Novosvobodnaya type. 1 – kurgan. 1, 2 – kurgan 2 – excavations N. I. Veselovski; 3 – burial site Klady 31/5; 4 – burial ground klady 28/1 (according to Rezepkin). Modified from Korenevskiy (2012).

The latest stage of the Maikop–Novosvobodnaya historical community is represented by the Novosvobodnaya dolmens, with a span ca. 3300–2800 BC, overlapping with the beginning of west Caucasian dolmens. Unlike the Maikop barrow burials, two rich tombs at Novosvobodnaya were constructed of stone slabs, in a plan that resembles those of the Dolmen tradition, but with distinct characteristics (Figure 39): the interior design and plans differ, with a pair of slabs placed close enough to form a narrow gap, separating two compartments, a paved burial chamber and an antechamber. Masonry is more precise, and large slabs form the roof and overhang the entrance, which faces south-east.

The entire structure is concealed beneath a barrow of stones defined by a kerb (Sagona 2017).

They were not used for collective burials, and the deceased were placed on the right side of the chamber, accompanied by a rich assemblage, although it did not reach the high level of Maikop kurgans. During this period, there is a decline in the number of objects made of precious metals, and an increase in copper objects, with an improvement in copperworking seen in elaborate forms of weapons and tools. Jewellery and metal (golden, but also silver) beads, on the other hand, increase in this late phase (Sagona 2017).

Ceramic evolves from the limited Maikop repertoire to tall-necked jars with incised decoration. New sets of woodworking and leatherworking tools appear, and the lack of impurity in the copper points to an origin of the metal ores in the Balkans. Spearheads from the northern Caucasus are similar to those from the Kura–Araxes culture found in the southern Caucasus and Arslantepe. Their subsistence economy is assumed to be based on stockbreeding of ovicaprids, cattle, and pigs (Sagona 2017).

The other tradition of the area, the Colchian culture, probably developed from indigenous groups that occupied the wetlands and lowlands for over two millennia.

VI.4.2. Kura–Araxes

By 2900 BC, the Kura–Araxes culture was spread throughout much of south-west Asia, which suggests that they competed against northern Mesopotamian societies. The widespread dissemination of this material culture, along with the small size of most sites, the ephemeral nature of their settlements, and their presence in both fertile lowlands and seasonally-inhospitable highlands, suggest that they were formed, at least in part, by mobile pastoralists (Alizadeh et al. 2018).

Kura–Araxes groups primarily inhabited mountains and intermontane valleys of the surrounding highland zone, and they had access to metals, precious and semi-precious stones, stones for tool making, wood, and animal products; resources that were abundant in the mountain area, and essential for Mesopotamian societies. Metallurgical sites like Köhne Shahar suggest that a developing complex of exchange networks and interaction with specialised craft economies facilitated the culture's expansion, by filling a supply vacuum created by the collapse of Uruk colonies (Alizadeh et al. 2018).

In Arslantepe, around 3000 BC, the Palatial system collapsed, apparently by a big fire that destroyed the palace and the whole centralised state forever, including the Mesopotamian-type society, administrative system, and officials. This event seems to be related to the gradual expansion of Kura–Araxes pastoralists, whose seasonal occupation of the site eventually turned into a permanent residence for their chiefs (Frangipane, Manuelli, and Vignola 2017).

New settlements were established, with an outstanding area on top of the mound, consisting of a likely chief hut (ca. 2900 BC) separated from the rest of the settlement by a timber palisade, and an imposing mudbrick building with a reception hall, and store rooms full of vessels and foodstuffs. Pottery had simple shapes, resembling those of north-eastern Anatolian and southern Caucasian origin, no longer central Anatolian, although decoration and technology corresponded to the previous tradition (Frangipane, Manuelli, and Vignola 2017).

The changes from a seasonal occupation to a rural village with mudbrick houses and pottery of the post-Uruk tradition happened ca. 2800 BC, with both communities—the traditional, sedentary one, and the pastoral itinerant community from north-east Anatolia and the southern Caucasus—apparently negotiating, interacting, and clashing, with either side alternatively succeeding, taking control and possession of the mound. The identity of the two groups must have been clearly perceived, and no evidence is found to suggest cultural inclusion or mixing, whereas episodes of conflict are evident (Frangipane 2015).

The social instability and political upheaval are also noticed by the emergence in the region of human sacrifice, usually a resource of hierarchical social structures that accompanied early state-formation processes. In the vacuum of political centralisation that followed the withdrawal of Uruk material and the appearance of Kura–Araxes, instability among smaller polities must have created thus the necessary environment for the introduction of human sacrifice. With the appearance of vast administrative state systems in southern Mesopotamia in the next millennium, this practice disappeared again from the archaeological record (Hassett and Sağlamtimur 2018).

vi.4. Northern Caucasians

Novosvobodnaya (ca. 3600–3300 BC) and late Maikop samples (ca. 3300–3100 BC) in the northern Caucasus foothills also show continuity of ancestry with Maikop samples, falling among the Armenian and Iranian Chalcolithic individuals. Important phylogenetic differences are seen, though: Novosvobodnaya shows hg. J2a1-L26 in two samples from Klady, one of them J2a1a1a2b2a3b1-Y3020, and the other J2a1a1a2b2a3b1a-Y11200 (xY30811-, Z30682-), the same haplogroup found previously in Eneolithic Caucasus (see above *§iv.4. Late Middle Easterners*), and found today mainly in Northeast Caucasian populations; and G2a2a-PF3147 (expanded with Anatolia Neolithic farmers) in one sample from Dlinnaya Polyana; whereas Late Maikop shows hg. L-M20 in one sample from Sinyukha and two from Marinskaya, probably all L2-595 (formed ca. 21000 BC, TMRCA ca. 3200 BC). Haplogroup J1-L255, found previously during the Mesolithic, is also reported for Late Maikop in Marinskaya.

Two late Maikop outliers from the north Caucasus steppe show a higher proportion of Anatolian and Iranian farmer-related ancestry. This may have been driven either by Pontic–Caspian steppe migrations, or by the admixture with local Caucasus populations of AME ancestry. The presence of haplogroup R1a1b-YP1272^{+}, a typical eastern European lineage, in a sample from Sharakhalsun (ca. 3230 BC), suggests the former as the most likely explanation; the sample from Ipatovo (ca. 3260 BC) shows hg. T1-L206^{+}, a typically Middle Eastern lineage (Wang et al. 2019).

This *Caucasus Eneolithic*-like ancestry is also continued in Kura–Araxes (Wang et al. 2019), in early samples (ca. 3500–3100 BC) from the south (Kaps, Armenia), one of hg G2b2a2-FGC2964 (formed ca. 13700 BC, TMRCA ca. 1100 BC), found previously in an Iranian Neolithic individual ca. 7300 BC; and in later Kura–Araxes samples (ca. 3100–2800 BC) in the north-east (Velikent, Dagestan), one of hg J1a2b1-Z1842 (formed ca. 5800 BC, TMRCA ca. 4000 BC), a haplogroup probably found later in a west Anatolia Bronze Age sample (ca. 2500 BC), and widely distributed in modern populations of the Middle East, which supports its expansion with Kura–Araxes peoples, and its association with modern speakers of Northeast Caucasian languages. Increased CHG ancestry (ca. 60%) is also seen in other three Early Bronze Age individuals from the Kura–Araxes culture in Armenia dated ca. 3300–2500 BC (Lazaridis et al. 2016), with a late sample from Kalavan (ca. 2550 BC) showing what seems to be the latest finding of hg. R1b1a2-V1636, already part of a non-Indo-European community (see above *§iv.2. Indo-Anatolians*).

An outlier from the Zagros Mountains in Hajji Firuz Tepe also shows elevated Steppe-related ancestry, and clusters between Kura–Araxes and Yamna samples (Narasimhan et al. 2018), consistent with the incorporation of North Caucasus-like populations within the expanding Kura–Araxes groups. The radiocarbon date published (ca. 2465–2286 BC) is compatible with that interpretation, although the collapse of different archaeological layers in the same site has yielded unreliable dates for (at least) one other sample, and it may therefore correspond to a much later date, in particular the Late Bronze Age – Early Iron Age (see *§viii.14. Caucasians and Armenians*).

Based on the territorial expansion of the Kura–Araxes culture, and on the subsequent groups that emerged in its core territories after its demise, the language spread by these southern Caucasian peoples was probably Hurro-Urartian, which may support a connection with North-East Caucasian languages in a hypothetic Alarodian group (Diakonoff and Starostin 1988), at least from a genetic point of view. Territories of the north-western Caucasus, occupied by Maikop, Novosvobodnaya, and Dolmen traditions, would probably then represent evolving North-West Caucasian-speaking peoples.

VI.5. Africa and the Levant

The initial spread of herding into eastern Africa (ca. 3000 BC) coincided with the emergence of a distinctive monumental tradition centred around "pillar sites" built near Lake Turkana, Kenya. These monumental sites more likely served commemorative purposes similar to many of the previous Saharan ceremonial sites before it (see *§V.1. Africa and the Levant*), although they exhibit architecturally distinct elements. These construction changes coincided with the end of the African Humid Period (ca. 3500–3000 BC), which brought about profound changes in environment, economy, and material cultural expression, coupled with a major population collapse due to the decline in favourable climatic conditions (Brierley, Manning, and Maslin 2018).

In the Lake Turkana area, retreating shorelines ca. 3300–2000 BC disrupted fishing practices and exposed new habitats for herbivores, while exchange and/or herder immigration brought cattle and caprines into northwest Kenya, transforming economic strategies to include mobile herding. While previous fishers used local lithic raw materials, the new herders preferred obsidian from varied local, distant, and island sources, which point to extended exchange networks, including boat travel (Hildebrand et al. 2018).

Monumental mortuary expression appearing in the Sahara, Sahel, Nile, and Turkana at the same time as the dramatic environmental shifts—and the accompanying change to herding economy—marks probably a social change rather than the emergence of hierarchical social forms. Distinct forms of commemoration include cattle burials in the central Sahara, megaliths in the eastern Sahara, aggregate cemeteries in the southern Sahara and along the Nile, built mortuary spaces in the Red Sea Hills and around Lake Turkana, and cairn and cremation treatments linked to early pastoralism in central Kenya.

In Mesopotamia, rulers of the Early Dynastic periods (ca. 2900–2350 BC) were leaders of city–states (the so-called ‘theocratic temple-states’), where estates of the gods were possibly the property of the king and his ruling family, and the ruler was thus a protector of a city in the name of the city’s tutelary deity. Political centralisation dominated in Mesopotamia under the two dynasties of Akkad and Ur, when East Semitic-speaking elites would eventually dominate over the whole society after the rise of Sargon of Akkad. The Mesopotamian king became both a divine figure and a warrior and conqueror (Kristiansen and Larsson 2005).

In the Fertile Crescent, a specialised economy of sheep–goats already evident in the Late Chalcolithic reaches a full development in the mid–3rd millennium BC, perhaps because of commodification of textiles and wool production in Near Eastern polities. The elaborate networks of roads during this period, with a pastoral economic activity growing beyond settled areas and population, are probably the result of interactions between settlements, where individual farmers, labour supply, and flocks of caprines moved across the landscape and were drawn to cities from the surrounding villages or exogenous sources. Urban centres and larger settlements were particularly affected by this demand, with textual evidence from Ebla and Tell Beydar of an institutionalised and centralised pastoral economy, where massive flocks of caprines were directly managed by the palace (Altaweel and Palmisano 2018).

vi.5. Semites and Berbers

East Semitic languages probably entered Mesopotamia from the desert to the west of its core area before 2900 BC, since the first attestations come from Akkadian personal names in Sumerian texts about the 29th century BC. Similarly, the Kish Civilisation—encompassing Semitic states like Ebla and Mari in the north, or Abu Salabikh and Kish in central Mesopotamia—shows probably the first historical record of the language, in the 30th century. Both East Semitic migration events can then be related to the collapse of the Uruk period ca. 3100 BC.

The Bronze Age Levantine population from the site of ʿAyn Ghazal, Jordan (ca. 2490–2300 BC), can be modelled as Levantine Pre-Pottery Neolithic agriculturalists from Motza, Israel, and ʿAyn Ghazal, dated ca. 8300–6700 BC (ca. 58%), with contributions of a population similar to Iran Chalcolithic (ca. 42%), from a more recent period (Lazaridis et al. 2016). It has been suggested that samples from Sidon, Lebanon (ca. 1700 BC) can be modelled as a mixture of Levant Chalcolithic (ca. 48%) and Iran Neolithic or Late Neolithic-related ancestry (Haber et al. 2017; Harney et al. 2018).

The difference between both populations lies then in the Anatolian-related ancestry found in Levant Chalcolithic (ca. 36%), also found in the northern population, which suggests the reintroduction in the south of a population not affected by this Anatolian migration, potentially then from farther south. The lack of relationship between Levant Chalcolithic ancestry and present-day East African Levantine-related ancestry (Harney et al. 2018) further supports a migration of Proto-Semitic from north-east Africa into the southern Levant, and then a back-migration to the south into Arabia and East Africa.

Among Levantine Bronze Age individuals, there is one sample (ca. 2400 BC) of J2b1-M205 lineage (formed ca. 13800 BC, TMRCA ca. 3300 BC), and another (ca. 2100 BC) of hg. J1a2b-Z1828, a haplogroup found previously in an Anatolian sample of the Bronze Age (see *§v.1. Early Semites*). Similarly, there is an individual from a Canaanite burial pit in Tel Shaddud (ca. 1250 BC) reported as of hg. J[17], which clusters—similar to another sample of hg. R1b1a1b-M269 (see below *§viii.12. Greeks and Philistines*)—among modern Levantine populations (van den Brink et al. 2017). The spread of early Semitic peoples was thus probably linked to communities of different local haplogroups, before the known Y-chromosome bottleneck of J1a2a1a2d2b2b-Z2331 lineages, particularly with the early expansion of Central Semitic dialects to the south.

[17] Tentative SNP call J obtained with Yleaf, from Wang et al. (2019) supplementary materials.

The predominant East African genetic component of the Horn of Africa points to genetic homogeneity of all populations of the area, whether Afroasiatic (Omotic, Cushitic, Semitic) or Nilotic (van Dorp et al. 2015). They present a great degree of continuity with the ancient Mota individual (ca. 2520 BC), of hg. E1b1a2-M329 (Gallego Llorente et al. 2015). The Maasai from Kenia are also closely related, showing ca. 50% E1b1b-M215 (Pagani et al. 2012), and regional hunter-gatherers from the Horn of Africa—such as the Chabu, the Majang, and the Shekkacho—retain strong genetic affinities with the Mota individual (Gopalan et al. 2019), supporting the original association of this haplogroup and ancestry with indigenous Nilo-Saharan languages.

The Eurasian admixture events inferred from modern populations in Sudan and Ethiopia (Hollfelder et al. 2017) suggest the likely expansion of Egyptian speakers from the north through the Nile, and the likely expansion of Semitic in the Horn of Africa from Arabia is possibly associated with the "eastern"/Iranian farmer-related ancestry found among modern Afar and Somali (Skoglund et al. 2017).

On the basis of genetic data from Pastoralist Neolithic individuals, two phases of admixture can be detected, associated with the spread of pastoralism: the first one (likely ca. 4000–3000 BC) in north-eastern Africa, possibly (based on earlier herding dates from the region) through South Sudan and reaching the Turkana Basin first, although they may have moved via the Horn of Africa; the second one (ca. 2000 BC) between this admixed Early Neolithic Pastoralist group and eastern African foragers, both in the Turkana Basin and during the initial trickle of herding into the south-central Rift Valley (Prendergast et al. 2019).

Descendants of these Early Neolithic Pastoralist and local forager groups gave likely rise to the groups who developed the Pastoralist Neolithic culture traditions of southern Kenya and northern Tanzania. The earliest samples available to date are a man and a woman from Prettejohn's Gully (ca. 2000 BC), whose ancestry profile suggest that they represent an initial (maybe one among many) limited dispersal of herder groups into the south-central Rift Valley that did not leave large numbers of descendants, while the group that gave rise to the Pastoral Neolithic cluster was much more demographically successful than the others. The lineage of this male is E2-M75 (xE2b-M98), while most Neolithic Pastoralists sampled belong to different E1b1b1-M35.1 subclades, apart from E2-M75, E1b1a-V38, and A-M13 lineages, further supporting the gradual and stepped admixture with local forager groups (Prendergast et al. 2019).

Whereas modern Omotic speakers—except those groups among Cushitic and Semitic groups—show strong affinities with the Mota individual, Cushites show continuity of an ancestry already found in a sample from Tanzania (ca. 1050 BC), with higher hunter-gatherer admixture than Bantus and mtDNA from the Rift Valley, suggesting that this Afro-Asiatic branch was widespread to the south before the more recent Bantu expansion, and thus likely to be associated with the Savannah Pastoralist Neolithic (Kießling, Mous, and Nurse 2008).

While ancient Afroasiatic languages were possibly introduced in the area by the expansion of R1b1b-V88 lineages and spread with pastoralism (see *§iv.5. Late Afrasians*), it remains unclear which lineages might have expanded Semitic languages to the region. Given the prevalence of haplogroup T1a1a1b2-CTS2214 near the Gulf of Aden, and the wide ancient distribution of this haplogroup through the Middle East (see *§iv.4. Late Middle Easterners*), the presence of some late subclades in the area probably reflects an acculturation of some East African or Middle Eastern group and subsequent Y-chromosome bottlenecks in the area. The various ‘western’ (sub-Saharan African admixture) and ‘eastern’ influences (south Asian and Levantine/European admixture) creating a west–east axis in the Arabian Peninsula support the nature of this region as a sink of different prehistoric migrations rather than a source (Cavadas et al. 2019).

Lexicological studies show that a Common Berber dialect *continuum* must have been still in close contact still around the foundation of Carthage (ca. 800 BC), based on early Phoenician/Punic loans found in most branches (Blažek 2014), which is compatible with the estimated dates for the disintegration of the language (Blažek 2010). This is supported in genetics by the incorporation and further expansion of this Afroasiatic branch under a bottleneck of E1b1b1b1a-M81 lineages, whose late successful expansion is coincident with that date (see above *§iii.4. Northern Africans*).

VII. Late Chalcolithic

VII.1. Eastern Corded Ware expansion

VII.1.1. Central Europe

Pits and traces of houses are more common in Polish sites after 2600–2400 BC (although absent in Lesser Poland), and there is a clear correlation with light sandy soils, on sites usually spread on slightly exposed elevations within low relief, most often of river valleys and lake shores. In certain areas of the Northern European Lowland (such as Mecklenburg, Masuria, the Polish Lowlands, or the Baltic coast area) there is a trend to more spacious sites, a higher number of sunken features, and richer assemblages of movable items, as well as to multi-stage occupation of certain settlement sites on attractive land areas (Włodarczak 2017).

Around the mid–3rd millennium BC, the number of mounds built decreased, and the number of burials dug into existing mounds increased, at the same time as flat cemeteries emerged. Radiocarbon analyses indicate that the expansion of kurgans probably peaked ca. 2600/2500 BC, weakening afterwards, and disappearing completely after ca. 2400/2300 BC, probably representing the diminishing importance of ceremonial–funeral centres as regional landmarks organising the territory of a given group (Włodarczak 2017). Kurgans appearing later, in the Únětice or Strzyżów groups, represent a new, different tradition (see *§VIII.8. Eastern EEBA province*).

The expansion into the forest zone of eastern and north-eastern Poland changed the landscape from hunter-gatherer societies to an economy based primarily on large herds of animals, mainly cattle, while agriculture was hindered by the soils. Settlers occupied primarily the lower zones, often riverbank areas of river valleys, and most remains come from seasonal campsites, with a mix of CWC and Neman traditions. These settlers of the mid–3rd millennium BC were probably related to the Masurian lakeland. The emergence of an allocthonic population is marked by the rare graves of this area, showing infiltrations initially mainly from Lesser Poland, and later (after 2500 BC) from the western Baltic zone (Włodarczak 2017).

There is a strong connection between the rituals of the Single Grave culture and those of the west Baltic region, connected through the Northern European Plains. This relationship becomes clear from the younger phase of the CWC development (ca. 2600–2500 BC) and continues until the demise of the culture. It is marked by specific forms of graves (with implementation of stone structures), and by grave goods typical of the west Baltic region.

VII.1.2. Middle Dnieper

The origins of the Middle Dnieper culture should most likely be traced back to the forest-steppe area of the Dnieper Basin. Concentrated between the Berezina, Dnieper, and Sozh rivers, on the Desna and drainage basin of the Middle Dnieper (from the confluence with the Pripyat in the north to the confluence with the Ros in the south), there are dispersed findings as far as the Middle Pripyat, Upper Neman, and the Seym drainage basin. Most likely, the culture spanned a long period from ca. 2600–1800 BC (Krenke et al. 2013).

However, the earliest Middle Dnieper samples are related to CWC graves between the Upper Vistula and the Bug, containing pottery with Middle Dnieper traits, dated probably ca. 2650/2600 BC or earlier, which establishes the beginning of the culture probably to the west of its core area ca. 2700 BC, with the expansion of the A-horizon (Krenke et al. 2013).

The "Kyiv hoard" and other hoards (like Steblivka) of Corded Ware tribes that populated the Volhynia and western Podolia regions, of willow–leaf metallurgical industry, evidence also the direct connection of the Middle Dnieper peoples to these CWC groups. The battle–axes of the Ingush type, proper of the forest-steppe cultures east of the Vistula river, also mark a completely different direction of inspiration (Klochko and Kośko 2011).

In fact, during the period of ca. 2800–2400 BC, the area of Lesser Poland (with its numerous kurgans and catacomb burials) is considered the western fringe of an area spreading to the east, to the middle Dniester and middle Dnieper river basins, i.e. regions bordering the steppe oecumene. This 'eastern connection' of funeral ritual, raw materials, and stylistic traits of artefacts is also identified in some graves of the Polish Lowlands (Włodarczak 2017).

VII.1.3. Fatyanovo–Balanovo

The Fatyanovo (or Fatyanovo–Balanovo) culture was the easternmost group of the Corded Ware culture, and occupied the centre of the Russian Plain, from Lake Ilmen and the Upper Dnieper drainage to the Wiatka River and the middle course of the Volga. From the few available radiocarbon dates, the oldest ones come from the plains of the Moskva river and from the late Volosovo culture containing also Fatyanovo materials, and in combination they suggest ca. 2700 BC for its appearance in the region, and ca. 2000 BC for their disappearance The Volosovo culture of foragers eventually disappeared (ca. 2300 BC) when the Fatyanovo culture expanded into the Upper and Middle Volga basin (Krenke et al. 2013).

The origin of the Fatyanovo culture is complicated, because it involves at its earliest stage different Corded Ware influences. This is evidenced in neighbouring sites on the Moskva river plains: one, potentially slightly older site, with some materials paralleling the Nida site, of Circum-Baltic and Polish features; and another site, 300 m. downstream, showing a connection with materials from the Khanevo cemetery, in turn a *bridge* to the Middle Dnieper culture. This suggests that groups belonging to different strands of the classic corded ware tradition penetrated the Moscow region. The Balanovo culture to the east seems to have been Fatyanovo's metallurgical heartland, with the Sura–Sviyaga group surviving long after the demise of Fatyanovo (Krenke et al. 2013).

Just before 2500 BC, Corded Ware, Single Grave and Battle Axe, Rzucewo, Middle Dnieper and Fatyanovo–Balanovo cultures arrived at their peak of landscape occupation, domination and coherence. Fatyanovo is exemplified mainly by grave finds, featuring rectangular pits with single burials, with the dead positioned contracted lying on the side, or supine with raised knees, and grave goods of clay pots, animal-tooth pendants, and rarely bronze jewellery. Male graves are identified by stone battle–axes (Parzinger 2013).

VII.1.4. Battle Axe culture

The early, skilfully made Corded Ware culture pots found in Sweden were both imported (in Southern Sweden from north-eastern Estonia and possibly Finland) and made with local clays by skilled potters (in Central Sweden), which supports the relocation of CWC potters from a place where the craft was already well established, namely the eastern part of the Baltic around the Gulf of Finland. The arrival of grog from Sweden at Finnish and Estonian sites may suggest a two-way movement across the Baltic Sea, although it probably represents the tempering of new pots with old ones, either brought to the region through migration or intermarriage, or by commercial contacts (Holmqvist et al. 2018). The CWC seemingly reached east-central Sweden from regions further to the east, where there is evidence of animal husbandry, but only very few signs of plant cultivation (Vanhanen et al. 2019).

The so-called Middle or Intermediate Zone ceramics, attributed to a 2nd wave of Corded Ware migrants from Estonia into Finland, has been recently proposed to be the result of a hybridisation that began soon after the arrival of Corded Ware, at least on the south-eastern coast and the Karelian Isthmus, with influences transmitted towards the inland and the middle-zone. Furthermore, most CWC materials associated with this hybrid pottery come from mixed, multi-period settlement contexts, and also include organic tempers in local groups, which are similar to the so-called Estonian (or late) Corded Ware (Nordqvist 2018). Late Estonian CWC remains show continuity of the preference for terrestrial foodstuffs in the eastern Baltic region, based on domestic animals complemented with agriculture, in contrast with the earlier hunter-gatherer diet (Varul et al. 2019).

There is a close connection of the Corded Ware tradition of the Karelian Isthmus pottery with the central Russian Fatyanovo culture, as well as between the eastern Gulf of Finland and Russian battle axe culture (Nordqvist 2018). These contacts and interactions between eastern CWC groups points to the close cultural connection between them.

There are hundreds of Corded Ware settlements identified to date in eastern Fennoscandia—most of them residential, recurrent activity or camp sites—and thousands of remains, more than in other Scandinavian territory. While the central area of Corded Ware habitation does not seem to include the inland or the northern territories, scattered findings of Corded Ware materials to the east, north, and north-east of these core territories (Nordqvist and Häkälä 2014) may point to isolated vanguard settlers or to imitations of indigenous groups.

In Finland, Corded Ware vessels are associated with beaker-type ‘drinking’ vessels, often in grave deposits, as well as amphorae and S-shaped pots. Corded Ware settlements, even coastal ones, show reliance on terrestrial ruminants, which could be either domesticated (e.g. cattle) or wild (e.g. elk, forest reindeer), although milk fat residues must have originated from domesticated stock. Therefore, the introduction of animal domestication as a new subsistence strategy can be traced back to at least ca. 2500 BC in Finland (Cramp et al. 2014).

vii.1. Western and Eastern Uralians

Later samples of the Single Grave culture include six individuals from Esperstedt, Saxony-Anhalt (dated ca. 2500–2050 BC), of hg. R1a1a1-M417 (possibly xR1a1a1b-Z645), and one outlier (ca. 2560–2300 BC), with a mean of ca. 71% Steppe ancestry (Mathieson et al. 2015). The outlier has what appears to be a recent contribution from Yamna, clustering closer to Yamna samples than any other Corded Ware sample (except for the Baltic outliers), probably due to exogamy with nearby late Yamna settlers of Hungary or early East Bell Beakers. Five males among them have been inferred to be relatives *via* paternal line (Monroy Kuhn, Jakobsson, and Günther 2017), and one of these, the outlier, is a second-degree relative to the other four.

This interpretation of a recent contribution from Yamna in central Europe is supported by samples of the Corded Ware group from Brandýsek, Bohemia (ca. 2900–2500 BC), which show diminished Steppe ancestry (ca. 40%), and two samples of hg. R1a1a-M198 together with one I2a1b1b-Y6098 (Olalde et al. 2018). The resurgence of this typically Neolithic haplogroup with a marked increase in NWAN ancestry (ca. 45%) seems to suggest a resurgence of local Neolithic groups, which supports the nature of the Esperstedt outlier as an exception among late Corded Ware samples.

Four late Corded Ware samples (ca. 2570–2340 BC) from double burials of related people, among fourteen individuals of a multiple burial in Pikutkowo, Poland, show that they are genetically significantly closer to WHG than to steppe individuals (especially one of the investigated pairs), and can be modelled as an admixture between Corded Ware and local Neolithic populations with hunter-gatherer affinities (such as TRB, ca. 63%). Two samples are of hg. I2a1b1a2b1-L801 (Fernandes et al. 2018), which appeared earlier on GAC samples from Poland (see *§v.6. Late Uralians*), support the resurgence of local lineages among different central European groups at the end of the Corded Ware period.

One sample from Spiginas, Lithuania (ca. 2130–1750 BC) of hg. R1a1a1b1a2b-CTS1211 (of the R1a1a1b1a2-Z280 trunk), of the Battle Axe culture (Mittnik, Wang, et al. 2018), evidences the continuity of typical Corded Ware lineages in the area. Based on later Baltic and Poland Bronze Age samples, this precise subclade probably expanded from this and neighbouring southern areas, or resurged from previous populations of the area (see *§viii.8. Balto-Slavs*).

VII.2. Pontic–Caspian steppes

VII.2.1. Poltavka

The Poltavka culture (ca. 2800–2200 BC), known almost exclusively through its graves, presents a tradition quite similar to Yamna, but with a distinctive style of pottery, and changes in the shape of the grave pit, in details of the mortuary rituals, and in metal tools and weapon styles (Figure 40).

Poltavka cemeteries appear in the same geographic region as the north-eastern group of the early Yamna culture. In the Don–Volga steppes, it overlaps with the Catacomb culture, and its graves there show side chambers—shallow hollows undercut into the side of the grave—equivalent to (although clearly distinct from) Catacomb graves. Five Catacomb-style graves have been found in the Samara Valley, as early as ca. 2750 BC, always as isolated additions to earlier kurgans, suggesting contact and exchange between regions on both sides of the Volga. Most kurgans involved the body placed in a single chamber, with a wide step, beneath a kurgan surrounded by a circular ditch, and graves contained usually an adult male, although adult female central burials have also been found (Kuznetsov and Mochalov 2016; Murphy and Khokhlov 2016).

A coetaneous culture overlapping geographically with Poltavka is the Vol'sko-Lbishche group, with sites on the elevated, forested height west of the Volga, later appearing in Samara. Of the twelve known MBA settlements and seasonal camps in Samara, eight contained Abashevo materials (see *§VIII.17.1.*

Abashevo), while 3 showed Vol'sko-Lbishche pottery. Only two, overlapping with the latter, showed Poltavka pottery, which was 10 times lower in artefact density than succeeding Srubna materials, all of which supports the higher mobility of Poltavka seasonal camps (Kuznetsov and Mochalov 2016).

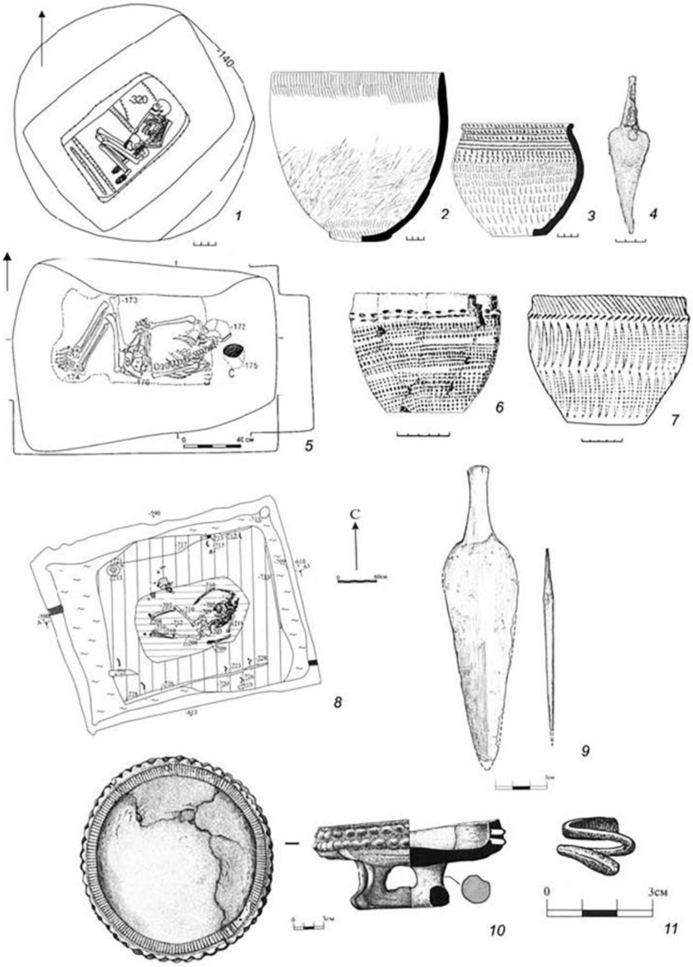

Figure 40. Materials of the late (Poltavka) stage of the Yamna culture in the Volga-Ural region: 1-4 - Orenburg Cis-Urals (Morgunova et al., 2010); 5–7 - Samara Volga region (Vasiliev et al, 2000); 8-11 - The golden kound in the Lower Volga Region (A Passage, 2009). From Morgunova (2014).

Poltavka continues the previous Don–Volga–Ural tradition of predominant sheep-herding economy. Tin from Irtysh sources is found in Troy IIg (ca. 2300–2200 BC), which points to an international east–west trade network in tin across the steppes, and to the connection of Poltavka with Trans-Uralian cultures. In the southern Ural steppes, an intermediate variant called the Tamar-Utkul type has been defined, also called pre-Ural variant of the Late Yamna culture (Bogdanov 2004). Pastoral economy and kurgan burial rituals show continuity with early Yamna.

VI.2.2. Catacomb

Most Yamna burials west of the Black Sea have radiocarbon dates ca. 2880–2580 BC. Only a small proportion of sites at the Lower Danube shows later dates, with a dilution of the wider Pit–Grave phenomenon. This third stage of pit–graves shows a re-appearance of individuals buried contracted to the side or in extended body position as secondary burials in the mounds, perhaps under the influence of the Catacomb Grave culture or further to the east, or locally at the Lower Danube (Frînculeasa, Preda, and Heyd 2015).

By 2500 BC, Yamna is already on the decline, and is gradually transforming everywhere ca. 2600–2400 into the Catacomb Grave culture, while losing grip of settlements in the western Pontic area and retreating thus to its north Pontic core zone. It is hypothesized that the reduction in winter precipitations and an increase in precipitation during the warm season may have caused the increase in productivity of phytocenoses providing more favourable conditions for early cattle breeders, explaining the bloom of the Catacomb culture in the desert steppes (Khomutova et al. 2019).

The Catacomb culture (ca. 2500–1950 BC) is centred on the Dnieper–Azov–Don–Caspian steppes, starting thus during the emergence of the European Early Bronze Age, marking the shift of the centre of gravity from the east-central European lowlands (with west Yamna settlers) to western Europe (with Bell Beakers) and to the Aegean. Methodological problems make it difficult to distinguish late Yamna from Catacomb burials in the Prut, Carpathian, and Danube areas up to the East Thracian Plain, but it seems established that the culture was centred on the north-west Pontic steppes, with less frequent and intensive infiltrations on the Danube than the previous Yamna culture (Frînculeasa, Preda, and Heyd 2015).

The earliest finds appeared in the area between the Don, Volga, and Caucasus foothills during the late Yamna stage, which is compatible with the burial ritual featuring prominently north Pontic and Kuban tradition of wagon burials, representing members of the social elite. The standard burials are catacomb grave complexes—kurgans with an entrance shaft and burial niches in its side walls—with the dead buried in both crouched and supine positions. The aridity of the previous period continues, as do the seasonal camps with tent-like shelters in the steppe, supporting their cattle-breeding economy. Part of their population probably remained behind in permanent river settlements, engaging in agriculture and pit-breeding, and with scattered complex fortifications and communal grave buildings showing a more complex organisation (Parzinger 2013).

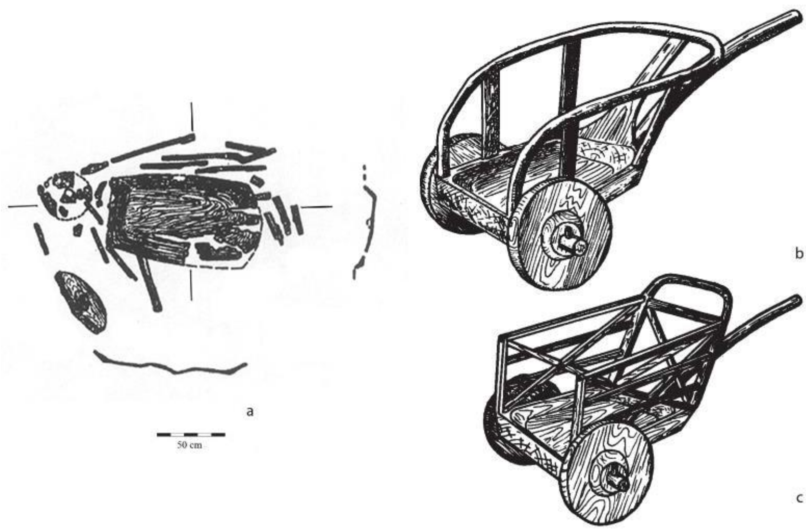

Figure 41. Two-wheeled wagon from burial 27 of the kurgan Tyagunova Mogila (a) and two reconstruction proposals (b–c), by Cherednichenko and Pustovalov (1991), modified from (Pustovalov 2000).

The first two-wheeled vehicles appear in the Black Sea region in Tyagunova Mogila (Figure 41) and Bolshoi Ipatovskyi Kurgan. Both carts are small (diameter up to 60 cm), single-piece disk wheels with an integral nave independently rotating on the axle, and can thus be seen as forerunners of an actual chariot, similar to the vehicles known in the Near East at this time. While the role of the domestic horse in the economy is unclear, there is a clear presence of horses as ritual offerings in burials, suggesting their great social importance (Chechushkov and Epimakhov 2018).

Its subsistence economy, communication, mobility, and exchange patterns are altered for major parts of the population, although a continuous presence of steppe-related settlements is seen in the Lower Danube and Dobruja regions. The rise of metallurgy and the relevance of craftsmen associated with the Early Bronze Age, which began during the Yamna period, acquires probably its full meaning and greatest extent during the Catacomb period, judging by the number of metallurgists' graves in the region during the 3rd millennium, in what has been identified as the Inhul–Donets Early Bronze Age Civilisation (Klochko 2013).

Common bronze artefacts are slender shaft–hole axes, adzes, chisels, daggers with flanged hilts, and different blades, as well as little spirals, beads, and hair rings. Present are also stone clubheads and flint spears and arrowheads. Pottery shows local differences, as in the previous Yamna period, but some cross-regional styles can be distinguished, such as pots with funnel or cylinder necks, deep bowls with short rims, and incense burners (Parzinger 2013).

vii.2. Early Indo-Iranians

Investigated samples from the steppe include six individuals of the Poltavka culture in the Samara region (ca. 2900–2200 BC), seven of the North Caucasus culture (ca. 2800–2500 BC)—in the piedmont steppe of the central northern Caucasus—and six from the Catacomb culture in the Kuban, Caspian, and piedmont steppes (ca. 2600–2200 BC), almost all showing continuation of the typical Steppe ancestry profile of Yamna. In contrast to Poltavka, which shows low EFF contribution (ca. 9%, i.e. between Yamna Kalmykia, of ca. 5%, and Yamna Samara, of ca. 12%), Catacomb shows a slightly higher mean EEF contribution (ca. 17%), with some individuals clearly shifted towards Yamna samples from the North Caucasus and towards Maikop outliers (showing a similar EEF ancestry), which is compatible with genetic continuity in the same territory. All samples with reported Y-chromosome haplogroup (five Poltavka, five North Caucasus, three Catacomb) show R1b1a1b1-L23, and among them two R1b1a1b1a-Z2103 lineages are confirmed in Poltavka; four in North Caucasus, two of them R1b1a1b1b3a-Z2109 positive for Y20993^{+} (TMRCA ca. 2800 BC), a subclade of KMS67 (formed ca. 3500 BC, TMRCA ca. 3300 BC), which was found earlier in a Yamna individual from the Samara region; and another R1b1a1b1b3a-Z2109 (formed ca. 3500 BC, TMRCA ca. 3500 BC) among Catacomb samples (Mathieson et al. 2015; Haak et al. 2015; Wang et al. 2019). One sample without a clear cultural adscription from Stalingrad Quarry (ca. 2680 BC) also belongs to hg. R1b1a1b1a-Z2103 (Allentoft et al. 2015).

A sample from Deriïvka (ca. 2900–2700 BC), also of R1b1a1b1a-Z2103 subclade, classified as Late Neolithic (without background information), is a clear outlier, clustering closely with north Pontic Neolithic samples, with contributions of Steppe and NWAN ancestry (Mathieson et al. 2018). This recent admixture of a typical Yamna lineage in the forest-steppe of the north Pontic area—the sample belonging thus probably to the late Yamna or early Catacomb culture—may suggest either the survival of small pockets of local populations among expanding Yamna clans, or an admixture with neighbouring northern peoples from the forest area which expanded to the south. The latter would be justified by the intense contacts of the late Yamna/Catacomb culture with the Middle and Upper Dnieper, evidenced by parallelisms in material culture of Catacomb with the Middle Dnieper culture (Klochko and Kośko 2009).

A Poltavka outlier from the Sok River in Samara (ca. 2900–2500 BC) clusters closely with Central European samples of the Corded Ware culture, and shows hg. R1a1a1b2a-Z94 (formed ca. 2700 BC, TMRCA ca. 2700 BC), a subclade of R1a1a1b2-Z93, widely distributed in the subsequent period in the steppes and Central Asia (Mathieson et al. 2015). This grave was most likely established on top of an older Poltavka cemetery, where a Sintashta cemetery was later found. Nevertheless, assuming the date is correct, it would be the first genetic proof of the intense interaction and admixture in the Volga–Ural region leading to the Sintashta culture, between Abashevo in the forest-steppe area and Poltavka peoples in the steppes. This close interaction with a Uralic-speaking culture makes Poltavka the most likely representative of a Pre-Proto-Indo-Iranian-speaking community.

VII.3. Southern Caucasus

The 3rd millennium BC is represented in the Caucasus by good precipitation and warm temperatures, which promoted a good forest cover in the Bedeni Plateau and the Trialeti region. This probably influenced the dramatic transformation in human behaviour and material culture in the region, represented by the appearance of the so-called Early Kurgan period by the mid–3rd millennium (Karim, Sepideh, and Mohammadi 2018).

This process has been associated with newcomers of a significantly different lifestyle and means of subsistence, possibly associated with a mobile economy, appearing at the same time as the Kura–Araxes traditions disappear. This evidence and the lack of proof of coexistence with the new population suggest a violent end of the culture in the region. In this *push–pull* process, Near Eastern societies form the south had an important role, judging by the cultural changes of Kura–Araxes communities, and the adoption of a sedentary village life by the newcomers (Karim, Sepideh, and Mohammadi 2018).

The appearance of fortifications in certain sites before the end also evidence the increase of intergroup conflicts and militarism during the Early Bronze Age. While the new groups of cattle herding pastoralists with wheeled carts and oxen-pulled wagons appear in the north, the Kura–Araxes communities subsequently moved farther south. It is unclear if the newcomers are part of a southern Caucasus culture – associated with the emerging Trialeti culture –, or if they came from further north, but some settlements seem to have been abandoned without traces of a violent end (Karim, Sepideh, and Mohammadi 2018).

Although the appearance of barrow cultures is abrupt, a transitional period can be observed in certain sites, showing late Kura–Araxes and local elements at the same time. Communities of the Middle Bronze Age I (Martkopi, Early Trialeti) buried their dead beneath large stone mounds, circular in plan, sometimes covered with a layer of earth, and their dimensions likely reflected social status. The most common item in funerary assemblages is pottery. Graves are often multiple (Karim, Sepideh, and Mohammadi 2018).

The Bedeni barrow tradition (in the high country and the lowlands) shows a more diverse range of burials, with the most popular one represented by large timber structures constructed in a deep rectangular or square grave pit, with aboveground mortuary architecture. Barrows show occasionally a gender-based differentiation reminiscent of the Yamna culture, and sometimes wagons are included in the graves, as was typical of some north Pontic groups. Not all burials were monumental or had a rich assemblage (Karim, Sepideh, and Mohammadi 2018).

The few studied Bedeni settlements show villages surrounded by defensive structures—e.g. a stone perimeter wall, or flanking ditches—formed by multiple houses with a plan reminiscent of the Kura–Araxes tradition: square with slightly rounded corners, with an anteroom and a main rectangular room with a central fixed, baked-clay hearth. Innovations in ritual behaviour with respect to the previous period is the appearance of platforms, which apparently replace hearths as focal points; the use of pit digging and filling; and also the burning of abandoned villages (Karim, Sepideh, and Mohammadi 2018).

Bedeni pottery shows coarse wares proper of the previous Kura–Araxes period, but also an innovative and highly developed potting tradition inspired over time by new advances in metalworking, since many vessels have a metallic look about them. There is a high level of woodworking, and sophisticated lithic industry, with a new projectile design different to the tanged and barbed arrowheads of the Kura–Araxes, more effective with grater penetrating power (Karim, Sepideh, and Mohammadi 2018).

vii.3. Southern Caucasians

In the North Caucasus steppes and piedmont, continuity with Steppe ancestry is seen. In the Caucasus region proper and to the south, the latest Kura–Araxes samples available and the subsequent North Caucasus, Dolmen, and Lola samples depict continuity of a typical Caucasus ancestry (see *§v.2. Early Caucasians*), hence the described prehistoric geographical and genetic barrier to steppe invasions (Wang et al. 2019).

Increased CHG ancestry (ca. 60%) is also found among three Early Bronze Age individuals from the Kura–Araxes culture in Armenia dated ca. 3300–2500 BC (Lazaridis et al. 2016), with a late sample (ca. 2550 BC) showing what seems to be a resurge of haplogroup R1b1a-L388 (formed ca. 15100 BC, TMRCA 13600 BC), ancestral to R1b1a1-P297, in the area, with subclade R1b1a2-V1636 (formed ca. 13600 BC, TMRCA ca. 4700 BC).

An outlier from Hajji Firuz Tepe in the north-western Zagros Mountains harbours elevated Steppe-related ancestry and clusters closely to a Yamna outlier from Ozera, Ukraine, and even more closely to Maikop and Armenia Chalcolithic samples (Narasimhan et al. 2018). This is consistent with the incorporation of groups similar to the known Maikop outliers of the northern Caucasus within the expanding Kura–Araxes groups (see *§vi.4. Northern Caucasians*), receiving thus contributions of Maikop and/or Kura–Araxes from the south.

Even though the radiocarbon dates published for the site (in this case ca. 2465–2286 BC) are unreliable, because of the collapse of different archaeological layers, it represents in any case most likely a Caucasus population with Steppe ancestry, rather than a direct migration from the steppe. The invasion of a Maikop-related population to the south is compatible with the described presence of wagons and rich assemblages in Bedeni. Given the uncertain dates, a late steppe-related population cannot be discarded, although Iron Age steppe-related populations, probably incoming from the Balkans, show a more southern cluster in the PCA (see *§viii.14. Caucasians and Armenians*).

VII.4. Aegean Early Bronze Age

In the first centuries of the 3rd millennium BC, new networks of exchange and trade developed, and social complexity increased in Northern Mesopotamia, reaching its peak in the Sumerian Early Dynastic III and Akkadian periods. The new political organisation that consisted at first of more or less independent rival city–states, out of which grew the hegemonial "empire foundation" of the Akkadian period at the end of the 24th century BC. Its centre was in southern Mesopotamia, urbanised since the 4th millennium BC (Ökse 2017).

Humid climatic conditions in the Near East had moved the border of minimal precipitation for dry-farming towards the south, creating a large arable region. No urban centres dating to these centuries are observed in the Upper Tigris, whose settlement structures reflected permanent rural settlements inhabited by egalitarian societies (Ninenvite V) until ca. 2600/2500 BC. These societies changed gradually from a sedentary life to a mobile one with seasonal activities, until the Akkadian supremacy (Ökse 2017).

Flood fills in the valleys of the Euphrates and Tigris indicate an area not suitable for sedentary life from ca. 2650 BC, which created a trend to new settlements on plateaus, or transition to pastoral economies. A settlement decline in the Upper Tigris must have occurred in concert with trade routes gaining importance in the south, and increasing pastoralism in the north. The new system connected regions such as Turkmenistan and Afghanistan in

Central Asia, the Arabian Peninsula, the Indian Ocean as far as the Harappa Culture of the Indus Valley and north-western India, and integrated Levantine-eastern Mediterranean and Anatolian regions, previously considered marginal regions. The last to be absorbed was the area around the Aegean, i.e. western Anatolia and Greece, gradually incorporated since ca. 2750 BC, developing a western nucleus of exchange and trade ca. 2500–2250 BC (Ökse 2017).

The Early Helladic-Cycladic-Minoan II included the following advances: stratified society with many prestige and status objects of the elite, of urbanisation, a three-fold structured settlement system and population growth; quasi-monumental architecture and organised communal works; complex administration and standardised systems of measuring and weighting; economic specialisation and mass production such as wheel-made pottery; and large quantities of copper, gold, and silver, as well as the first tin–bronzes (Heyd 2013).

This period showed a climate favouring agricultural production, based on a mixed small-scale and intensive system, which included Mediterranean polyculture based on grain, wine, and olive oil, apart from figs. There is also an increase in domestic animals and in the use of secondary products like wool, milk, and cheese from the beginning of the 3rd millennium. This contributed to the constant growth of the population and enlargement of urban centres, reaching a population density that would only recur in the late Bronze Age Autarchies were replaced by specialised trading systems, and dependencies were created. Long-distance trade is inferred from exotic objects decorated in the Indus area, and coastal settlements specialised in maritime trading were built in this period. Social hierarchies developed, as well as the notion of territory, political control and ‘chiefdoms’ in general (Ökse 2017).

The new rural sites established ca. 2400/2300 BC in the Upper Tigris coincide with the period of aridity that moved the minimal border of precipitation again to the north, and probably impacted the socioeconomy of northern Mesopotamia, which forced the Akkadian kings to repopulate the

Upper Tigris region, in order to establish a new agricultural system to provide for food. The new sites showed pottery similar to that produced in the Habur region, indicating a strong relation to the Akkadian territory administered from the Palace at Tell Brak (Ökse 2017).

At the end of this period ca. 2300–2200 BC, a crisis appears in Mesopotamia, then the Levant and Anatolia, and finally the Aegean region, where connections were eventually broken, and trade was cut off. Settlements shrink in size and are abandoned, and demographic levels fall. People of foreign origin take the opportunity of a serious weakening of the whole system to move into these regions in crisis, in the western Aegean during the Early Helladic III period, which lasts ca. 2200–2000 BC, reaching its lowest point ca. 2000 BC in the Middle Helladic (Ökse 2017).

vii.4. Aegeans and Anatolians

Minoans from the Lasithi plateau in the highlands of eastern Crete (ca. 2400–1700 BC) and from the coast of southern Crete (ca. 2200–2700 BC) were a homogeneous population, with an ancestry shared with Bronze Age south-western Anatolians of Harmanören–Göndürle Höyük (2800–2300 BC). All Aegean populations derived most of their ancestry from an Anatolia Neolithic-related population (ca. 62-86%), but with contributions of Iran Neolithic-related ancestry (ca. 9-32%), which was already present during the Neolithic in samples from central Anatolia and in Tepecik-Çiftlik. Two Minoans from Lasithi and one Anatolian individual from the Bronze Age showed haplogroup J-M304, which was rare or non-existent in earlier populations from Greece and western Anatolia, dominated by G2-P287 (Lazaridis et al. 2017):

Minoans show hg. J2a1d-M319 (formed ca. 11000 BC, TMRCA ca. 9700 BC), with haplogroup J2a-M410 found first in the Caucasus, in the Palaeolithic individual from Kotias Klde, and later hg. J2a1-L26 is widely distributed during the Bronze Age from Central Asians in the east to Assyrians and Mycenaeans in the west, which suggests a potential expansion with CHG/Iranian farmer-related ancestry in the Chalcolithic (see *§iv.4. Late*

Middle Easterners). The Minoan sample from southern Crete, of hg. G2a2b2a-P303 (a lineage found in central and eastern European farmers), shows thus continuity of regional male lines.

Based on subsequent migrations, the incoming population of J2a1-L26 subclades may have brought from the east languages ancestral (or related) to Tyrsenian, which would be the common substrate described for Greek and Anatolian. Their integration with other peoples, such as Assyrians in the Bronze Age, proves that the high demographic density and advanced political organisation of Near Eastern cultures may have allowed for different lineages to become integrated into different communities speaking diverse languages, depending on the ruling elites of each period and region. This long-term connection between Anatolia and the Aegean may also support the proposal of a Hatto-Minoan, and its potential relationship with Sumerian (Schrijver 2015).

The south-western Anatolian BA sample shows J1a2b-Z1828 (formed ca. 16000 BC, TMRCA ca. 6100 BC), which was also found in the Levantine Bronze Age (Lazaridis et al. 2017). This hints at ancestral southern Anatolian populations which were probably responsible for the introduction of Levant-related ancestry in the region.

In Anatolia, the first attestation of Anatolian languages is believed to occur in typical masculine personal names found among inscriptions from Armi (ca. 2500–2300 BC) a regional state which enjoyed a privileged relationship with Ebla, a Semitic-speaking Kingdom from south-eastern Anatolia and the northern Levant. The kingdom of Armi was possibly located in the Upper Tigris, in a recently Semiticised area related to silver and copper trade with the north (Bonechi 1990; Archi 2011).

In the late 3rd millennium, the heartland of Hittites probably lay in the upper reaches of the Halys River, in a zone between the Luwian heartland to the southwest, in the Lower Land south of the Tuz Gölü central Anatolia, and the Hattians to the north on the central Anatolian plateau. This tentative location is based on the mixed influence of Hattic and Luwian on early Hittite, and on the presence of Hattic loanwords in prehistoric Hittite *through* an intermediary Luwian language. Poor evidence exists of the Luwian presence in west Anatolia, with few scraps of evidence suggesting that early forms of Carian and Lydian may have been the spoken languages of the area (Melchert 2011).

VII.5. The Balkans

The population of Bronze Age tell settlements from the Carpathian Basin show ritual practices in common with the Mycenaean world, with an official cult practised in specific buildings, like temples destined to serve the entire community, complemented by a family cult, represented by fireplaces and small altar pieces or miniature wagons made of clay (Gogaltan 2012).

There were a potential solar cult (reminiscent of the Zeus/Apollo cult) before its appearance later in the Urnfields culture and in the Nordic Bronze Age; human sacrifices potentially addressed to a deity of war (such as Ares); food offerings potentially for some deity of fertility (like the “Great Mother”); animal idols and drinking vessels; a “hero cult” with weapons and other metal objects, etc. (Gogaltan 2012). All of this strengthens the idea of a common Balkan community, in contact with central European cultures during the Bronze Age.

The peripheries from the Aegean Early Bronze Age developed a dynamic new social and economic system through contacts with the core areas, by way of imitation and innovation. The direct exchange network included the eastern Balkans (northern Aegean), with Bulgaria and western Anatolia; the western Balkans, with the eastern Adriatic coast as well as the inland; and the south-central Mediterranean area, particularly Sicily, Malta, and Apulia, which were eventually under the expansion of Bell Beakers (Heyd 2013).

After west Yamna groups lost their internal coherence and direct contacts with the north Pontic homeland in the mid–3rd millennium, the Aegean became the new cultural model for the Balkan population (Heyd 2013):

From the East Thracian Plain to Troy, after ca. 2500 BC, local cultures become more complex, with graves of local leaders and elites; ritual sites and buried hoards, imports including jewellery of gold and silver, weaponry, and thousands of large and varied golden artefacts; a new dress code that came with widespread dress pins; etc.

In the west the Aegean influence is felt earlier in graves from the East Adriatic coast up to the Danube, perhaps even earlier than 2750 BC, judging by a hierarchically structured settlement of Vučedol and similar sites along the Danube. A trade connection is created between local elites in the Adriatic (including south-eastern Italy) that persists after the demise of the previously dominant Vučedol complex, as witnessed in prestige object imports in regional groups such as Vinkovci in Slavonia and Syrmia, Bubanj Hum III and Armenochóri in eastern Serbia and Macedonia, Belotić-Bela Crkva in Central Serbia, and Cetina along the Adriatic coast.

Overall, a "chiefdom" system based on prestige goods comes into being in both territories, In the east along the Adriatic coast, a maritime trade system develops, as well as local concentration, cultural regionalisation (where rather small areas develop a cultural identity), and a wave of centralisation. Cetina, however, under the influence of the Bell Beaker culture (see *§VIII.9.1. Cetina*), remains apart from these social changes, as evidenced by the absence of prestige goods and its drive to expand to the south in Albania and then in the Peloponnese during the Early Helladic II to III (i.e. ca. 2200 BC).

vii.5. Palaeo-Balkan peoples

One west Yamna individual from Mednikarovo in Bulgaria (ca. 2950 BC), of hg. I2a1b1a2a2a-L699, shows contributions of NWAN-related ancestry, with a clear 'southern' drift in the PCA towards Balkan populations (Mathieson et al. 2018). A similar ancestry (and shift in PCA) is found in a sample of the Vučedol culture from Beli Manastir (ca. 2775 BC), of hg. R1b1a1b1a-Z2103, contrasting with the other available Vučedol sample, which clusters closely to other Balkan Bronze Age populations, in turn clustering closely to Anatolian farmers (see *§viii.11. Thracians and Albanians*).

Other investigated individuals from this period with contributions of Steppe ancestry (general mean ca. 30%) include: two from the EBA barrow necropolis of Beli Breyag (ca. 3400–1600 BC), with hg. I-M170 and I2a1b-M436; two from the same grave-pit, of five tall individuals laid extended on their backs, east–west orientated, head to the East and ochre-stained, from Smyadovo (ca. 3300–3000 BC), of hg. I2a1b1a2-CTS10057 and 12a1b1a2a-L701; one from the Ezero culture in Sabrano (ca. 3100–2900 BC); one from the Kairyaka necropolis under a mound in Merichleri (ca. 3000–2900 BC), buried in a small pit head to the East and ochre-stained, with legs bent at the knees, of hg. I2a1b1a2a2-Y5606; and two from Dzhulyunitsa (ca. 3300–2700 BC), one in a flexed position, of hg. G2a2a1a2-L91 and H2-P96 (Mathieson et al. 2018).

The high NWAN-related ancestry in populations from the Eastern Balkans is explained by the admixture of expanding Yamna settlers with Balkan farmer communities, which had the highest population density of Europe in this period (Müller and Diachenko 2019). While the presence of 12a1b1a2a-L701 in one sample of the LBK from Hungary (ca. 5300–4900 BC) makes this identification unclear, it seems that the simultaneous emergence of I2a1b1-M223 samples in different sites of the Eastern Balkans after the Yamna expansion in the north-west Pontic area must be related to the spread of I2a1b1a2a2a-L699 lineages from Yamna (see *§vi.1. Disintegrating Indo-Europeans*). The lack of this haplogroup in previous samples from the region supports this as the most likely explanation.

The modern distribution involving early R1b1a1b1b-Z2103 lineages includes R1b1a1b1b3-Z2106 subclades R1b1a1b1b3a-Z2108 (formed ca. 3600 BC, TMRCA ca. 3600 BC), and further R1b1a1b1b3a1-Z2110 (formed ca. 3600 BC, TMRCA ca. 3400 BC), found in modern populations from the Balkans and Central Europe; R1b1a1b1b2-L277.1 (formed ca. 2100 BC, TMRCA ca. 2100 BC), also found in the Balkans; and R1b1a1b1b1-L584 (formed ca. 3200 BC, TMRCA ca. 2900 BC), found in Armenian and other

Central European populations. The early split of R1b1a1b1b-Z2103, found widespread also among ancient and modern Indo-Iranians, makes a proper identification of certain lineages with the spread of certain peoples (and specific routes of expansion) difficult without ancient samples.

VII.6. Iberia

The Proto-Beaker package probably emerged in a south-western Iberian region, part of the southern and west-central Iberia that participated in the evolution to complex, huge fortified settlement sites like Los Millares (Figure 42) and Zambujal, and other even larger macro-villages. The regions around the lower and upper Guadiana and the upper Guadalquivir rivers stand out as two of the most densely settled territories in Iberia, probably related to their agricultural potential and their rich copper ore deposits. Macro-villages in this region extend over more than 100 ha (Heyd 2013).

Figure 42. Painting of Copper Age walled settlement of Los Millares, by Miguel Salvatierra Cuenca. Photography by Jose Mª Yuste. From Wikipedia.

This local development must be discussed in light of the “Transformation of Europe”, the demographic, cultural, and economic pressure brought about by western Yamna migrants disturbing the equilibrium in central Europe. However, another often discussed influence are the contacts with Early Bronze Age cultures from the Aegean, and probably also the Levant. This east–west Mediterranean connection is evidenced for example by the exchange and use of ivory (Heyd 2013).

The dimensions of the settlement complexes are therefore essentially an expression of the available work force and agricultural wealth of these societies, as well as of the demographic increase observed during the 3rd millennium, all consequence of the new exceedingly productive subsistence strategies. Most Iberian Copper Age communities of any size and geographic location expressed a strong preference for communal values, as shown by collective burial practices and communal organisation of part of the economic production, such as open spaces dedicated to storage pits, specialised metalworking areas, grinding equipment, flint knapping traces, etc. (Risch et al. 2015).

Their connection is also seen in a common universe of decorative motifs, signs, and symbolically meaningful artefacts, apart from the sharing of long distance networks, evidenced by metalworking technology, flint artefacts, and the use of raw materials such as ivory (Risch et al. 2015).

The presence of exotic materials such as ivory, ostrich eggshell, or amber becomes evident, but these foreign elements are most highly concentrated at the largest archaeological sites, such as Valencina de la Concepción or Los Millares, where there was a greater capacity for the mobilisation of work and acquisition of foreign raw materials (Murillo-Barroso and Montero-Ruiz 2017).

Ditched enclosures and fortified settlements coexisted and were thus probably specialised in their economic practices. Both types of settlements were associated with megalithic tombs or subterranean grave structures in the immediate vicinity, *hypogea*, and large pits, with deceased of all ages and sexes buried there over generations. *Tholoi* and natural caves were also used during this time, with differences in funerary rites not representing apparently unsurmountable cultural barriers (Risch et al. 2015).

Nevertheless, the Iberian Copper Age was essentially dominated by a rather mobile residential pattern, with unfortified occupations, often less than 0.5 ha, found in very different topographical positions. Basic features of the subsistence economy include intensive agriculture on the most fertile or humid soils, but also a firmly established husbandry (with milk and wool as by-products), with hunting, gathering and fishing providing important complementary resources. Many of these smaller settlements were probably dependent agricultural communities, compelled to pay tribute to the larger, more complex settlements (Risch et al. 2015).

These Chalcolithic societies thrived in the Final Neolithic–Chalcolithic period, with small and short-lived chiefdoms, transegalitarian and hierarchical polities. The demographic density increased during the pre-Beaker period in the Meseta and in the south-east, peaking during the initial Beaker phase, while the south-western region shows a more discrete growth peaking during the pre-Beaker phase and dropping abruptly ca. 2500 BC, just prior to the Beaker period (Blanco-González et al. 2018).

The introduction of Bell Beaker pottery ca. 2600/2500 BC, quickly expanded through the Atlantic coast, shows a variable importance in the rest of Iberia. In the area of Los Millares, it appears only in certain settlements, while in the south-west Bell Beakers are rare when not completely absent. Furthermore, there is no clear correlation with specific types of habitation, funerary structures, or with metal production (Blanco-González et al. 2018).

The EBA shows changes in south-eastern Spain partially synchronic with those in Italy and the Balkans ca. 23rd/22nd century BC, marking a profound social, political, and ideological evolution. A substantial number of 14C dates confirms that most, if not all, of the Chalcolithic fortified settlements and Late Neolithic–Chalcolithic monumental ditched enclosures had been abandoned by 2200 BC (Blanco-González et al. 2018).

The older networks of symbolical axes made of exotic rocks, flint, ivory and decorated schist plaques, Bell Beaker pottery, etc. collapsed rather abruptly or was reorganised at a much more local scale. In the funerary sphere, this date marks the abandonment of a collective burial rite. However, while the Atlantic coast shows an abrupt de-intensification of human pressure, the central and eastern Iberian regions do not show these fluctuations (Blanco-González et al. 2018).

vii.6. Basque-Iberians

Intensified contacts during the Final Neolithic–Chalcolithic in Iberia–southern France, including common social and economic developments, with the newly created exchange networks and the demographic expansion, are potentially the mark of an expanding common ethnolinguistic community, which may be identified with an Ibero-Basque group (Villar Liébana 2014).

Neolithic individuals from Iberia and France show a large proportion of hunter-gatherer ancestry, continued in a mean of ca. 25% for Middle Neolithic (higher in the north-west, lesser in south-western Iberia) and ca. 30% for Chalcolithic populations, from a source closer to north-western Iberia (Canes1-like) with admixture events that happened most likely between the Early and Middle Neolithic period. While Neolithic samples from Iberia and south-western France include mixed G2-P287, I2-M438, and R1b1b-V88 lineages, the majority of the reported Iberian/France Late Neolithic–Chalcolithic Y-chromosome haplogroups are I2-M438 subclades (Martiniano et al. 2017; Lipson et al. 2017; Gunther et al. 2015; Valdiosera et al. 2018; Olalde et al. 2018; Olalde et al. 2019):

Of the I-M170 lineages, there are at least six I2a1a1-CTS595, of them two I2a1a1a-L158 (formed ca. 16200, TMRCA ca. 9700 BC), concentrated in south-western Iberia, with one sample from the centre. At least one of them is I2a1a1a1-Y3992 (formed ca. 9700 BC, TMRCA ca. 6300 BC), reported from northern Iberia, a lineage shared with north Italian and Balkan Chalcolithic samples, and found in one Early Neolithic sample (ca. 5200 BC), suggesting a spread coinciding with the Neolithic expansion and later migrations from western Europe.

There are at least twenty-seven I2a1b-M436 lineages, also found in one Early Neolithic sample (ca. 5200 BC). Probably most are under I2a1b1b-Y6098 (formed ca. 6000 BC, TMRCA ca. 2900 BC), at least eleven under I2a1b1b1-S23680/S23467 subclades (formed ca. 6000 BC, TMRCA ca. 5700 BC), most of them from the south, but appearing in sites all over Iberia, with one I2a1b1b-Y6098 sample found in a Corded Ware sample from Czechia. Three of them are I2a1b1a2b-Z161 lineages, and also appear scattered all over Iberia in Neolithic and Calcolithic samples.

There are at least eight I2a1a2-M423 lineages in south-western Iberia, northern Iberia, southern France Megalithic, and the Neolithic from the British Isles, being a haplogroup widespread among central European hunter-gatherers and later farmer populations.

There are also seventeen G2a-P15. At least six G2a2b-L30 samples, three within G2a2b2b1a1-F872, two G2a2b2b1a1a-PF3378 (formed ca. 6900 BC, TMRCA ca. 3800 BC), at least one of them G2a2b2a1a1c1a-Z1903 (formed ca. 6100, TMRCA ca. 2500 BC); and seven G2a2a-PF3147 lineages, probably all within the G2a2a1-PF3148 tree, likely continuing an Early Neolithic G2a2a1a3-FGC34625 lineage (formed ca. 8900 BC, TMRCA ca. 7400 BC) that is found in at least two Late Neolithic samples; and there are also three F-M89 (also found during the Early Neolithic and in the Early Bronze Age); and seven H-L901 lineages, at least three of them H2-P96, scattered in different regions.

If there was a Basque-Iberian language, it should be identified with Chalcolithic communities of Iberia and France before the East (or Classic) Bell Beaker expansion. The possibility of a Basque-Iberian language may be supported by the genetic homogeneity and continuity during the whole Neolithic period and during the Chalcolithic. Cultural expansions of western Europe (either with or without population movements), first with the Megalithic culture in the Middle Neolithic, and then with the Proto-Beaker package in the late Chalcolithic, may also be adduced to support this cultural unity. The language of this group should then be associated with the language of early Neolithic farmers, and thus possibly related to their expansion through the Mediterranean (Villar Liébana 2014). The fact that the ancestors of Basques and Iberians were isolated from each other in the Chalcolithic, after the arrival of East Bell Beakers, and were thus surrounded by Indo-European languages but still showed common linguistic traits in the Iron Age seems to support their ancient connection rather than recent areal contacts.

VII.7. Bell Beaker culture

VII.7.1. The Bell Beaker package

The Bell Beaker phenomenon is defined by groups that show a common know-how in technology, especially regarding pottery, copper metallurgy (Amzallag 2009), and flint. No single unified network of know-how transmission can be reconstructed, only local or regional networks (Linden 2015). Despite this, a supra-local homogeneity can be observed in the whole of Europe from ca. 2500 BC “in similar funerary rituals, in the way of interacting with territory, in the way of representing iconography and decorating pottery, and in the way of representing social differences” (Martínez and Salanova 2015). The Bell Beaker phenomenon made thus the previous regional networks of western Europe uniform with identical social codes.

With the advent of radiocarbon dating, the compilation of Bell Beaker pottery dates (Müller and VanVilligen 2001) showed that the most likely origin of the pottery style was Iberia, pointing to high quality, tall beakers of the so-called maritime style. Only later were these dates and the Bell Beaker migrations integrated together in a common paradigm, when it was noted that the expansion of beakers with lower profiles and a more complex decoration, from East Group beakers, were replaced in the Danube area by plain jars, cups and plates. These vessels then dominated in the later developments of the culture (Harrison and Heyd 2007).

The migration of mobile Yamna migrants into the plains of the lower Danube and the central Carpathian basin is noted in small and large groups in the Balkans, establishing pastoral societies as forerunners of Heyd's "Yamna package", with domesticated horses, ox-drawn wagons, and herds of cattle and sheep, and noticed as far as southern and central Germany. The so-called "proto-Bell Beaker package" is composed of essential early elements—such as the Maritime Beaker, copper knives and awls, advanced archery skills and reliance on the bow and arrow, and decorated textiles, perhaps also V perforated buttons—but lacks boars' tusk bow-shaped pendants, stone wrist-guards, and the type of tanged dagger that become identified with the Classical Bell Beaker package later.

This proto-Beaker package arises at the same time ca. 2900–2800 BC in the Tagus river estuary with a high concentration of monotonously decorated early Bell Beakers, associated with a new culture of large fortified settlements, megalithic tombs and collective burials. The proto-package is found for example in the Maritime Beaker, and it expanded ca. 2700–2500 BC, getting enriched through some areas in western Europe (e.g. in the corded Beaker type), but clear internal social boundaries existed in this period. This fashionable Bell Beaker *idea* turned into the classical "Bell Beaker Package" during its expansion to the east, reaching the Rhône and Britany in the 26th century BC, then arriving in central Europe (Suppl. Fig. 10.B), and the Csepel group of the Carpathian basin, around 2500 BC (Harrison and Heyd 2007).

The transformed, classical Beaker package includes (Harrison and Heyd 2007):

1. The Beaker networks on an international scale, a system of power based on knowledge from distant parts (for the relevance of craftsmen in these networks, see below). This is related to the introduction of standardised and rich coloured textiles (dyes and morands), and refined drinking vessels (the bell beaker) used to share alcoholic drinks.

2. The creation of a socially inclusive system of belief, where additional identities (or social positions) are developed for people to acquire, which allows more people to participate (with defined roles) in the ceremonies of social promotion attached to the Beaker package, and thus welcoming more people to an enhanced status, with its new privileges.
3. The warrior self-consciousness, selecting the bow and arrow as status object for men. In its origin, macro-villages were designed for defence by many archers. The choice of archery with the expansion of the package creates a deliberate contrast to earlier styles of combat, which used hafted axes and daggers for close hand–to–hand fighting. Archery allows the warrior to fight at a distance, even from horseback, and can be concealed, which seems antithetical to a code of honour based on individual combat, where rivals face each other within hand's reach.
4. The specific female counterpart to the male warrior, apparent in life on stelae (before the expansion of East Bell Beakers) and in death in the female Beaker graves. This was added probably late due to the Yamna package in western Europe, because it is absent in Iberia but present in Central Europe before its adoption by East Bell Beakers.
5. A specific religious expression linked to sun worship, generalised throughout Europe in the 4th millennium BC. A stela from Sion depicts the rising sun, and East Bell Beaker groups place the dead so that men and women face eastwards towards the sunrise (see below), which continues the western European solar cult.

All these were part of the "Transformation of Europe" ca. 2900–2700, but the Bell Beaker package combined them into a single visual message of power, knowledge, heraldic objects and status, reinforced by a religious element. Local conflict in Sion shows that even Central European Bell Beakers (with an almost full-fledged package) did not show unity, until the expansion of the East Bell Beaker group.

For example, the composite (half-reflexed) bow, which required specialised craftsmanship, expanded to all of Europe with the spread of East Bell Beakers after 2500 BC, but its development (from the original Iberian model) must have happened during the transition of Yamna to Bell Beaker, judging by its depiction in an anthropomorphic stela from a Yamna kurgan in Natalivka ca. 2700–2500 BC (see Figure 43), and its later spread throughout the Eurasian steppe (Klochko and Kośko 1987). The typical proto-Beaker bow, as represented in stelae and bow-shaped pendants, were simple longbows. Double-curved composite bows of small size were more practical and maneuverable, ideal for use from horseback, a warfare technique probably present in eastern Europe at this time (Corboud 2009; Ryan, Desideri, and Besse 2018).

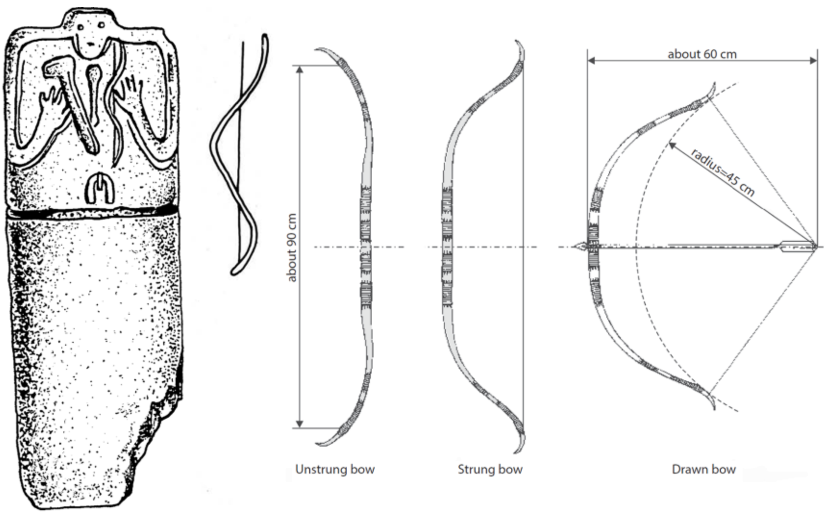

Figure 43. Left: Anthropomorphic stela above a kurgan grave of the Yamna culture (in a territory of previous Lower Mikhailovka culture), ca. 2700–2500 BC, depicting a man fitted out with the attributes of power (battle axe, staff of office, and composite bow), after V.N. Danilenko. Right: Reconstruction of a bow from the Bell Beaker culture based on depictions in stelae by Corboud (2009), modified from Ryan, Desideri, and Besse (2018): Composite bows have a wider middle and a curve at both ends, which compresses the bow allowing for it to be shorter, yet with a more efficient transfer of energy to the arrow, maintaining the power seen in longbows. They were more

complicated to make and required a higher degree of know-how than the simpler, single-piece wooden yew bows previously prevalent in Europe.

The phenomenon accelerated dramatically when more people being involved seized the opportunity to promote themselves, by adopting the now well-defined package of novelties, so around 2500 BC Bell Beakers expanded explosively (Suppl. Fig. 11). It became thus a pan-European phenomenon, incorporating distant regions following the Atlantic and Mediterranean coasts and the main river systems, such as the Danube, Rhine and Rhône, and their tributaries. Distinct regional traditions were incorporated to different expanding currents, and eventually four large geographical entities could be discerned: the Central European domain or *East Group*, an Atlantic domain, a Mediterranean domain, and a north-west European domain including the Northern European Lowlands and Scandinavia. Within these large entities, different groups could be distinguished, such as the Rhenish/Dutch Beaker or the Northern Italian Beaker groups (Heyd 2013).

With the emblematically decorated Bell Beaker, also shared previously to some extent in the Corded Ware beaker and in western Proto-Beakers, the ideal communal drinking vessel had on average enough content so that several persons could consume a special drink out of it, and its form forced one to use both hands for drinking, and then to hand it over again with both hands, in an almost ritual manner, to the neighbour. However, two elements seem to have been more interesting innovations for newcomers of any cultural background: the dagger idea—no matter if from metal or flint—and the archery idea, materialised in the arrowheads and wristguards (Heyd 2013).

VII.7.2. East Bell Beaker group

The Bell Beaker migrations over all Europe have long been associated with the expansion over central and western Europe of Yamna migrants through the Carpathian basin (Gimbutas 1993). Specific correspondences were found in burial rites, armament, costume, ornaments, technology in general, and also in ranked society, funerary rites, belief in life after death, and in general symbolism.

Through the Upper Danube, west of the main settlement regions in the Hungarian Plains, Yamna migrants spread to southern Germany—following the routes previously created by western Yamna settlers and vanguard groups (see *§VI.1.2. East-central European lowlands*)—where decorated cup styles, domestic pot types, and grave dagger types from the Middle Danube were adopted around 2500 BC (Anthony 2007). Contemporaneous with this migration was the evolution noted in the Classical Bell Beaker culture expanded by the East group (Heyd 2007):

- ranked family-based social structures, rooted on self-sufficient farmsteads;
- a progressive specialisation in stockbreeding and plant cultivation of less demanding species;
- burials following family units, signalled by 'founder' graves;
- and no defensive position, hill forts, or fortifications, unlike later chiefdoms of the Bronze Age, where families and single persons gain power.

This structure allowed for individual and social mobility, increased communication and internal exchange of information, goods, genes, and social values (Heyd 2007).

Findings of regions north of the Alps, from modern east Switzerland to west Hungary, belong to the East (or Middle European) group of the Bell Beaker culture. Special territories of this group include the Bohemian and the Moravian provinces, which are also the source of northern Silesian and Lesser Poland groups, as well as the Csepel group in Hungary. Common traits (Figure 44) of the core East group are (Heyd 2007):

- Specific finds such as the stocky and intricately decorated East Group Beaker, often with metope decoration; the many jars, simple cups, and plates appearing as *Begleitkeramik* (accompanying pottery); and smaller findings like broad 4-hole wristguards, decorated boar tusk bow-shaped pendants, and V-shaped perforated bone buttons.

- Specific spectrum of settlement pottery, more varied than funerary ones, clearly distinguishable from western Bell Beaker groups and Balkan EBA cultures.
- Homogeneous, intensively worked burial custom with many graves organised in necropolis of up to 150 graves (in Moravia and Hungary also with cremation), constrained to certain rules, which had as a result the uncommon and characteristic bipolar gender-differentiated burial where men were buried with their heads to the north, and women with their heads to the south:
  - Gender-specific ritual, with men buried on the left side, females on their right side, both sexes in a foetal position.
  - Main orientation of the grave pit and corpse is north–south.
  - The dead face to the east.
- Settlement type through non-intrusive frame-like, boat-shaped long houses featuring the use of light (which makes them difficult to find).

The Classical Bell Beaker culture associated with this East Group is divided into phases from its initial stage ca. 2500 to the Early Bronze Age innovation waves ca. 2200 BC, which account for some 12-13 generations, assuming that each generation lasted 20–25 years. While eastern groups seem to go steadily through all phases, western ones in southern Germany have shorter initial and later phases, which point to an east–west drift of innovations during this period (Heyd 2007).

Socially, East Bell Beaker graves do not show superior status at regional or supra-regional level. Because the burial goods reflected their use in real life, it is conceivable that views of the afterlife were aligned with the world of real objects and accompanying social categories. Cemeteries show relatively strong kinship ties, signalled by the ‘founder’ graves. which point to these groups as family units in a wide sense (Heyd 2007).

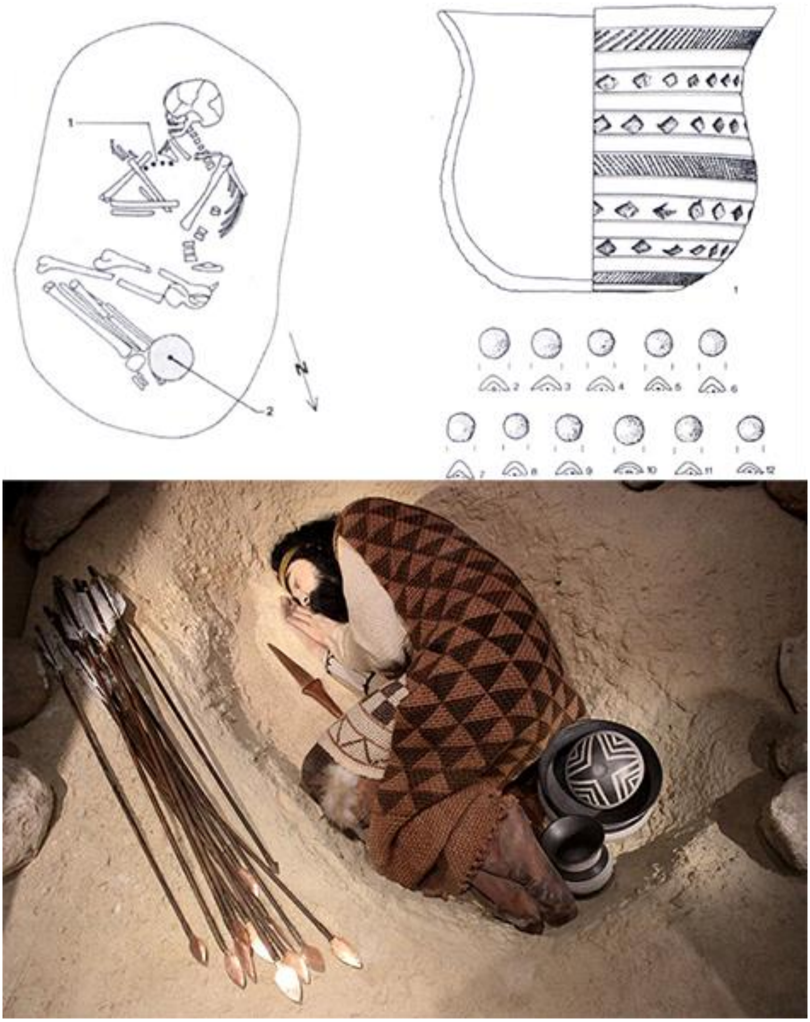

Figure 44. Top: Osterhofen-Altenmark, grave 4: South German sample burial of the East Bell Beaker group, modified from Heyd (2004). Bottom: Reconstruction of a Bell Beaker burial (National Archeological Museum of Spain).

Evidence points to an organisation into isolated communities living in fertile areas in a closely packed farmstead as the smallest unit, consisting of a single dwelling house inhabited by one family unit (with a small number of inhabitants), perhaps with additional farm buildings. These self-sufficient social units were economically specialised to a certain extent. Farmsteads located close to each other, sometimes connected through favourable landscapes, formed real settlements. However, where landscapes were not favourable, no central place is found (which is incompatible with the settlement model of egalitarian farmsteads), and neither are hill forts or fortifications of any kind, proper of later, Bronze Age groups (Heyd 2007).

This egalitarian organisation contrasts with previous hamlets of the region (e.g. in the Corded Ware culture), clusters of a few independent households with their own dwelling houses and adjacent communal farm buildings, or villages, representing middle-sized settlement units. Advantages of this new organisation are (Heyd 2007):

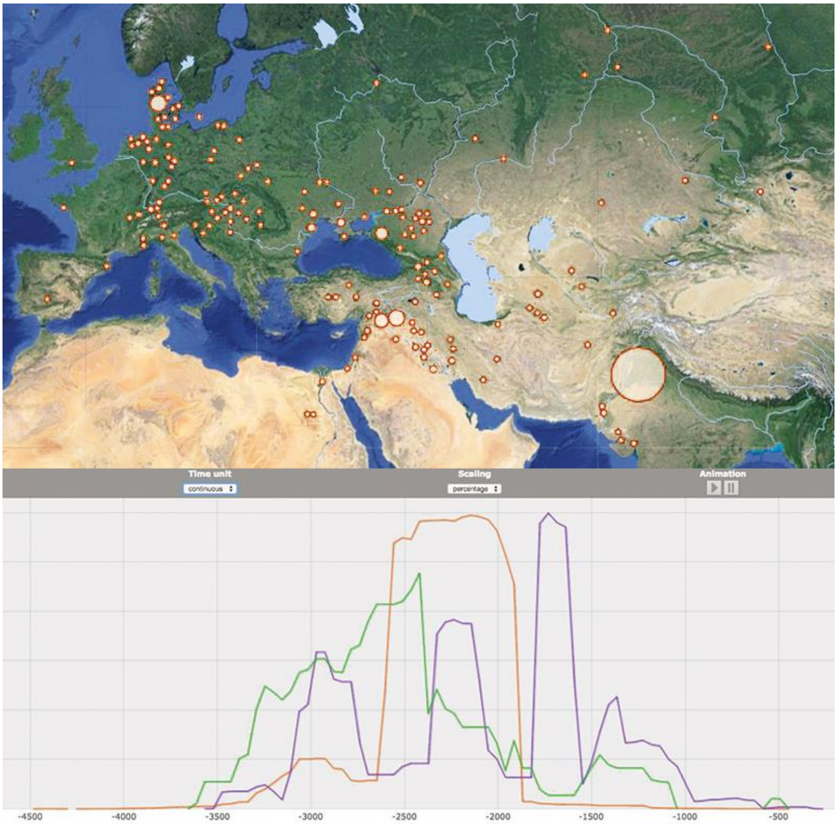

Figure 45. Top image: Map with evidence of animal traction before ca. 2000 BC. Bottom image: frequency of finds of evidence for animal traction (orange), cylinder seals (purple) and potter's wheels (green) in the 4th and 3rd millennium BC (query from the Digital Atlas of Innovations). The data points to an early peak in the expansion of this innovation at the turn of the 4th–3rd millennium BC, while direct evidence supports

a radical increase from around the mid–3rd millennium BC until the early 2nd millennium, coinciding with the expansion of East Bell Beakers and related European Early Bronze Age cultures. Data and image modified from Klimscha (2017).

- Economic units are independent and make opportunistic alliances, reacting flexibly to emergencies and dangers from the outside.
- They are more mobile, probably reflecting cattle-breeding and transhumance as the dominant herding strategy, individually and collectively, with less permanent settlements (Figure 45).
- The command of an increased communication system, with internal exchange of information, goods, genes, and social values. They seem to have invested more in mobile possessions, such as copper and cattle, than in settlements.

About prestige goods, which distinguished the buried individuals among these general egalitarian customs, the most common ones are copper tanged daggers, small flint daggers, wristguards, decorated bow pendants, and flint arrowheads in men's graves, together with copper awls and V-perforated bone buttons from women's graves, and gold and amber objects that in both male and female graves (Heyd 2007):

- In comparison with Corded Ware graves, gold objects seem to increase in abundance dramatically, although they represent small quantities even in well-equipped graves, which suggests its origin as rare imported objects. Its presence continues into subsequent Early Bronze Age cultures.
- For the first time, amber goods—until this moment constrained to cultures in contact with the Baltic, like TRB, GAC, and CWC—reach western Europe, and this connection forms the basis for the later 'amber route' of the fully developed Bronze Age. Shells in female burials, associated with neck ornaments made of V-perforated bone buttons, link Bell Beaker to the Mediterranean, probably travelling through the Alps.

- Flint daggers, which spread with the Transformation of Europe, became prevalent in Europe after the expansion of Yamna, and with Bell Beaker they replaced the traditional stone battle axes, which had dominated burials in the region for a thousand years. Copper daggers, in many cases miniatures, are probably to be understood as symbolic artefacts, in a rank similar to the most precious objects, gold and amber artefacts.

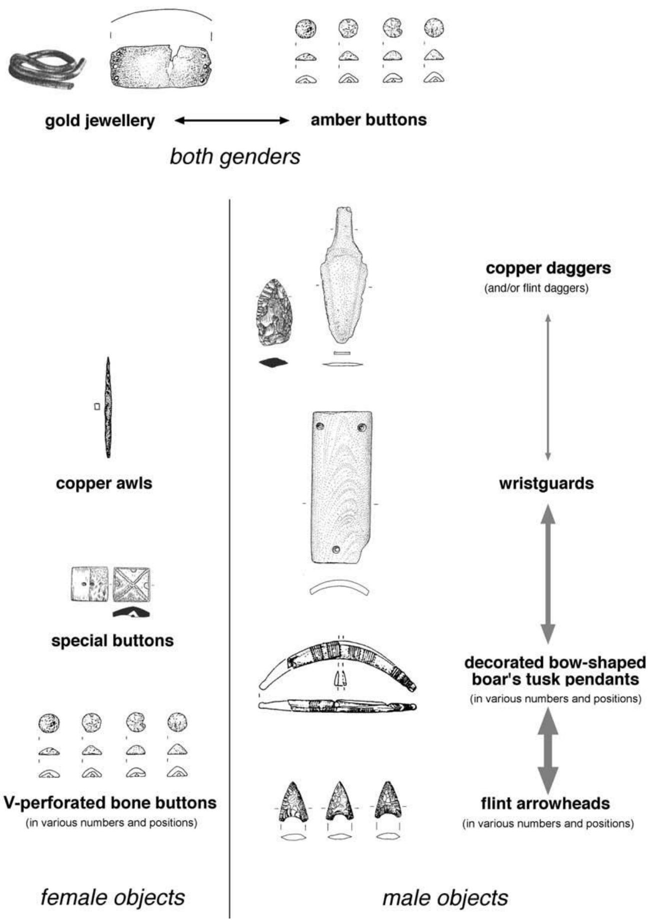

Figure 46. Special grave goods in the Bell Beaker East Group. From top to bottom, rarer to more frequent objects, indicating its relative ranking. From Heyd (2007).

All these grave objects might have had special symbolic and magical values, connected with the social position of their owners, and demonstrating long-distance communication, an international system of values, and a supra-regional trade network. Apparently, the number of artefacts and their association (Figure 46) show a hierarchy of importance of these objects (Heyd 2007).

Similar to the evolution of ‘holed’ axes of the LBK culture as battle axes in Central Europe (and their cultural successors in the Corded Ware culture), the explosive expansion of arrowheads in East Bell Beaker demonstrate its evolved function and ideology, in contrast to the frequent findings but in small numbers in LBK and in the Danube megalithic traditions. The archery image typical of the “archer’s package” and the complete set of archery equipment that appear in certain characteristic “archer burials” (where long wooden bows are supposed to have been interred too) point to a status object of the warrior (Heyd 2007). Specialised archery may be inferred from osteological remains (Ryan, Desideri, and Besse 2018). Horse riding-related osteological marks irrupt in central and western Europe with the expansion of Bell Beakers, as do horse bone remains, which support the suggested expansion of mounted archery.

The closest known specimen to modern horse domesticates comes from Dunaujvarus, an East BBC site in Hungary (end of the 3rd millennium BC), which shows a more archaic branch than those found in two contemporary Sintashta sites. This supports the separation of this lineage with the expansion of Yamna settlers to the west, as horse domesticates kept evolving in the steppes and spread westwards into Europe with later population movements. The early expansion of this branch with Yamna is further supported by the archaic Y-chromosome lineage and mtDNA line of the Dunaujvarus sample (Fages et al.).

The expansion of this archaic branch of horse domesticates with East Bell Beakers is evidenced by its admixture with a source close to Iberian specimens, suggesting long-distance exchange of horses during the Bell Beaker phenomenon; and by the finding of a Pre-Iberian specimen from Els Vilars (ca. 700–550 BC) which shows the same archaic branch (i.e. before the separation of Sintashta horses), hence likely of Iberian/Central European Bell Beaker descent (Fages et al.).

In a few cases, children were also interred with these prestige warrior goods, pointing to its supposed future role, possibly through his father's line, suggesting thus rules of inheritance and dictated social status from birth. Such rich graves for infants existed also in CWC ca. 2700–2500 BC, although there was a clear differentiation according to the age of the deceased (the CWC 'age classes'), which is not found in East Bell Beakers (Heyd 2007).

Like dagger graves (a prestige good) or craftsmen's graves, such warrior graves are rare, and some individuals are even physically larger, showing a better physical constitution. Nevertheless, these special graves occur within family cemeteries, but there are no gross inter-cemetery differences, which point to a loose regional connection between family units coexisting as equals. The internal hierarchy of family units—in the (at least funerary) egalitarian Bell Beaker society—points to an initial stage of stratification on its way to the fully stratified Bronze Age societies (Heyd 2007).

Craftsmen's graves (metalworkers, but also flintworkers) show their role in metal exploitation and prestige good production, especially graves of metalworkers (with copper daggers and wristguards, and special forms of grave construction), showing their particular economic and social importance in the Bell Beaker society. There is a clear direct evolution from the hundreds of craftsmen's graves of the northern and north-western Pontic Yamna and Catacomb graves (ca. 2750–2250 BC), to the other, western European end in the Amesbury Archer in England (Heyd 2013).

VII.7.3. Contacts Bell Beaker – Corded Ware

Settlement areas of both cultures, the Bell Beaker and the Corded Ware culture, especially in the common territories of central Europe, seemed to remain separated. Available data suggest rejection and aversion, but also some form of social discourse between the groups (Heyd 2007).

Neighbouring groups of Bell Beaker, Globular Amphora and Corded Ware cultures of east-central Europe show certain similar artefacts, but made of different materials, and with different interpretations, which might signal imitation among culturally different groups. These cultural differences between Corded Ware and Bell Beaker cultures are maintained over vast distances, from east to west Europe (Czebreszuk and Szmyt 2008), potentially suggesting a strong ethnolinguistic difference (Figure 47). With the interaction of both groups, Corded Ware burials adapted to Bell Beaker customs, and a decline in Corded Ware remains is found in shared areas.

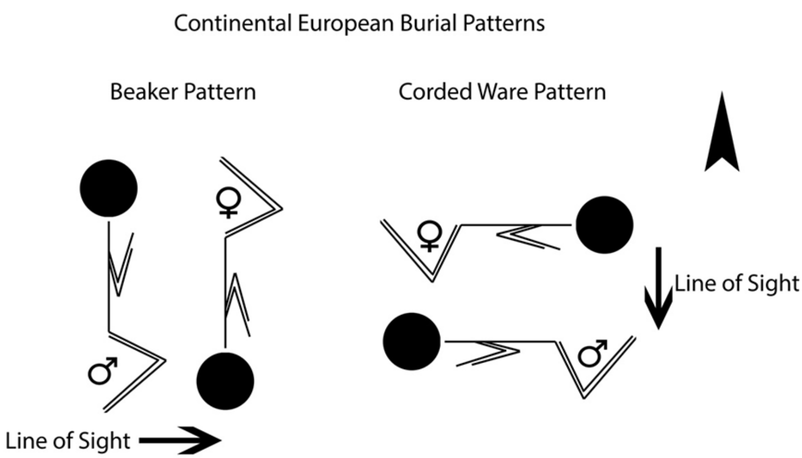

Figure 47. Contrasting continental Bell Beaker and Corded Ware burial patterns. Image from Heise (2014).

The pattern observed is of spatial separation followed by partial integration (dissolution of the spatial-cultural divide), suggesting a land capture by the expanding Bell Beaker culture, and also an ethnic dimension based on cultural expressions and physical anthropology (Heyd 2007). The different strategies of East Bell Beaker groups with local Corded Ware (or derived) groups, as well as other Late Copper Age groups, ranging from full separation to co-operation, shows a different ideological resolution to these interactions in the Late Copper Age, and the creation of new social identities in Central European EBA groups (Bertemes and Heyd 2002):

- the Danubian Early Bronze Age of Southern German groups, with a strong Bell Beaker foundation (based on the exclusion of Corded Ware groups to the south and west of the Middle Danube);
- the Únětice Early Bronze Age, on a strong west Carpathian foundation (based originally on the mix of Moravian Bell Beakers with Transdanubian cultures);
- the Eastern Early Bronze Age (Proto-Mierzanowice), with origins in Epi-Corded Ware cultures (based on a mix of Bell Beaker of Lesser Poland with Carpathian cultures);
- and Bell Beakers from the Polish Plains, mixing with late Corded Ware groups in Eastern Europe to form Trzciniec.

The regional substrate for many eastern and northern European Bell Beaker groups is in many cases formed by late Corded Ware culture groups, with some pottery types persisting in later times, and with individual burials being also used by later settlers. However, in western and southern Bell Beaker territory, previous regional substrates do not herald the Bell Beaker groups, with newer settlements using locations different to Late Neolithic sites, and collective graves being reused or substituted by individual graves (Besse 2014).

In certain small, remote regions, possibly unaffected by the initial explosive expansions along rivers and coasts, Corded Ware groups dominate the records ca. 2500–2200 BC, such as in German Franconia and the Tauber River Valley. Gradually, though, these isolated units decrease in numbers and their ideology seems to have faded, no longer having a supra-regional grip, merging eventually within the succeeding Early Bronze Age cultures (Besse 2014).

Tumulus building was identified by Gimbutas as one of the main cultural manifestations of the Kurgan culture (and "Kurgan people") that spread Indo-European languages during the Neolithic. The practice of mound-building (and single graves) is nevertheless so widespread in time and space that it is hard to associate it with one particular ethnic group (Harding 2011).

vii.7. North-West Indo-Europeans

At the end of the Chalcolithic period, migration waves reached the Carpathian Basin: Yamna from the east, and Proto-Beakers from the north-west (Szécsényi-Nagy et al. 2018), probably following the Danube. Early individuals from the Yamna culture in Hungary show a fully homogeneous admixture with other Yamna groups, with one of four samples showing initial admixture with local EEF populations, hence the slightly elevated contribution (ca. 17%), statistically non-significant. A further contribution is seen in a later individual, with ca. 27% EEF ancestry, and a clear 'central European' shift in the PCA (Wang et al. 2018). Late Chalcolithic samples from Hungary showed mainly NWAN (ca. 86%) and WHG (ca. 14%) ancestry (Olalde et al. 2018).

This admixture of Yamna lineages with local populations represents thus the most likely starting point of emerging East Bell Beakers that expanded from the Middle Danube in all directions (Suppl. Graph. 9). These early stages of admixture are also consistent with the extreme genetic differentiation among early Bell Beaker samples from Hungary (Suppl. Graph. 10), e.g. in Szigetszentmiklós, in the Csepel island (ca. 2450–2150 BC): one of hg. R1b1a2a2-Z2103 shows 75% Steppe ancestry, and clusters closely with the Yamna Hungary EBA sample in the PCA; with him there are one individual of hg. R1b1a1b1a-L51 (ca. 47% Steppe ancestry), one of hg. I2a1a1a-L158 (ca. 59% Steppe ancestry), and another of hg. I2a1b1-M223 (ca. 47% Steppe ancestry), all four males with typical burial position and Bell Beaker assemblages (Olalde et al. 2018).

Slightly later samples from the same site, from the succeeding Proto-Nagyrév culture, show a higher variability of haplogroups in the area (see

§viii.11. Thracians and Albanians), including the presence of a basal lineage R1b1a1b1a1a-L151* (formed ca. 2800 BC, TMRCA ca. 2800 BC), further supporting the nature of the Carpathian Basin and the area around the Tisza river as the *sink* of Yamna settlers. The *source* of expanding Bell Beakers, which show a clear Y-chromosome bottleneck of R1b1a1b1a1a-L151 subclades, was probably closer to the Middle Danube area, between the Devín Gate and the Danube Bend, around the Little Alföld.

Previous to these Early Bronze Age samples from Hungary, where most paternal lineages descend from elite males of Yamna clans, the Carpathian Basin showed typical East European farmer ancestry and lineages, approximately half G2a2-L1259 and half I2-M438 subclades. Subclade I2a1a1a-L158 is found in two samples from Balatonlelle (one ca. 3600–3000 BC, another ca. 3330–2930 BC), with the same haplogroup also reported in later East Bell Beakers from the area (Lipson et al. 2017). Steppe ancestry has been found thus spreading with expanding East Bell Beakers to the west, whereas no substantial contribution is found from Iberian Beaker Complex-associated individuals to central Europe (Olalde et al. 2018).

The expansion of Yamna settlers with a main bottleneck under haplogroup R1b1a1b1a-L51 from western Yamna settlers—evidenced by the expansion of its subclade R1b1a1b1a1a-L151 with Bell Beakers—is also supported by the finding of subclade R1b1a1b1a1-L52* in south-eastern France, and by the distribution of its other subclade R1b1a1b1a2-Z2118 (formed ca. 3700 BC, TMRCA ca. 3100 BC) in south-eastern Europe, hence likely associated with early west Yamna settlers, and the further expansion under SNP Z2116 (formed ca. 3100 BC, TMRCA ca. 2700 BC) into R1b1a1b1a2a-S1161 (TMRA ca. 2700 BC) throughout central and western Europe.

Speakers of the North-West Indo-European language have been recently associated with expanding East Bell Beakers (Mallory 2013), as an offshoot of Yamna, due to the fitting guesstimates for this reconstructed stage. The expansion of the Proto-Beaker archaeological package along the Upper

Danube probably allowed for its cultural diffusion through the river basin among the thousands of Yamna settlers related to the Pannonian Steppe—distributed from the Tisza River and its tributaries and the Middle Danube up to the Austrian Burgenland—just before the renewed impulse of expansion of the classical Bell Beaker folk.

Agricultural substrate loanwords in common to Palaeo-Balkan languages, some of them with potential traits of Afroasiatic nature, are probably due to contacts of expanding Yamna settlers with farming communities of the north Pontic and the Lower Danube regions, which had strong links with hunter-gatherers of haplogroup R1b1b-V88 (Kroonen 2012). The few loanwords of a supposed Vasconic-like origin, apparently concentrated in a later stage, are probably due to contacts with communities derived directly from the early waves of NWAN-related European farmers, probably from the Pannonian Basin, where most non-Indo-European substrate words in North-West Indo-European were likely borrowed. It is therefore likely that the evolution from a Pre-North-West Indo-European stage to a fully-fledged North-West Indo-European language spanned the west Yamna (ca. 3300/3100 BC) to the expanding East Bell Beaker community (ca. 2500-2300 BC).

A Clash of Chiefs

rex militaris, rex sacrorum

A Clash of Chiefs

rex militaris,

rex sacrorum

Carlos Quiles

A Clash of Chiefs

rex militaris,

rex sacrorum

Carlos Quiles

A Song of Sheep and Horses

Book 2

ACADEMIA PRĪSCA

2019

A SONG OF SHEEP AND HORSES:

EURAFRASIA NOSTRATICA, EURASIA INDOURALICA

Book One: A Game of Clans: *collectores venatoresque, agricolae pastoresque.*

Book Two: A Clash of Chiefs: *rex militaris, rex sacrorum.*

Book Three: A Storm of Words: *vetera verba, priscae linguae.*

Book Four: A Feat of Crowds: *hic sunt leones, hic sunt dracones.*

Version: 1.2 (first printed edition), June 1st, 2019

ISBN-13: 978-1-072-02353-1 paperback

 cquiles@academiaprisca.org

ACADEMIA PRISCA

Avda. Sta. María de la Cabeza, 3, E-LL, Badajoz 06001, Spain.

European Union

Work based on Quiles, Carlos (2017). Indo-European demic diffusion model (3rd ed.). Badajoz, Spain: Universidad de Extremadura. DOI: 10.13140/RG.2.2.35620.58241

Official site: <https://indo-european.eu/asosah/>

Publisher's site: <https://academiaprisca.org/>

Full text and latest revisions: <https://indo-european.info>

Blog for images, discussion, and new findings: <https://indo-european.eu/>

Cover image *Bronzegießerei* by Gerhard Beuthner, appeared in Erdal-Bilderreihe Nr. 115 Bild 1 (1930).

VIII. Early Bronze Age

VIII.1. The European Early Bronze Age

The European Early Bronze Age (EEBA), although difficult to define for all cultures involved, may be said to have begun with changes in settlement systems, burial customs and material culture, in particular the mostly plain pottery. This process began ca. 2500 BC in the entire Carpathian Basin, Italy, and to the east, with a general decrease in decoration on pottery: Vessels are no longer messengers or symbols indicating an affiliation to an identity group; their functional aspect is emphasised. Begleitkeramik are common starting with the Classical Bell Beaker, including jugs, cups, and bowls, low and deep (Heyd 2013).

This innovation process progresses gradually ca. 2400–2250 BC in a wide area from the Lower Danube down to the Alps and northern Italy, and is recognised in the Carpathian Basin by a return to tell settlements as a development from south to north, affecting Vinkovci, then reaching the Danube, and finally early Nagyrév ca. 2250–2000 BC. Exotic objects that would later become iconic of the Bronze Age begin to appear (Heyd 2013). Continuous use or emergence of circular enclosures in central Europe, appearing (or being essentially improved) after ca. 2500 BC in northern

Germany, Iberia, the British Isles, or Bulgaria, suggest a renewed Europe-wide concept of sanctuary, and extensive communication networks with intellectual and religious contents circulating alongside raw materials (Spatzier and Bertemes 2018).

The regional organisation changes thus from trans-regional cultural phenomena prevalent ca. 2750–2500 BC, like Vučedol and Makó/Kosihý–Čaka, to a cultural fragmentation after ca. 2400 BC with 5 new regional units, apart from the continuing late Makó/Kosihý–Čaka, late Somogyvár–Nagýrev, Nyírség, Gyula-Roşia, Maros (Pitvaros), Ada, Gornea-Orleşt. Distinguished by a significant degree of similarity of material culture (burial ritual and pottery), they seem to be a sign of the birth of chiefdoms and tribal organisation (Heyd 2013).

This combination of graves with Bronze Age equipment, cultural fragmentation and tell resettling and expansion gradually expands in importance and consistency, from 2300 BC and especially 2200 BC onwards. This influence is appreciated rather soon in neighbouring cultures, such as the exotic objects appearing in the early/mid–23rd century BC in the Csepel group of the Bell Beaker culture, like a copper/bronze halberd and roll-headed pins or *Noppenringe* (Heyd 2013).

After the expansion of the Classical Bell Beakers ca. 2500 BC, the Middle and Lower Danube (up to central Germany) and Moravia turn into the cradle of the new Early Bronze Age Civilisation (Figure 48). This expansion and subsequent connected cultural developments are responsible for the creation of extensive sociocultural contacts that will last, with certain evolutionary changes, the whole European Bronze Age. Communities tend to concentrate along interregional trade routes, and long-range exchange becomes common, supporting the unifying, true pan-European nature of the Bell Beaker people, later intensified by certain regional centres (usually in central Europe) throughout the Bronze and Iron Ages (Heyd 2013).

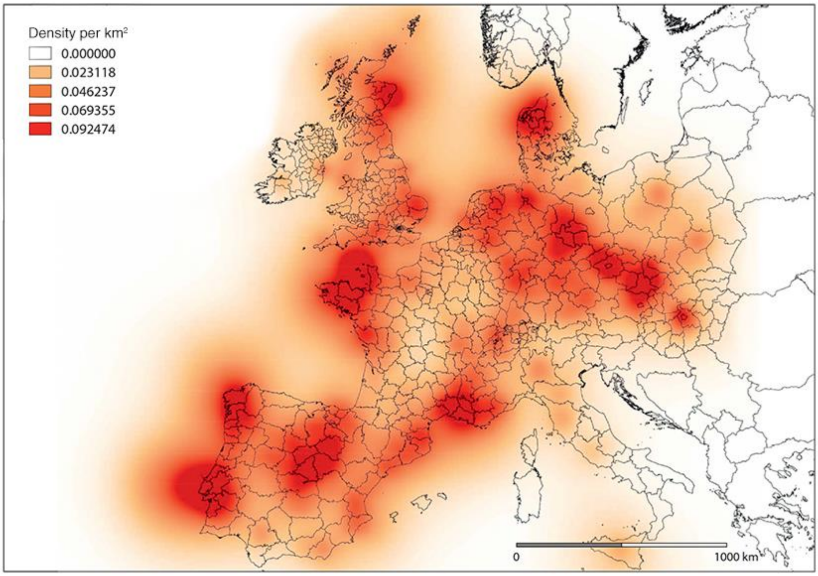

Figure 48. Density analysis of Bell Beaker distribution per region. Combination of different levels of B-spline interpolation. Modified from Bilger (2019). Values and analysis explained in the original open access paper.

Significant waves of regional fragmentation and emancipation from previous traditions are also seen over the 23rd century BC in Bell Beaker territories in the vicinity of the Carpathian Basin, such as Oggau-Wipfing in the Middle Danube, Proto-Únětice in the Moravian province, or Chłopice–Veselé in Lesser Poland. Apart from the fragmentation, the first centralisation waves appear with the first fortifications on hills in southern areas, and longhouses predominate as living places and foci of the new settlement planning (Heyd 2013).

After ca. 2200 BC, a gradual and continuous process involving the intensification of cultural subsystems is seen, and then massively in the 21st century BC. Metallurgy increases in regional centres. Eventually, the next stage of a full-fledged “European Bronze Age package” is reached from ca. 2000 BC on, when wide parts of temperate Europe develop a system of intensified exchange where trade becomes established, based on a hierarchically organised society, with many prestige and status objects belonging to the elites, culminating in their lavishly equipped graves (e.g.

Leubingen and Helmsdorf in Germany, Łęki Małe in Poland, Thun-Renzenbühl in Switzerland, Kermonen en Plouvorn and Saint Adrien in Brittany, and Bush and Clandon in Wessex), and large metal hoards. There are also precious metal vessels, economic specialisation, specialised craft production, and widely available tin–bronze (Heyd 2013).

EBA groups emerge therefore within a unifying framework established previously by expanding East Bell Beakers, which shows thus common cross-regional features, such as shared object forms, burial rites, and new technologies, like the introduction of tin–bronze, and the advent of complex metalworking techniques. All groups are connected from west to east, from north to south Europe, through farming communities that show the emergence of a leading social group of chieftains, characterised by rich single graves with votive depositions, as well as hoards with new kinds of ceremonial weapons, such as solid-hilted daggers (Vollgriffdolche) and halberds (Heyd 2013).

The Early European Bronze Age region becomes finally divided into three fundamentally distinct provinces of cultural material and burial rituals, which act as cultural centres that influence adjacent regions. Three supra-regional culture complexes formed by different groups appear between the Rhine in the West and Transdanubia in the east, the Alps to the south, and the line between Mittelelbe–Saale-region to Upper Silesia/Lesser Poland: its common basis is built by the East Bell Beaker group and regional European groups. Mainly along the Danube appears the Danube Early Bronze Age culture; to the north appears the Únětice complex, forming separated regional *Únětice cultures*; and the Eastern Early Bronze Age is formed by the Nitra, Mierzanowice and Košťany groups, to the north of the Danube and to the east of the Morava in East Moravia, in south-west Slovakia and Lesser Poland, including (with Košťany) the northern Carpathian Basin (Heyd 2013).

These central groups are delimited from Western Early Bronze Age cultures (Adlerberg and Rhône, based on the West Bell Beaker groups), from Carpathian cultures (Makó/Kosihý–Čaka, Somogyvár–Vinkovci, and

Vučedol), and from other northern traditions based on Bell Beaker cultures – like the Veluwe-type Beakers from the Netherlands and the Rhein – or Corded Ware – like Riesenbecher, apart from the developing Nordic Dagger period to the north. Lower Danube, Únětice, and Nordic BA, strongly unified in that they are saturated with huge amounts of diverse metal goods. This is interpreted as a response to a great demand for prestige objects by local communities, and indirect indication of their social differentiation and ranking, as part of the materialisation process of the transformation in ideology (Kadrow 1998).

During the evolution of this Early Bronze period, different shifting independent ("pan-European") centres of cultural and technological innovations can be seen in Central Europe, from the Upper Danube ca. 2200–2050 BC; to the northern ranges of Únětice ca. 2050–1900 BC; to the Bohemia and Moravian regions ca. 1900–1750 BC; and later, ca. 1750–1400 BC, to one centre in the north-eastern part of the Carpathian Basin (a complex of Füzesabony, Mad'arovce, and Věteřov cultures), in contact with the Aegean world, and another represented by the circle of Nordic cultures, with a singular culture. A different European centre, heir of an important Corded Ware culture influence on Bell Beakers, developed early (at least ca. 2300 BC) as the Epi-Corded Carpathian Cultural Circle, which manifested itself in the Mierzanowice culture (Kadrow 1998).

The real transformational change in Bell Beakers, shifting from a unifying expanding culture to the different regionalisation trends, starts when the centre of gravity shifts from expanding Bell Beakers ca. 2500/2400 BC to the *real* trade boosted by Aegean influence ca. 2300/2200 BC. The intermediate period sees both worlds meeting in their respective expansions, e.g. in the Adriatic, in the Carpathian Basin, and possibly even in Iberia (Heyd 2013).

viii.1. Old Europeans

Yamna admixed with local EEF-like populations from Hungary before (and during) their evolution into Classical or East Bell Beakers. During their explosive expansion, tens of thousands of Yamna/East Bell Beaker migrants[18] also admixed with local European populations through exogamy, revealing multiple male-biased migration waves, based on the prevalent Yamna R1b1a1b1-L23 (especially R1b1a1b1a1a-L151) lineages and the reported replacements of male lines in all European territories where it spread, in some cases—like the British Isles or Iberia—close to 100%, while the spread of Steppe ancestry was in many cases inferior to 50% and usually decreasing with distance (Olalde et al. 2018). Nevertheless, a reported early Bell Beaker sample from France, likely from the Eastern Swiss–Alsatian–Southwestern German province[19], shows elevated Steppe ancestry and clusters quite close to Yamna (Brunel 2018), showing that the Yamna-like cluster was still prevalent among expanding East Bell Beakers ca. 2500 BC (Suppl. Fig. 10.C).

The admixture of non-Iberian Bell Beakers relative to Yamna samples has been described as mainly with EEF populations with hunter-gatherer ancestry closer to Körös (in a La Braña–Körös WHG cline), higher than the one found in samples from Hungary LCA or Germany MN. The admixture in Iberian Bell Beakers shows a better fit with previous Iberian populations (from the Neolithic or Chalcolithic), except for Copper Age populations from the north, which harbour more hunter-gatherer ancestry.

In the case of Iberia, as is most likely the case at least in in south-western European samples, the best fit of a source population for Steppe ancestry are Bell Beakers from Germany (CEU BBC). Other sources such as Bell Beakers from France or the Netherlands failed, likely because they have slightly higher proportions of steppe ancestry than the true source population (Olalde et al. 2019). This further supports the admixture of Yamna settlers all over the Upper Danube before the transition to the Classical Bell Beaker culture and its expansion all over Europe.

---

[18] Estimate by Volker Heyd (2018) based on the number of barrows found to date.

[19] Informal report of the Ph.D. Thesis does not include the specific locations. Samples investigated come from northern France, Alsace, and the Mediterranean region, with Alsace having the earliest investigated Bell Beaker burials to date in France.

Similarly, early samples from the British Isles show high variability in ancestry compatible with recent admixture, like the Boscombe Bowmen collective burial, where two closely related individuals (ca. 2500-2140 BC), likely third-degree relatives, share ca. 13–43% ancestry and show the lowest and one of the highest amounts of Steppe-related ancestry, respectively (Olalde et al. 2018).

The reported Steppe ancestry in some later Bell Beaker samples from central, east-central, and northern European territories, and in the British Isles, is higher instead of lower (Olalde et al. 2018). Similar to the increase in Iberian farmer contribution found exclusively in Bell Beakers from Iberia, this increase in Steppe ancestry in certain late Bell Beaker groups compared to earlier ones from nearby regions is explained by exogamy, more specifically admixture with females of local Corded Ware peoples, who are the best fit for that increased ancestral component from the steppe.

So, for example, Bell Beakers from the Netherlands (and consequently the British Isles, see *§viii.5. Pre-Celts*) show elevated Steppe ancestry, in excess of that found in Central European Bell Beakers, who are the likely origin of expansions northward through the Rhine, and southward into Iberia and Italy (Olalde et al. 2019). This difference is also seen in the *northward* shift of the Dutch–British cluster, toward the earlier Corded Ware cluster.

The precise evolution of Yamna-derived vs. Corded Ware-derived Steppe ancestry in certain regions is difficult to describe with precision without detailed temporal and regional transects, since Yamna pioneer groups seem to have been in contact with Corded Ware groups from central Europe, who show an increased Yamna-like Steppe ancestry likely due to exogamy (see *§vii.1. Western and Eastern Uralians*), at the same time as these Yamna settlers may have also increased their Corded Ware-like Steppe ancestry around the Middle and Upper Danube through exogamy, prior to their emergence as East Bell Beakers

Unlike the admixture of peoples of Yamna descent with EEF populations found in Bell Beakers, where typical Early European farmer mtDNA subclades are found together with typical Yamna Y-DNA lineages (Olalde et al. 2018), it is difficult to pinpoint precise mtDNA subclades in Bell Beakers corresponding to their admixture with Corded Ware peoples, because of the shared mtDNA originally from the Pontic–Caspian steppes, and because of the previous admixture of central European Corded Ware peoples with EEF populations, too (Juras et al. 2018), similar to Yamna groups from Hungary (see *§vii.7. North-West Indo-Europeans*).

Main R1b1a1b1a1a-L151 subclades expanding with East Bell Beakers are R1b1a1b1a1a1-U106/S21/M405 (TMRCA ca. 2700 BC) and R1b1a1b1a1a2-P312/S116 (TMRCA ca. 2500 BC), with a comparatively earlier successful expansion of the former's surviving subclades. The earliest R1b1a1b1a1a1-U106 subclades are found during the late 3rd millennium BC in Scandinavia (Allentoft et al. 2015) and Bohemia, and slightly later in the Netherlands, while R1b1a1b1a1a2-P312 subclades are found everywhere in Europe (Olalde et al. 2018), except for northern Scandinavia, which suggests a bottleneck of hg. R1b1a1b1a1a1-U106 in migrating Bell Beakers in Jutland.

The main R1b1a1b1a1a2-P312 subclades R1b1a1b1a1a2b-U152, R1b1a1b1a1a2a-DF27, and R1b1a1b1a1a2c-S461 share an early TMRCA ca. 2500 BC. Nevertheless, only R1b1a1b1a1a2b-U152 lineages are found widespread in different EEBA provinces at the end of the 3rd millennium, including the Upper Danube, Iberia, Bohemia, Poland, and Hungary (Olalde et al. 2018). R1b1a1b1a1a2a-DF27 is found early in a sample from Quedlinburg[20] in central Europe (Mathieson et al. 2015), in Iberian Bronze Age samples (Valdiosera et al. 2018), and one much later among Longobards in Hungary (Amorim et al. 2018), with a clear bottleneck in south-western Europe, especially beyond the Pyrenées. R1b1a1b1a1a2c-S461 lineages are

[20] ZZ11+ equivalent (ancestral to DF27 and U152); DF27+? In 390k BAM file, but short, may actually belong to chromosomes 2 or 5. Additional information from Alex Williamson.

mainly found in Bell Beakers from Britain and later Bronze Age populations, in a bottleneck caused by the expansion to the British Isles (Olalde et al. 2018).

Rarer R1b1a1b1a1a2-P312 subclades include R1b1a1b1a1a2d-L238 (TMRCA ca. 2500 BC), reported in an old Icelander (Ebenesersdóttir et al. 2018), and present mainly among modern peoples of Scandinavian descent, which may suggest its early expansion to the north; R1b1a1b1a1a2e-DF19^{+} (TMRCA ca. 2500 BC), found in a Roman individual from Britain (Martiniano et al. 2016), and among modern northern Europeans; and R1b1a1b1a1a2f-DF99 (TMRCA ca. 2000 BC), found in an early medieval Longobard (Amorim et al. 2018) and among modern northern-central Europeans.

Due to the early TMRCA of R1b1a1b1a1a-L151 lineages, and to the occasional finding of early subclades of the most common lineages in distant territories, the split of hg. R1b1a1b1a1a-L151 in expanding clans must have happened early during the Yamna Hungary–early East Bell Beaker society. It is impossible, then, to assign any R1b1a1b1a1a-L151 lineage to a specific Early Bronze Age community, in spite of the known majority distributions in certain regions. The association of certain subclades with specific linguistic communities needs to be understood, therefore, as the product of gradual and successive Y-chromosome bottlenecks, and a simplification of the ancient picture based on the limited data available.

Studies of ancient European hydronymy, reflected in the so-called Old European pattern (Krahe 1964, 1949; Nicolaisen 1957), reveals a quasi-uniform name-giving system for water courses that shows Indo-European water-words and suffixes following rules of Late Proto-Indo-European word formation (Adrados 1998). This points to an ancient wave of Late Indo-European speakers that spread over northern, western, and central Europe, before the proto-historic Celtic and Germanic expansions, including the British Isles, the Italian and Iberian peninsulas, the Balkans, and the Northern European Plains up to the Neman River in Lithuania.

The expansion of the Bell Beaker folk, originally from their North-West Indo-European homeland in the Yamna Hungary–East Bell Beaker community (Mallory 2013), and especially the expansion of R1b1a1b1-L23 lineages, under further Y-chromosome bottlenecks of R1b1a1b1a1a-L151 subclades (Cassidy et al. 2016), should therefore be associated with the spread of these *Old Europeans* throughout Europe, where their dialects would later evolve into the majority of the attested Indo-European branches of Europe.

VIII.2. Southern EEBA province

VIII.2.1. Northern Italy

Northern Italian regions south of the Alps show the evolution of Final Neolithic attributes to the earliest western Proto-Beaker package before ca. 2500 BC, which did not include wristguards, copper knives, ornaments of amber, and showed scarce arrowheads or V-buttons (using instead flat or round beads), but did include anthropomorphic stelae, such as those found in Sion and Aosta. Eventually, the eastern or Classical Beaker ideology imposed itself after ca. 2500 BC (ca. 2425 BC for Sion and Aosta), quickly and violently if we take the destruction of stelae by incoming groups as a representation of the wider social and cultural struggle between groups, which ended in the overthrowing of early Beaker peoples by the new immigrants (Harrison and Heyd 2007).

This province is associated with the rivers draining into the Po south of the Alps, and had thus links to the East Bell Beaker group to the north through the Danube; to the northern groups through the Rhine; and to western and south-western groups through the Rhône. Remedello societies of the north and Rinaldone in the west, heirs of the warrior ideology that had expanded earlier with the Yamna package (see *§VI.2. The Transformation of Europe*), were more receptive to Beaker novelties. Although the Alps have been considered a natural and cultural barrier since Roman times, they worked during prehistory as a bridge between central European and Mediterranean cultures (Harrison and Heyd 2007).

Northern Italy belonged thus from the very beginning, together with the East Bell Beaker groups, and possibly also the Middle-Elbe Saale region, to the core area of the expanding Classical Bell Beaker phenomenon (after ca. 2500 BC), reflected in the appearance of distinctive ornaments and fittings of polished shell to the south. However, after this disruptive and expansive Middle Bell Beaker period, later phases of the Bell Beaker culture reflect a reduction in range and volume. The Northern Italian EBA (starting ca.

2300/2200 BC) began probably delayed compared with south-central Hungary, through connections with innovations and ideas from the Adriatic. Communities showed new equipment, burial rules (the first proper individual graves), and material culture including globular cups and bone, shell, and metal jewellery, apart from *pithoi* graves of children (Heyd 2013).

Northern Italian groups resumed then their traditional contacts with the south and west, continuing customs of Beaker burials, as well as new fashions of dress and ornament introduced from a wide area of northern Italy, especially the Polada culture, which shows the beginning of its classical stage by the introduction of wetland and lakeside settlement sites ca. 2100 BC, with rich metal inventory including typical flanged axes, triangular daggers, and various forms of jewellery (Heyd 2013).

Polada marks an increase in population and settlement, and a remarkable expansion starting around the southern banks of Lake Garda and the small lakes in the neighbouring morainic hills, eventually covering large areas of northern Italy and influencing neighbouring regions. Such an increase results in two main settlement models: pile–dwellings and *Terramara* villages (*Palafitte* and *Terramare*), the latter probably representing an expansion of settlements to the plain, into the Po, southern Trentino, eastern Lombardy, and eastern Veneto (Nicolis 2013).

This culture shows a mix of East Bell Beakers from the Danubian cultures and a local substratum which continues the previous Copper Age traditions, like the Remedello culture. In the later phase, Polada was also affected by Danubian cultures, and a real population influx has been suggested, given the evidence from Gata–Wieselburg group in sites of eastern Veneto. Metallurgy was similar to the Únětice cultural area. In the east-central Alps, the Inner Alpine group inherits characteristics from the late Alpine EBA—such as wing-head pins (a variant of the disc-head pins), and pottery with plastic cordon applications—displaying a noticeable influence from the Terramare complex throughout the MBA and LBA (della Casa 2013).

Figure 49. Terramara di Montale (Modena), abitazioni ricostruite. Photograph by Reever, image from Wikipedia.

Simple graves, often primary burials, are normally grouped in small cemeteries, but there are examples of double or triple burials. Tombs are covered by stones, and bodies placed in a flexed position on one side, orientated in a north–south direction or vice versa (Nicolis 2013). The offerings continued in these sites ca. 2100–1850, including lighting fires and piling more stones on previously used cairns, but burials were remade again around 1800 BC. All these developments point probably to an emphasis on the legendary antiquity of a lineage, where it was important for the EBA elite to be associated physically with the founding members of the community, even if that connection was not real (Harrison and Heyd 2007).

Pile–dwellings were built both in the water, on the lake bank, and on dry land, and there is continuity of settlements—with minor shifts—in the original region of Polada until the Late Bronze Age. During the Middle Bronze Age, the Terramara phenomenon expanded, starting ca. 1700/1650 BC, with large settlements with banks and fortifications spreading from the Po plain south to the Apennines, constituting a genuine colonisation of areas that peaks ca. 1550/1500 BC (Bernabò Brea 2009).

Materials, especially pottery, belong to the late Poladian and pile-dwelling periods, the Grotta Nuova finds from central Italy, and to a lesser extent elements from the western area. Structures built directly on the ground with apses belong more to the peninsular than to the plain, where houses are built on raised platforms, as in the pile-dwelling settlements (Cardarelli 2009). Settlements were small (1-2 ha), built on dry land, housing 100–200 people, and new farming techniques are seen, such as plough pulled by animals, crop rotation, and stabling.

Social organisation includes elite areas within individual settlements, but no hierarchical distinctions are made between the different settlements, so they probably formed *confederations* of villages (Bernabò Brea 2009). During the MBA and LBA, only cremation is used in the west, but it is combined with inhumation in the east. Remains of the dead were placed in urns, generally covered with a bowl and placed in small shallow pits, without burnt earth, and with scarce goods if any. In the case of inhumations, bodies were placed in flat graves, usually in a supine position (Nicolis 2013).

The LBA or Peschiera phase (1350/1300–1200 BC) shows the maximum development of pile–dwelling villages, with true centres of production and commerce in bronze objects, as well as the standardisation of objects and circulation of metal products on a continental scale. At the same time, settlements begin to differentiate within the context of a population increase and economic development, with some villages being abandoned, others extended (up to 20 ha, housing up to 1000 people), and others constructed anew. Dwellings are structured like ‘pile–dwellings on dry land’(Bernabò Brea 2009) and fortifications became imposing. Stability of the Terramara system was based on management of space, bartering, production and social relations (Nicolis 2013).

The Terramara system of pile–dwelling collapsed ca. 1200 BC, with the political instability brought about in the whole Mediterranean area. It has been traditionally argued that the radical depopulation of vast sectors of the Po Plain and the appearance of elements from the Po Plain/Terramare tradition in central-southern Italy in diminishing proportions resulted from the dispersal of groups, numerous or otherwise, of Terramare peoples from the north (Cardarelli 2009).

Some areas, like large valleys around Verona and the Po delta, were not affected by the crisis, and villages were relocated along main rivers and economies reorganised around complex production systems and wide-ranging trading networks. Mycenaean sherds are found in this area, probably from centres in Apulia which had Aegean craftsmen, or directly from the Greek mainland. In eastern Trentino, metallurgical production on a proto-industrial scale is seen ca. 1200–1000 BC, linked to the Luco/Laugen culture typical of the Alpine environment, and connected through centres of the Po plain with the Mediterranean (Nicolis 2013).

The Final Bronze Age shows the emergence of Frattesina in the north-eastern Po plain, the paramount centre of craftsmanship and trade, continuing the Terramare–Palafitte tradition on a much larger scale. Glass and antler artefacts, objects of bronze, faience, amber, and elephant ivory prove the central economic role of this site in a Cypriot–Phoenician trade system (Heyd 2013).

VIII.2.2. Central Italy

In central Italy (Etruria and neighbouring regions), the Early Bronze Age is defined Bell Beaker pottery of a style similar to the Polada culture. Settlements include open-air sites, along with rock shelters and caves that were used also for collective burial and cult practices. Pastoralism plays an important role, complemented by agriculture and hunting (Bietti Sestieri 2013).

Pre-Apennine facies dominate in central Italy ca. 2000–1500 BC. Settlements include open-air villages along the Adriatic and Tyrrhenian coasts in connection with lakes, while natural caves are used for settlement and collective burials featuring inhumation and cult practices. Subterranean multiple chamber tombs are considered exclusive to elite kin-groups. Pottery includes carinated or rounded cups and bowls, biconical or ovoid jugs, ovoid jars, and truncated-conical bowls. Grotta Nuova pottery appears in the earliest layers of the Capitoline Hill settlement in Rome. Copper ores were exploited during the Copper Age, and this activity intensifies during the Early Bronze Age, dominated by metallurgists and craftsmen who make them whole and distribute them (Bietti Sestieri 2013).

Apennine facies (Figure 50) define the final phase of the Middle Bronze Age (ca. 1500–1350 BC), and are widely distributed over the entire Italian peninsula. Pottery includes bowls, carinated and rounded cups, ovoid and biconical jars, with incised engraved decoration. Lake settlements increase, cave sites and shelters are still used in the Apennine regions and in the coastal Tyrrhenian area (Bietti Sestieri 2013).

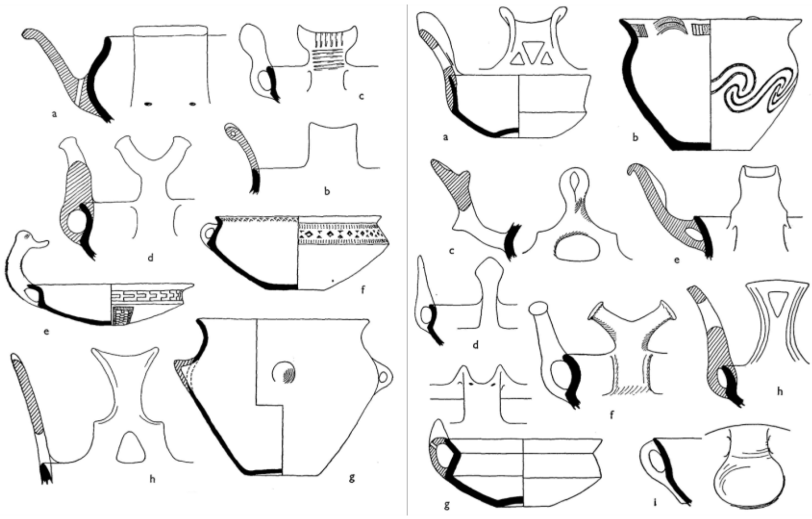

Figure 50. Characteristic Apennine pottery with northern (left) and southern (right) forms. Modified from Trump (2014).

The Late Bronze Age (starting ca. 1350 BC) shows the widespread distribution of Sub-Apennine pottery (until ca. 1000 BC)—with varied cups and bowls with plastic protrusions on handles—associated initially with Mycenaean pottery. In Etruria, the demographic crisis of Terramare is evidenced by the depopulation of the plains, although settlements continue in the Apennine area. Cremation cemeteries appear in Lazio and Apulia, with a close relationship with Palafitte–Terramare communities of the north, marked by formal features of northern type in the local pottery, which may signal the interest of northern communities in mining resources and access to the Adriatic. This period sees the widespread adoption of Peschiera bronzes—violin–bow fibulae, daggers, and flange-hilted swords—found in the Balkans, Aegean, Cyprus and the Levant. Use of metal intensifies, with bronze tools needed for all productive activities. Palafitte–Terramare appear up to southern Italy in small numbers (Bietti Sestieri 2013).

Large-scale interaction networks during the MBA and LBA between the Apennines and The Marches territories are supported in earlier times by the characteristic decorative motif of Apennine bowls, showing likely symbolic significance generically connected to family-group identities, possibly through marriage exchanges, rather than simple regional tradition. Exchange of raw materials (like flint) and perishable goods, as well as valuables like Baltic amber—shared with the Adriatic—also points to continued contacts. This close relationship is further supported by the shared mobile pastoralist economy, which may have allowed for the exploitation of nearby territories, reducing the perception of distance commonly travelled by shepherds (Moroni et al. 2019).

The Final Bronze Age facies (‘Chiusi-Cetona’) in Etruria shows formal similarities with north-eastern Po plain and Frattesina, with pottery decoration reminiscent of Terramare patterns. Inland settlements are mostly on hills and plateaus, and no evidence of occupation in future Villanovan centres along the Tyrrhenian coast is found. Funerary practices include small cremation cemeteries, with urns decorated with Vogelsonnenbarke (‘bird-sun-boat’) or birds’ heads patterns. This region participated in the international trade of bronze artefacts between Frattesina to the north-east and south-western regions (Bietti Sestieri 2013).

At the Final Bronze Age–Early Iron Age transition (ca. 1200–850 BC), different groups emerge. The Picene emerge in the Marche with hill settlements near the coast, continuing the Final Bronze, and demographic growth is documented in the area. In the inland Apennine and Adriatic coastal areas, facies are initially close to Lazio and southern Etruria, but during the Early Iron Age they show a systematic connection with the Picene facies. In southern Etruria, the Proto-Villanovan pottery is characterised by engraved and plastic decoration. The settlement system aims at territorial control, and a sophisticated metal industry and trading system emerges. Funerary ritual shows the acceptance of the ideological implications of cremation, being based on the urn as the house of the deceased, connected to the destruction of the body by fire and transition to a different dimension. The Early Iron Age Villanovan, direct ancestor of the Etruscan culture, shows cultural homogeneity and synchronous emergence of central and peripheral sites (Bietti Sestieri 2013).

The ancient Lazio evolved during the Final Bronze Age under the influence of southern Etruria, shown in similarities in material culture, ritual, and settlement patterns, but this influence faded at the end of this period, probably due to the consolidation of the region's ethnocultural identity. Apparently, chiefs, priests, and possibly chiefly priests were entitled to an exclusive burial ritual, with miniature assemblages including the indicators of the main social roles: sword for military-political power; knife and a statuette in the form of an offer for religious role. During the Early Iron Age, initially territorial organisation shows a connection with Fossa–grave groups of Campania and Calabria, which probably evidences the close ethnolinguistic connection of these regions. This connection shifts later to southern Etruria, under the Etruscan influence. Cremation cemeteries appear in the region (Bietti Sestieri 2013).

VIII.2.3. Southern Italy

Chalcolithic *Laterza* facies continues up to southern Lazio until the turn of the 2nd millennium BC. Unlike Late Copper Age northern and western Italian cultures like Remedello or Rinaldone, which had already a symbolism similar to the Bell Beaker message, cultures like Conelle and Laterza in the Adriatic basin were less receptive to the new package, which resulted in a different distribution of Beaker pots. This is also visible far to the south in Sicily, where Bell Beakers established a Beaker core in the west of the island, in the previous Conca d'Oro area. Western Sicily, although not part of the core, had in the south a role of transmitter of impulses similar to the role of the Rhenish/Dutch Bell Beaker to the north (Heyd 2013).

Quite relevant for the situation of Bell Beakers in these regions is the direct exchange links of these regions with the Aegean during the Early Bronze Age. The social background is different from other Aegean-related cultures: there are less prestige goods made of precious metal, no direct evidence of local elites, and burial traditions show collective graves are found in artificial grottos and caves. In the period 3000–2500 BC different single burials are seen from regional cultures related to Gaudo, Rinaldone or Remedello, but they are absent ca. 2500–2000 BC (Heyd 2013).

All these findings range from traded goods to prestige objects to imitations, and seem to have been mediated by certain important ports, such as the Steno site on the Ionian island of Levkas, which shows southern Greek mainland and Cyclades objects that appeared later in the Adriatic, and in Apulia and Sicily. Chronologically, Sicily would have been affected in the 25th century BC, Apulia and Cetina in the 24th c., and northern Italy (Polada) in the 23rd c. while the western half of Italy was influenced starting in the 22nd c. (Heyd 2013).

Numerous Proto-Apennine settlements are found along the Adriatic and Ionian coasts, particularly concentrated on the south-eastern regions. The earliest Mycenaean pottery occurs in the late Proto-Apennine period of coastal sites, while the Tyrrhenian area maritime contacts are more limited. Interior sites are few and concentrated in the control of natural routes. Funerary practices include inhumation and multiple or collective burials, with burial complexes including caves and underground chamber tombs, which are seen as correlates of the individual elite kin-groups of the local communities, emphasising the principal role of weapon-bearers (Bietti Sestieri 2013).

Metal artefacts are rare until the end of the Middle Bronze Age, which points to the lack of relevance for local economies. Trans-Adriatic contacts are evidenced by the widespread presence of Bronzes in northern Apulia, paralleled in the eastern Adriatic region, but absent in the south, while Mycenaean pottery is absent in the north and present in the south. This points to a specialised exchange system through the eastern Mediterranean. The final phase of the Middle Bronze Age shows a deterioration of the local system of coastal trading in the west, scarcity of Apenine settlements, and sites with Sicilian–Aeolian Thapsos–Milazzese facies, which point to the occupation of marginal areas of the peninsula by inhabitants from the Aeolian Islands. In the centre and east, the Aegean presence intensifies, with the association of local *impasto* with imported Mycenaean pottery. However, no colonisation can be seen, but rather small groups of Aegean sailors integrating within the local system of trade and manufacture of metals and amber. There is continuity of funerary practices (Bietti Sestieri 2013).

During the Late Bronze Age, Aegean contacts intensify. Abundant Mycenaean pottery – imported closed vessels (probably with varied contents) – are traded. Mycenaean pottery of south Italian production is found up to northern Italy, while eastern Mediterranean cultures look for look for metal and amber. Local bronze artefacts of Aegean type indicate the presence of foreign groups, a trend observed up to the Final Bronze Age. The Final Bronze Age and Iron Age (1200–720 BC) start with the invasion of the Aeolian islands and parts of north-eastern Sicily from the southern Tyrrhenian coast, following a deterioration of relationship. Local Proto-Geometric pottery and wheel-turned dolia are technological legacy of Aegean contacts, with coastal sites being prevalent—with trans-Adriatic routes still in use, and close Balkan connection with Apulia—while inland settlements control territory and long-distance communication (Bietti Sestieri 2013).

VIII.2.4. Sicily, Malta and the Aeolian islands

The first contacts with Sicily are seen ca. 2750–2500 BC, but most exchanges must have taken place during the peak of the Early Helladic IIb period (ca. 2500–2200 BC), with different objects made of precious metals found in graves. The third period, after ca. 2200 BC, saw further Aegean imports, in lesser quantity. Different from these are the trans-Adriatic contacts in central and northern Italy with the western Balkans, related to Cetina (see *§VIII.9.1. Cetina*). The Tarxien cremation cemetery in Malta, with a description similar to that of a tumulus, also shows a Mediterranean connection in small finds, metal artefacts, and pottery links. Malta also belonged to the marginal area of Bell Beaker presence, against the cultural background of the 'cremation cemetery' of Tarxien, V-buttons made of Spondylus shell and horizontal band-like decorated beaker-like vessels (Heyd 2013).

The Early Bronze Age in Sicily (ca. 2200–1500 BC), represented by the Castelluccio culture, is characterised by a system of coastal trade involving a great part of the central Mediterranean, which shows similar material culture: handmade *impasto* pottery—jars, high-handled carinated cups, open vessels on a high conical stand—with incised decoration and similar shapes, related to the local Copper Age tradition and to the Middle Helladic matt-painted pottery production. Other local groups are also visible in Sicily and Malta: Rodì-Tindari-Vallelunga (RTV) shows similarities with Proto-Apennine pottery from the mainland, with sites found in the Tyrrhenian coast of Calabria; Moarda, in the west and sporadically in the south, shows pottery clearly related to Bell Beaker pottery with Castelluccio influence. Systematic trade routes with the Aegean and eastern Mediterranean are apparent ca. 1700–1500 BC (Bietti Sestieri 2013).

The Early Bronze Age shows an organisation in small villages, showing some degree of functional specialisation and interdependence, joined to form clusters, probably corresponding to tribal groups. Coast and inland, as well as hills, plateaus and plains are occupied, with caves and open-air settlements adapted to the local environment for their subsistence economy. Local goods are mixed with exotic objects obtained through the trade system. Funerary rite is inhumation, usually multiple or collective, with special features possibly showing competition between kin-groups in the same community (Bietti Sestieri 2013).

The Middle Bronze Age is defined by the Thapsos–Milazzese culture in Sicily, the Aeolian Islands and the coast of Calabria, featuring handmade impasto with no painted decoration, showing formal and functional similarities to the previous RTV culture with local imitations of Mycenaean and Cypriot pottery. This period coincides with the maximum intensity of Aegean contacts and east Mediterranean–Cypriot participation. A decrease in the number of sites and concentration in the east-central zone in Sicily shows a more centralised political and territorial organisation, with dwelling structures characterised by circular or rectangular huts with stone foundations. Tombs are plain *grotticelle* (Bietti Sestieri 2013).

Aeolian villages, a cultural extension of Sicily in this period, are small, and trade is concentrated with northern regions of the peninsula to procure raw materials and artefacts. Increasingly hostile relationships are seen in the coast of Calabria with the establishment of Thapsos–Milazzese groups, coinciding with a decrease in local Apennine occupation and a decrease in Apennine pottery in Sicily, which has been interpreted as raids carried out in the mainland involving seizing objects and potentially people (Bietti Sestieri 2013).

The Late Bronze Age (starting ca. 1250 BC) is marked by an invasion from the mainland, probably the coast of Calabria. The Ausonian I culture, on the north-eastern zone, follows the Sub-Apennine culture, and there is a limited continuity of contacts and trade with the Aegean. A small amount of Proto-Villanovan pottery can also be seen, with some evidence of cremation and typical Proto-Villanovan urnfield. The Pantalica culture continues the Thapsos–Milazzese tradition, of Aegean influence, moving from the eastern to the southern coast and the interior. Mediterranean trade gradually shifts from the Aegean focus to the eastern Mediterranean, and to Sardinia as the far west post. Long-distance trade systems connecting northern Italy with the eastern Mediterranean remain in place (Bietti Sestieri 2013).

The Final Bronze Age–Early Iron Age transition (1100–800 BC) is defined by the Ausonian II culture, showing a local elaboration integrating formal and functional features of peninsular and Sicilian origin, with a systematic, strong connection to the Calabrian coast regarding metal extraction (from mining resources of Calabria) and production. Pantalica tradition survives in the west with the S. Angelo Muxaro group (Bietti Sestieri 2013).

viii.2. Italic peoples and Etruscans

viii.2.1. Italic and Venetic peoples

The admixture of northern Italian Bell Beakers with female locals is evident in three samples from Gui, Parma (ca. 2200–1930 BC), where a female and a male sample (of hg. R1b1a1b1a1a2-P312) show Steppe ancestry (ca. 26-30%), whereas another female, buried together with the male, shows a common ancestry with Neolithic and Copper Age European populations (Olalde et al. 2018).

Pre-Celtic and Proto-Italic languages must have been spoken to the north and south of the Alps, respectively, still in close contact for the short common Italo-Celtic period, potentially through the known contacts of northern Italy with Danubian cultures. The strongest genetic connection found between both communities to date lies in the presence of R1b1a1b1a1a2b-U152 subclades: R1b1a1b1a1a2b1-L2 lineages (TMRCA ca. 2500 BC) are found widespread in ancient Bell Beaker samples of central and western Europe, including Iberia, while other R1b1a1b1a1a2b-U152 (xR1b1a1b1a1a2b1-L2) lineages are prevalent in certain Italian regions, probably due to later regional bottlenecks.

R1b1a1b1a1a2b1-L2 lineages are found mainly in the north-east, potentially associated with ancient Venetic-speaking peoples, but they are possibly due to later Celtic expansions, since a spread of early eastern Urnfield cultures from Transdanubia is attested in the Po Valley (Váczi 2013). On the other hand, R1b1a1b1a1a2b3-Z56 lineages (TMRCA ca. 2200 BC) are prevalent in the west, and in modern west European populations, hence probably associated with ancient Italic-speaking peoples (and their later spread with the Roman expansion). Other R1b1a1b1a1a2b-U152 lineages also present in Italy, like R1b1a1b1a1a2b2-Z36, those with the Z192 mutation, and other basal lineages, have an ancient split time coinciding with the spread of East Bell Beakers (TMRCA ca. 2500 BC), and cannot be associated with specific regions, which makes any connection with ancient linguistic communities speculative at this moment.

Based on the current lack of data supporting an ancient genetic connection in terms of modern lineages, the early Italo-Celtic community was possibly based on cultural diffusion between communities to the north (Pre-Celts) and south (Pre-Italo-Venetians) of the Alps, visible in archaeology (see above). Similarly, the separation of Venetic from the common Italic trunk may have been quite early, with continuous contacts between both communities allowing for the spread of common innovations (Figure 51).

While Bronze Age samples of west-central Italy show a clear homogenisation of the genetic pool, with a shift in the PCA towards central Europe (away from the previous CHG/Iran Neolithic influence), and thus close to the modern Sardinian cluster, the few investigated Iron Age samples from the Republican period (ca. 700–20 BC) show a widespread genetic cluster encompassing the modern Italian ones, overlapping North Italian (ca. 60%) or South Italian/Sicilian (ca. 40%) clusters. The arrival or increase of EHG-, Levant Neolithic-, or CHG/IN-related ancestry in samples from this period suggest influence from previous population movements during the LBA from the north or through the Mediterranean, respectively. The Imperial Period shows influence from CHG/IN-related ancestry, but only sporadically Levant Neolithic[21].

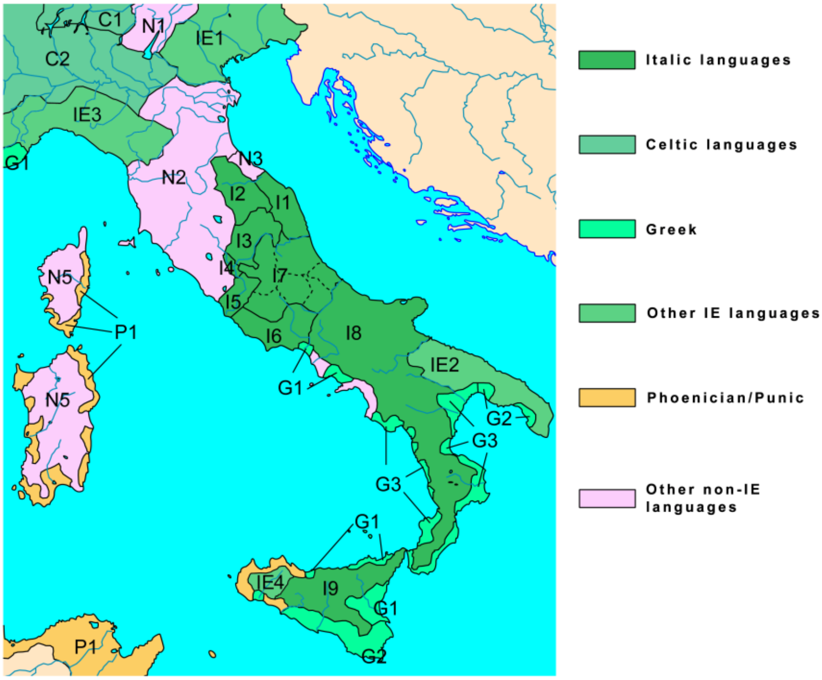

Figure 51. Languages of pre-Roman Italy and nearby islands: N1, Rhaetian; N2, Etruscan: N3, North Picene (Picene of Novilara); N5, Nuragic; C1, Lepontic; C2, Gaulish; I1, South Picene; I2, Umbrian; I3, Sabine; I4, Faliscan; I5, Latin; I6, Volscian and Hernican; I7, Central Italic (Marsian, Aequian, Paeligni, Marrucinian, Vestinian); I8, Oscan, Sidicini, Pre-Samnite; I9, Sicel; IE1, Venetic; IE2, Messapian; IE3, Ligurian; IE4, Elymian; G1-G2-G3, Greek dialects (G1: Ionic, G2: Aeolic, G3: Doric); P1, Punic. Image modified from Davius Sanctex.

The substantial genetic impact of the Roman conquest in Iberia can be seen in the shift of sampled Iberians from the Iron Age to the Classical period, including ten individuals from the site of L'Esquerda in the north-east (7th–8th

[21] Report from oral communication *A 12,000-year Genetic History of Rome and the Italian Peninsula*, by Hannah Moots, the 6th February 2019, at the Archaeology Center of Stanford University, about an unpublished study of 134 ancient samples from Lazio and surrounding areas spanning 12,000 years from the Upper Palaeolithic to the Renaissance.

c.), who show a central/eastern Mediterranean ancestry (ca. 25%) and corresponding shift in the PCA cluster, also observed in present-day Iberians outside of the Basque area. Interestingly, the first R1b1a1b1a1a2c-S461 lineage sampled in Iberia comes from the Roman site of Mas Gassol (ca. AD 200–500), likely representing population movements across the empire, including peoples from the northern Atlantic Façade (Olalde et al. 2019).

Preliminary reports from a forthcoming paper support this shift of Iberian samples from the Iron Age to the Roman and post-Roman period, closer to Iron Age samples from central Italy, which in turn show—like Etruscans—a position intermediate between Sardinians and central Europeans (see below). The reported Iron Age samples from Rome show a wide cluster including, possibly divisible in those of modern North and South Italians (Grugni et al. 2019). This also supports reports of how the city of Rome grew from a small city to become a mosaic of inhabitants from across the Mediterranean empire.

viii.2.2. Elymians and Sicels

A Bell Beaker sample from Per, western Sicily (ca. 2500–1900 BC) shows most of its ancestry from a NWAN source (ca. 93%) with few WHG-related ancestry, and none derived from the steppe (Olalde et al. 2018). The incursion of Steppe ancestry in Sicily (ca. 9%) appears only in Early Bronze Age samples from ca. 2300 BC on, coupled with the appearance of typical Bell Beaker R1b1a1b1a1a2-P312 lineages, four out of eight reported samples, with the other four being J-M304, at least one J2a1-L26 (Fernandes et al. 2019).

Two of the individuals of hg. R1b1a1b1a1a2-P312 (ca. 2300–2100 BC) are outliers, with ca. 40% and ca. 23% Steppe ancestry. At least two of the Bell Beaker lineages are R1b1a1b1a1a2a1-Z195, found in Iberian Bronze Age individuals. The origin of these Indo-European speakers in the north-west Mediterranean is further supported by the best fit of their source population found in Bell Beakers of high Steppe ancestry from Iberia, and those sampled from France (Fernandes et al. 2019).

Iranian-related ancestry is found in Sicily by the Middle Bronze Age (ca. 1800–1500 BC), with a consistent shift toward Mycenaeans in the PCA. Specifically, two of the three sampled individuals can only be fit with Iran Neolithic (ca. 15–18%) apart from NWAN- and WHG-related ancestry, with good fits obtained with Minoans. Of the two reported haplogroups, one from the Aegean-related group is G2a2b2a1a1c1a-Z1903, and another continuing the previous cluster is R1b1a1b1a1a2-P312. In the Late Bronze Age (ca. 1450–900 BC), a further incursion of Steppe-related ancestry (ca. 15%) is found, even though the two reported samples are one G2a2b2a1a1c1a-Z1903, and the other G2a2b2a1a1c1a2-FGC46572 (Fernandes et al. 2019).

Genetic shifts in Sicily reflect the complex history of the island during the Bronze Age, as described in archaeology. The Elymians represent the autochthonous people inhabiting west Sicily in the archaic period, and their fragmentary language is invariably considered Indo-European, most likely a Late Indo-European dialect (Marchesini 2012), probably not related to Greek (since Greek settlers would have recognized it). Given the findings of population genomics coupled with archaeology of west Sicily, it is quite possible that they represent the remnant population from the Sicilian EBA group, and their language would be related to the north-west Mediterranean (see below *viii.3. Ligurians and Iberians*).

The continued contacts of Sicily with the East Mediterranean are reflected particularly in the Middle Bronze Age, where archaeological contacts with the Aegean are more intense. The increase in Steppe ancestry in the Late Bronze Age is probably coincident with the arrival of Sicel-speaking peoples, which supports the close relationship of their language to Italic. Even though the chronological and regional transect of the available samples is limited, data seems to support the presence of a single language and writing culture from ca. 5th c. BC on, with several varieties roughly divided with archaeological cultures between the north-eastern part (more frequently subjected to innovations owing to contacts with other Italic dialects) and the southern one.

There is thus no linguistic or genetic reason to support a distinction between the *Sicels* and *Sicani*[22] (Poccetti 2012).

The term Sicanian as Pre-Indo-European remains thus a useful resource for the oldest stratum, geographically overlaid by the arrival of Indo-Europeans. This substrate does not survive into the 1st millennium BC, and there are no Sicanian inscriptions, but some recurring suffixes and topo-hydronymy may be classified as *Sicanian*, with a potential typological resemblance to Mediterranean names from Tartessus to Asia Minor, and in particular to the Aegean or 'Pre-Greek' toponymy (Simkin 2012).

viii.2.3. Etruscans

Preliminary reports from a forthcoming paper shows Etruscan Iron Age samples cluster close to Picentes, Samnites, and Umbri. This ancient Etruscan cluster appears to be intermediate between Central European and EEF populations, and in particular surrounded by modern Tuscans and North Italians (more Central European-like), Iberian Iron Age, modern Sardinians, and Iron Age Romans. The few reported Etruscans to date also cluster close to Italian Tuscans, but more shifted towards Sardinians (Ávila-Arcos 2015). While Etruscans may show the described LBA impact from the Eastern Mediterranean, the finding of one outlier closer to Central European Bell Beakers may show the described impact of an EHG-related population, potentially through Urnfield-related migrations.

---

[22] The term *Sicanian* as Pre-Indo-European remains thus a useful resource for the oldest stratum, geographically overlaid by the arrival of Indo-Europeans. This substrate certainly did not survive into the 1st millennium BC, and there are no Sicanian inscriptions or examples of the supposed language. However, some recurring suffixes (e.g. *-ssus*, *-ssa*) and topo-hydronymy may be classified as *Sicanian*, with a potential typological resemblance to Mediterranean names from Tartessus to Asia Minor, and in particular to the Aegean or 'Pre-Greek' toponymy (Simkin 2012).

The traditional association of Etruscans and the Tursēnoi of Lemnos in the Aegean seems supported by recent genetic research on the frequent contacts of Mediterranean peoples during the Bronze Age, and it is likely derived from a recent invasion of the Italian Peninsula by eastern peoples from Asia Minor, which justifies the recent Near Eastern cultural and linguistic influence of Etruscans (Magness 2001), as well as the indirect influence of the former in Latin and Osco-Umbrian through the expansion of the latter. The arrival of Tyrrhenian speakers may have been an infiltration of small elite groups with few material objects, which may be as difficult to pinpoint exactly as that of Proto-Greeks in the southern Balkans (Beekes 2003).

Nevertheless, it seems that the Proto-Villanova culture shows a break with the previous Bronze Age Apennine culture ca. 1200 BC (Briquel 1999; Torelli 2000), with Villanovan territory being mostly coincident with the later Etruscan-speaking zone, and no clear cultural break is seen between both cultures. This possibly implies the arrival of foreign peoples displacing or dominating Umbrians on their homeland around the River Umbro, with a timing fitting the famine among Tursēnoi in the Aegean, and the turmoil involving Sea Peoples (Beekes 2003). Increasing contacts between southern and central Italy and southern Greek mainland from the 13th c. BC on has been detected in terms of material culture, migrants, and also a potential transfer of livestock such as pigs (Meiri et al. 2019).

The language of Etruscans would then be closely related to that of the ancient Minoans. The concentration of J2a1b-M67 subclades in central-west and north-west Italians, with lesser presence in Provence and in northern Corsica (Di Cristofaro et al. 2018), may be associated with this migration, because haplogroup J2a1-L26 is found in Anatolian Neolithic-related populations. Even though this haplogroup is also found among Early European farmers from central Europe, the only ancient J2a1b-M67 subclade reported to date in Europe comes from Ludas-Varjú-dűlő (ca. 1200 BC), belonging to the Kyjatice group of the Urnfield culture (Gamba et al. 2014).

Since the Urnfield culture is also associated with the expansion of the Villanova culture, it is possible that this or similar contemporary samples of hg. J2a1b-M67 were associated with other expanding Tyrsenian peoples like the Raeti, from the central Alps, although this is too speculative at this moment. Based on modern populations, the diffusion of J2a1b-M67 lineages in Italy, with variance and coalescent time values comparable to those of the Middle East, has been described as potentially related to the 'Maritime Trojan Culture' involving the western Anatolian mainland and the eastern Aegean Sea. The high microsatellite variation age of J2a1b-M67 in Volterra, located in the core area of ancient Etruria, supports the ancestral source of the Etruscan gene pool in Asia Minor (Grugni et al. 2018).

A recent Anatolian connection was reported by examining mtDNA in modern populations of present day Tuscany (Brisighelli et al. 2009), but no major shift can be seen in the maternal ancestry of this region across 50 centuries, from the Eneolithic to modern Italians. The higher maternal diversity of Tuscany compared to neighbouring populations has been accumulating likely due to incoming peoples with a consistent social and sex (i.e. male) bias (Leonardi, Sandionigi, et al. 2018). The presence of Middle Eastern ancestry particularly in southern Italian and Sardinian populations, as a varying mixture of WHG, NWAN, CHG/IN and North African components depending on the specific region (Raveane et al. 2018), cannot be properly interpreted without access to a proper ancient DNA temporal and geographical transect.

An alternative possibility for Etruscans includes a resurge of a previous linguistic community, based on the potentially recent Chalcolithic migrations from Anatolia to the Italian Peninsula through southern Europe observed in the samples from Remedello (Kilinc et al. 2016). This situation would be therefore similar to the expansion of indigenous non-Indo-European languages in Iberia, in spite of the almost complete male population replacement. However, the close relationship with the population of Lemnos would require a movement of peoples in the opposite direction, which is not supported by the current archaeological and genetic investigation (Beekes 2003).

VIII.3. Mediterranean EEBA Province

VIII.3.1. El Argar

In south-east Iberia, the 22nd century BC sees the emergence of new residential, productive, and funerary practices known as “El Argar”, a highly hierarchical and integrated regional polity. Its culture does not show typical Bell Beaker pottery, specialised flint production, decorated stone, round dwellings with stone foundations, walled or ditched enclosures, collective burial rites, or any other local Iberian or Central European Chalcolithic feature (Risch et al. 2015). Amber, for example, loses its relevant social value as a marker of identity in the Argaric burial norm (Murillo-Barroso and Montero-Ruiz 2017).

Argaric communities stand out as a complete ignorance or fundamental rejection of the meaning and ideology of these objects, probably the consequence of a rejection of the incoming foreign population with Bell Beaker symbology, and thus also a different language and *Weltanschauung* (Risch et al. 2015). Despite this discontinuity with Iberian Chalcolithic traditions, Argaric cultures continue the tradition of linen textiles of Los Millares, connecting it to the previous Chalcolithic population of south-east Iberia (Marin Aguilera et al. 2019).

This culture brings a more regionalised system of influence; a complex settlement organisation and architecture, with hill forts ca. 1–6 ha as focus, occupied and expanded over the next 650 years; specific intramural rite in cists, rock cut tombs, large pottery vessels (*pithoi*), and pits, with funerary contexts corresponding at least to three social classes during its economic peak; large array of macro-lithic tools, but limited set of metal weapons, tools and ornaments; highly standardised and finely burnished pottery production. The Argaric settlements become complex urban or proto-urban centres (Risch et al. 2015).

Its material culture shows new bone, antler, and ivory working techniques and artefacts. Flint arrowheads and blade production disappear completely, while flint was used almost exclusively for the preparation of sickle blades. Palmela and leaf-shaped projectile points continue, suggesting the use of arrows armed with metal tips or bone points. A more developed arrow technology is also suggested by sandstone polishers with a central groove, used for shaping or sharpening of bone or metal tools, possibly also as arrow shaft straighteners. All this suggest an increased precision of arrow shooting, probably related to combat rather than hunting (Risch et al. 2015).

A whole new set of macro-lithic tools appear related to the new economy: elongated narrow type of grinding slab with slightly convex transversal profile, operated with wooden manos, enables the production of finer flour in less time; a cylindrical polisher made of slate or schist to separate honey from beeswax; tools related to metal production and maintenance, such as moulds of fine sandstone for axes, awls, and ingots, or metalworking hammers; etc. The appearance of these metalworking tools in male burials supports the social and economic value of this activity in the new social and economic context (Ache et al. 2017).

Single or double burials became the most common funerary ritual in El Argar, where communal burials—typical of the previous Iberian Chalcolithic cultures, before the arrival of East Bell Beakers—disappeared. Old customs were gradually replaced by the placement of tombs underneath the settled area rather than on its margins, the use of carefully built burials (contrasting with poor Final Copper Age burials), and including new offerings alongside the body, such as metal artefacts, halberds and riveted daggers, and well-manufactured pottery, depending on the social class. Silver and gold appear first as metal ornaments in the tombs of the elite, interpreted as an example of the differential access to metal ornaments in the Argaric society, with copper and bronze ornaments becoming more frequent after ca. 1800 BC (Murillo-Barroso and Montero-Ruiz 2017). This change in essential social customs further support the emergence of a new social order, dominated by a form of power within the first stages of a state organisation (Risch et al. 2015).

El Argar achieved a dominant position over resources and communication routes including neighbouring societies, as reflected in a preference for settlements on protected promontories, a socially selective burial ritual within the living space, and the movement of important raw materials like copper, silver, or ivory. Hilltop settlements are usually smaller than 0.5 ha, with a demographic density estimated as similar to El Argar settlements. These settlements share the use of plain pottery, as well as individual graves under some of the dwellings, with no apparent restrictions of sex or age (Risch et al. 2015).

It seems that the new system brought about a stabilisation of settlements and a subsequent increase in population and production. Argaric-like groups dominated over centres of communal storage and production, starting what seems a violent expansion ca. 2150–1900 BC into neighbouring regions—including La Mancha, the east coast, and western Andalucia—which do not display a comparable degree of social exploitation as the core regions. Smaller groups expanded further ca. 1700–1500 BC, northward to Valencia and eastward into the Guadalquivir River region, where they tried to impose their funerary practices and political relations (Figure 52), without attaining the intensity or stability of El Argar core territory (Lull, Micó, Herrada, et al. 2013).

The late Argaric subsistence production was dominated by extensive barley cultivation, which had a severe environmental impact in the most arid region of the Iberian Peninsula. Due to the dependence on such poor-quality crops, access to animal fat and honey became crucial, with evidence showing elites consuming this kind of high energy foods, e.g. through the separation of honey from beeswax through “pressed honey” method, using specialised tools made for this task (Ache et al. 2017).

The economic and social hegemony of El Argar ended ca. 1550 BC, apparently by internal forces, as suggested by the suppression of its ideological superstructure—end of traditional funerary practices—and its economic system, probably because of a subsistence crisis caused by the over-exploitation of the environment. In the southern peninsula, ca. 50% of upland settlements were abandoned. Post-Argaric societies tried to maintain a vertical system of production but on a local scale, returning to systems of self-sufficiency, with regionally diverse stockbreeding, agriculture, and metallurgy. Specialised workshops for cereals and textiles disappear, and pottery copies decorative motifs originally from Cogotas I style. There are some traces of regional centres of power with local, perhaps hereditary aristocracy, controlling interregional communication and centralising surpluses (Lull, Micó, Herrada, et al. 2013).

After the Late Bronze Age, most settlements were abandoned, and small settlements—some on hilltops—comprising huts with oval bases made of stone or mud-brick are found, with evidence supporting that they were specialised in stockbreeding. Eventually, near the 1st millennium BC, new hilltop centres appear, or existing settlements were reorganised, which evidence the emergence of specialised metallurgy. The south-western corner becomes a producer and consumer of Atlantic metals and metals from Sierra Morena, and possibly Sardinia (Lull, Micó, Herrada, et al. 2013).

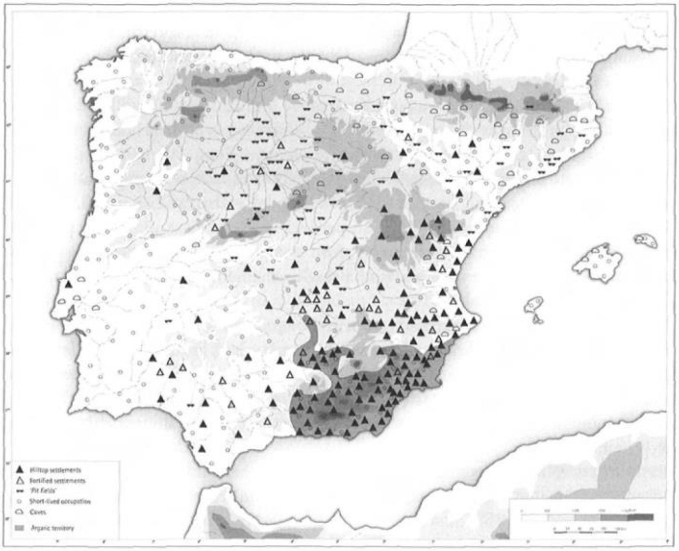

Figure 52. Settlement patterns in Iberia between c. 2200 and 1550 BC. Symbols simulate the form and density of settlement based on information derived from survey and excavation rather than indicating real locations. Notice, around the Argaric influence territory, the higher density of hilltop settlements (black triangles) and fortified settlements (blank triangles). Map by S. Gill and Lull, Micó, Herrada, et al. (2013).

VIII.3.2. North-West Mediterranean

Diverse pre-Beaker traditions overlapped in the north-western Mediterranean region, such as the Treïlles (3300–2800 BC) and the Véraza groups (3500–2500 BC). Lowland pit sites and cave occupations were common, and semi-nomadic farming was the main subsistence economy. There is no evidence of local metallurgy. During the Bell Beaker phase, Old Neolithic monuments were still reused; selected dead were interred with standardised mortuary assemblages in pits adapted for the purpose or individual cists (either laid flat, semi-flexed, or in very contracted positions), as well as *hypogea*, or caves. The first gold and copper smelting appear in the region, mainly found in funerary contexts, with its technology disconnected from the Iberian tradition. The *chaînes operatoires* and products on both sides of the Pyrenees—including Catalonia, Provence, Languedoc, and north-eastern Italy—were thus strikingly similar, with comparable atypical chemical compositions and characteristic metallic types, such as biconvex gold beads, copper tanged daggers, and breastplates (Blanco-González et al. 2018).

To the south-west, in the Middle Ebro basin, Chalcolithic groups show tumuli, multiple burial bits, megaliths, and natural caves, some later reused during the Bell Beaker phase, with settlements showing huts delimited by postholes, and elongated dug-out hearths. In Valencia, preferences continue since the Neolithic, with ditched enclosures and upland prominent sites. Burial practices show continued inhumations in pits and in caves. The Epi-Bell Beaker or late Bell Beaker fineware marks the onset of the Bronze Age ca. 2250 BC in the region. It is represented by the Arbolí, consisting of bowls with incised and impressed motifs (swags, garlands, suns, etc.), stemming from the south of the Pyrenees and reaching the Cantabrian fringe, the upper Duero, and

Alicante to the south. In the other direction, twin-bodied vessels expand from Valencia to the upper Ebro ca. 1900 BC (Blanco-González et al. 2018).

Metallurgy gains in importance, with the first bronze alloys concentrated in the Ebro / south Pyrenees area, and intense exchange networks are kept in the east Mediterranean, between groups belonging to Polada, Terramare, Únětice, and Rhône Basin Cultures, characterised by the production of polypod vases. Around 1600 BC, metallurgy had acquired social esteem akin to the Bell Beaker period, within a context of increasing social asymmetry evidenced by burials of metalworkers, although metallurgy is weakened in comparison with western and central European centres. There is an increase in agrarian production and sedentarisation, but mortuary customs continue to be—as in the Chalcolithic—highly varied, with cavities, orthostatic chambers and galleries, reused rock-cut caves or *hypogea*, and burials made in pits (Blanco-González et al. 2018).

This period ends with the start of the Late Bronze Age ca. 1600/1500 BC, coinciding with the appearance of the earliest Urnfield groups south of the Pyrenees, known as the Segre–Cinca I group (ca. 1650–1300 BC), showing contacts between Iberia and central Europe. It is associated with carinated button-handled vessels, akin to Italian Polada examples. Rectangular dwellings with stone foundations and the use of pottery vessels with fluted decoration (linked to the emergence of the funerary phenomenon of the Urnfields) buried in a pit along with grave goods in a pit, sometimes marked on the surface. Although this practice is found scattered in northern Portugal and the south-east, the greater density of graves in the north-east suggests that new populations may have crossed the Pyrenees bringing the Hallstatt culture, although certain previous forms of settlement and burial ritual remain (Lull, Micó, Herrada, et al. 2013). Reaching up to the Middle Ebro and Aragon, open-air nucleated sites become more frequent and stable. (Blanco-González et al. 2018).

Regions neighbouring north-east Iberia show different developments. In southern France, the funerary use of caves continues throughout the Bronze Age, with inhumations and cremations showing a more or less structure deposition, and collective family graves being also common, including small funeral monuments (mounds and/or enclosures). The Mailhacien culture shows huge cremation cemeteries. In east Iberia, however, the Bronce Mediterráneo or Iberian-Valencian Bronze Age from ca. 2200–1800 BC shows new upland permanent settlements, often fortified, probably due to the Argaric influence. Villages show rectangular dwellings with stony foundations; inhumations with burial furnishings (intramural and extramural), including dismembered human remains; agriculture with a focus on cereals and using irrigation; and an increase in settlements and human activity up to 1600 BC (Blanco-González et al. 2018). The influence of Post-Argaric settlements increases then to the north (see *§VIII.3.1. El Argar*).

VIII.3.3. Balearic Islands

The first phase of colonisation of the Balearic Islands started in Majorca ca. 2400–2300 BC, with populations probably from the north-western Mediterranean arc, judging by the affinities of its late Bell Beaker tradition with the Pyrenean style of north-eastern Iberia, Roussillon and Languedoc. Caves and rock shelters were used as settlements and occasionally as burial sites, and huts on open-air settlements were the most common construction. Settlements were occupied seasonally, and its subsistence economy was probably based on animal herding and slash–and–burn agriculture. Continuity with Iberian Bell Beakers is observed in pottery shapes (especially the typical Bell Beaker *Begleitkeramik*), bone manufacture, and funerary rites (Lull, Micó, Rihuete Herrada, et al. 2013).

During the next colonisation phase ca. 2100–1600 BC, the Epi-Bell Beaker–Dolmen archaeological group reaches Menorca and the Pine Islands. Settlements follow a similar pattern, with material culture showing pottery decorated with incised designs related to Bell Beaker style, hence ‘Epi-Bell

Beaker'. The most striking change is perceived in funerary contexts, where new kinds of tombs are used: it starts with hypogea with a single circular or oval chamber, provided with a megalithic entrance, similar to Catalan late Chalcolithic and Early Bronze Age examples. Dolmens—similar to megalithic tombs in Languedoc—follow in the 19th century BC, with monuments facing west and south-west. This orientation is prevalent in monuments in Languedoc and Provence, in contrast to neighbouring regions, where monuments face south or south-east. Grave goods are scarce and are composed mainly of objects of everyday use, and human remains show no apparent pattern (Lull, Micó, Rihuete Herrada, et al. 2013).

All this data point to long-lasting contacts of the Pyrenées–Languedoc societies—of north-east Catalonia and much of Mediterranean France—with populations that settled the Balearic Islands (Sureda 2018). It is believed that advances in technology, such as production of food and metallurgy, allowed for the permanent settlement of the islands. Social violence and demographic pressure in the mainland may have been the triggering factor for the development of a safer, distant community, which is supported by the scarcity of fortifications, preference for lowland locations, absence of specialised weapons, and predominance of collective burial rites, as well as absence of gold and silver ornaments (Lull, Micó, Rihuete Herrada, et al. 2013).

The Naviform group (ca. 1600–1100 BC) is characterised by the emergence of large buildings with an elongated floor plan and Cyclopean stone walls, used for craft production, showing a moderate division of labour between buildings. This architecture coincides with the abandonment of natural caves and the appearance of new types of funerary structures alongside the previous types, with communal tombs reflecting autonomous social units. In its late phase, more diversity in the naviform pattern is seen, as well as growing relevance of bronze working and agriculture within their subsistence economy (Lull, Micó, Rihuete Herrada, et al. 2013).

The Proto-Talayotic period (ca. 1100–850 BC) represents the end of the naviform society, with settlements organised in compact urban areas, organised around a large, tall stone building possibly ancestral to the *talaiots*. Collective funerary practices continued the use of natural caves and funerary structures like *hypogea*, but also saw the emergence of the *navetas*, large stone buildings with a circular or apse-shaped plan, tombs used for the burials of up to hundreds of bodies. Grave goods become more numerous and varied, a feature shared across the islands. This unity comes to an end with the Talaiotic period, where the construction of compact settlements or *talaiots* represent the affirmation of the community rather than the celebration of the past and the ancestors at a distance from the settlements (Lull, Micó, Rihuete Herrada, et al. 2013).

VIII.3.4. Sardinia and Corsica

The Chalcolithic culture of Monte Carlo covers the whole island during the 3rd millennium BC, with an economy based on agriculture, animal husbandry, fishing, and trading with the central Mediterranean. The appearance and wide diffusion of the Bell Beaker pottery coincides with the Bonnanaro culture or Corona Moltana tradition (ca. 2200–1900 BC), and the appearance of thousands of Domus de Janas (‘House of the Fairies / Witches’). Burial rituals involve monumental tombs, also with reused anthropomorphic menhirs; appearance of metal; and small number of settlements, possibly small farms over wide areas (Lo Schiavo 2013). Small, self-sufficient and autonomous groups probably dispersed throughout the territory to form single village groupings, organised along lines of kinship (Perra 2009).

In the second phase of the EBA, the limited expansion of S. Iroxi tradition evidences cultural contacts with Iberia, and especially El Argar, as seen in sword shapes, although the copper used for manufacture is local. Pottery is scarce, and settlements are unknown, but there is an explosion of local metallurgical production. There is some cultural continuity with the Nuragic period, represented strongly by the large flanged axes, very similar to a type found in the Lazio area. The shape does not change in Sardinia, though, contrary to the evolution on the mainland, which probably indicates the independent development on the island. The Sa Turricula culture shows renewed contacts with the Italian peninsula at the end of the EBA and beginning of the MBA (Lo Schiavo 2013).

The characteristic ‘corridor nuraghi’ or ‘proto-nuraghi’ and *tholos* nuraghi, together with villages, and the characteristic collective burials—and eventually worship places—called ‘Giant’s tombs’, appear first, concentrated in the central and northern parts of the island, used as territorial markers. Metope patterns in pottery appearing slightly later. This society is interpreted as evolving from kinship-based during the previous period to communal-based, where there is a concentrated, common effort to erect great monuments in dominant positions, and there is an obvious spread of settlement nuclei (Lo Schiavo 2013).

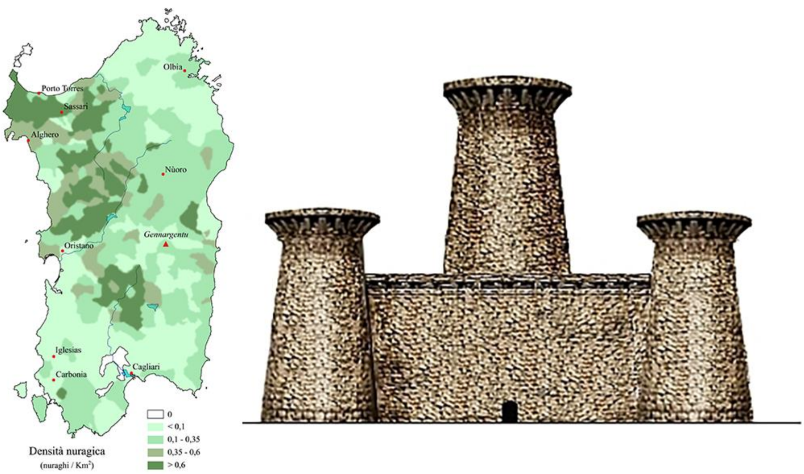

Figure 53. Left: Nuragic density in Sardinia, from Wikipedia based on data from Kriek (2003). Right: Nuraghe, Sardinia 1600 BC. Design by Kenny Arne Lang Antonsen and Jimmy John Antonsen. From Wikipedia.

Eventually, the nuraghi evolve into a golden age within the MBA–FBA transition, with complex architecture showing multi-towered, polylobate, regular or irregular structures with stone enclosures and bastions. This needed a concentrated, communal local effort, where size, number and complexity of constructions were probably considered status symbols, showing an inherited awareness of earlier kinship tradition. Based on the expansion of monumental constructions, local communities seem to unify under a centralised power (Figure 53). The building technique and structure of tombs change into 'isodomic' constructions (in regular layers), also rising in complexity, although they remain large chambers for collective burials. Metallurgical production seems to also benefit from the new organisation. Storage silos are built inside the nuraghi, and advanced cultivation of cereals seem to have been the main subsistence economy. Characteristic 'Nuragic grey' pottery appears associated with Mycenaean pottery, and spreads through central-southern Sardinia. However, differences in pottery seem to reflect local productions, since the Nuragic Civilisation is homogenous throughout the island (Lo Schiavo 2013).

At the transition of the EBA – Early Iron Age (from ca. 11th century BC), the traditionally close connections with the Cypriot and the Agean world during the MBA shift again to the Iberian Peninsula. Territorial systems enlarge, and the ritual or religious dimension—reflected in the increasingly religious nature of the nuraghi—is used as means of expression and overcoming conflicts, reaffirming social unity, and legitimising the power of emerging groups (Perra 2009).

The funerary practice of individual inhumations in cist graves with grave goods, and shaft tombs with grave goods, begin to appear. This is probably connected with Phoenicians, Semitic peoples settling in the island and circulating copper in the form of oxhide ingots through Mediterranean routes. Contacts across the Tyrrhenian Sea with peninsular Italy intensify, strengthening their relationship, as evidenced in written sources with interconnected genealogies, mythologies, and common designations (Lo Schiavo 2013).

viii.3. Ligurians and Iberians

viii.3.1. Ligurians and Sorothaptic peoples

Bell Beaker samples from south-eastern France, from Haute-Savoie (ca. 2300 BC), of hg. R1b1a1b1a1a-L151, and Le Lauzet–Ubaye (ca. 2050 BC), of hg. R1b1a1b1a1a2b1-L2, show Steppe ancestry (50%) apart from France Middle Neolithic ancestry, indicating the presence of East Bell Beaker migrants (Olalde et al. 2018).

In Iberia, there are clear north–south and west–east clines of Central European ancestry in Iberia, with the highest values attested in the centre and north-west (around 65% to 90%), with slightly less and more variable reach in early samples from the south-west (ca. 16% to 61%), while samples from the north-east (ca. 30% to 50%) and especially the south-east around El Argar (ca. 20 to 35%) show lower values. The dates for samples with Steppe ancestry, appearing earlier in the Meseta, are also compatible with different waves that reached each region at a different pace, probably allowing for the survival of local languages in the most distant and isolated southern regions.

Early Bell Beakers from Cerdanyola, north-east Iberia (ca. 2800–2300 BC) show no Steppe ancestry and typical Neolithic haplogroups, among them one I2a1b-M436, three R1b1b-V88 (shared with earlier north-east Iberians and Sardinians), and two G2-P287. This is compatible with a late expansion of East Bell Beakers of R1b1a1b1-L23 lineages, which did eventually replace all indigenous male lines of Iberia after ca. 2000 BC. Among Bronze Age samples from the north-east (ca. 2000–1400 BC), all showing Steppe ancestry (ca. 30–50%), the four reported Y-chromosome haplogroups are R1b1a1b1a1a-L151, at least two of them R1b1a1b1a1a2a1-Z195 (Olalde et al. 2019).

The archaeological connection of Bell Beakers from the north-west Mediterranean (north-east Iberians and groups from southern France) with north Italian Bell Beakers is also supported by the expansion of R1b1a1b1a1a2b-U152 (xR1b1a1b1a1a2b1-L2) lineages, present today in west and north-west Italy, and by the expansion of R1b1a1b1a1a2a-DF27 lineages in France and (with subsequent bottlenecks) south of the Pyrenées.

Subclades particularly associated with Iberia include the consecutive subclades R1b1a1b1a1a2a1a-Z272 (TMRCA ca. 2300 BC) and R1b1a1b1a1a2a1b-Z198 (TMRCA ca. 2700 BC), both peaking in modern eastern Iberian populations (Solé-Morata et al. 2017). Later expansions of these haplogroups to the south with the Reconquista and repeopling of east and south-east Iberia by the north-eastern Iberian kingdoms do not let us reconstruct their ancient distribution without a proper sampling of ancient populations.

Ligurian is a fragmentary Indo-European language spoken in southern France and north-eastern Italy during the Iron Age. Little is known of the language, with certain phonological traits placing it likely outside the Italic or Celtic branches (Prósper 2017), but nevertheless more closely related to them than to other North-West Indo-European dialects. The Apuani tribe, bordering Etruria during Roman times, show half of the reported Y-DNA of R1b1a1b1a1a2b3-Z56 lineages[23].

Ligurian is probably the most closely related language to the ancestral Indo-European dialects spread with East Bell Beakers through ancient Liguria and north-eastern Iberia, as well as (probably) the Balearic Islands and Corsica, before the expansion of Iberian languages from south-east Iberia. The Pre-Celtic Sorothaptic language, believed to be behind certain toponyms and inscriptions around the Pyrenees (Coromines 1976), was therefore probably closely related to Ligurian.

vii.3.2. Iberians

Early samples from south-eastern Iberia also show no incursion of Steppe ancestry and continuity with Chalcolithic lineages, one non-I-M170 and two I-M170, at least one of them I2a1a2-M423. Similar to the north-east, Bronze

[23] Information by Richard Rocca (2018).

Age samples (ca. 2100–1000 BC) show Steppe ancestry, with those from El Argar in Cabezo Redondo and Pirulejo (ca. 2000–1500 BC) showing less Steppe ancestry (ca. 20–35%) than those on the periphery, most likely also connected to the culture (ca. 23–45%). There are at least eight R1b1a1b1a1a-L151 over nine reported haplogroups, among them one from Coveta del Frare (ca. 1840 BC) is positive for SNPs ZZ12$^+$ and BY3332$^+$ (Valdiosera et al. 2018; Olalde et al. 2019), confirms the expansion of this haplogroup also in the culture that most likely expanded Iberian languages to the north and west.

The expansion of East Bell Beakers in Iberia seems thus to have reached thus later south-eastern Iberia, with El Argar culture being preceded by a break in Chalcolithic cultural traditions, suggesting an upheaval of existing social structures or an influx of groups that cannot be distinguished from the local population at the present of genetic resolution, e.g. from south-eastern Europe (Szecsenyi-Nagy et al. 2017), possibly in part as a reaction to the spread of the Bell Beaker culture. The infiltration of Bell Beaker lineages, probably through exogamy among established chiefs of El Argar, must have led to the evident language shift in spite of the successful expansion of Yamna male lines over the indigenous ones, since ancient non-Indo-European speakers were genetically similar to Indo-European speakers (Olalde et al. 2019).

Nevertheless, one sample from Covacha del Ángel in southern Iberia (ca. 1700 BC), without clear archaeological context, shows a typical Neolithic haplogroup G2a2b2a1a1b-Z738 (formed ca. 8700 BC, TMRCA ca. 5200 BC), reported as xCTS4703 (González-Fortes et al. 2019), hence from an upper clade of a lineage widely distributed in modern European samples, which may be alternatively interpreted as a resurgence of a local population, or alternatively a haplogroup incorporated during the expansion of Central European Bell Beakers.

Proto-Iberian, probably surviving only in El Argar ca. 2000 BC, must have spread with this culture's early expansion to the west into Andalusia, to the north-west into the Meseta, and to the north into the Valencian Region, possibly representing eventually the most densely populated areas of Iberia during the Bronze Age, with the lesser proportion of Steppe ancestry being another clear data further supporting the gradual southward expansion of North-West Indo-European-speaking Bell Beakers that must have left a clear opportunity for local groups to thrive (Olalde et al. 2019).

The arrival of Celts with the Urnfield culture and their occupation of the south Pyrenees and the Meseta (see below *§viii.6. Celts*), with language change reaching up to south-west Iberia, must have caused population movements in the east, with Iberian-speaking populations retreating to the coast and possibly expanding slightly later to the north along the coast, replacing or displacing Ligurian-like speakers to their proto-historical territory. The arrival of Phoenician and Greek settlers, with increased trade and probably renewed demographic pressure (Matisoo-Smith et al. 2018; Zalloua et al. 2018), may have caused their expansion to inner territories again.

Iron Age samples from Iberians in north-east Spain show a variable increase of CEU BBC ancestry (32–98%) related to the previous period, with an increase related to the contribution of 'foreign' sources (from central European groups) shared with Celtiberian samples, although such contribution found in Iberians (ca. 18%) is lower than the one found in Celtiberians (ca. 35%), compared to the contribution of Bronze Age Iberian sources (Olalde et al. 2019). This increased ancestry found in Pre-Iberian and Iberian samples after the Urnfield period likely reveals the expansion of Iberian-speaking groups and Iberian languages over previous Celtic-speaking areas in north-eastern Spain and south-eastern France.

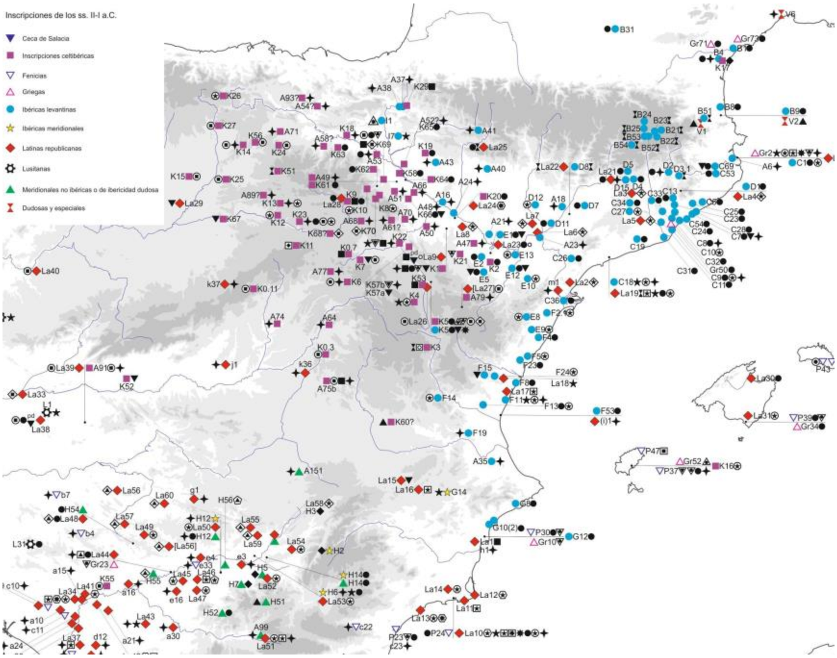

Figure 54. Inscriptions in Iberia ca. 2nd–1st c. BC. Purple squares show Celtiberian inscriptions, blue circles show Iberian inscriptions. Image modified from Hesperia – Banco de datos de lenguas paleohispánicas.

The first Balearic settlers of the Early Bronze Age, represented by an individual from Mallorca (ca. 2400-2300 BC) had substantial Steppe ancestry (ca. 37%), with the closest source being Iberian Bell Beaker individuals of high Steppe ancestry, hence likely from a north-western Mediterranean source. Two later individuals from the Middle Bronze Age show lower Steppe-related ancestry in Menorca (ca. 23%) and Formentera (ca. 26%). The source of this increase in indigenous ancestry may be linked to both Iberia Chalcolithic and Sardinia Nuragic ancestry, although the mtDNA haplogroup U5b1 found in the Menorca MBA sample is observed in multiple Iberia Chalcolithic individuals, but not in Sardinia. This may suggest that both Talaiotic peoples from the Balearic Islands and the ancestors of Nuragic Sardinians received gene flow from an unsampled Iberian Chalcolithic-related group (Fernandes et al. 2019).

The expansion or resurgence of Iberian languages in the west Mediterranean islands may be thus related to the appearance of megalithic structures, as a sign of resurging pre-Beaker customs (possibly under the influence of eastern Iberia), such as *talaiots* in the Balearic Islands, the *nuraghi* in Sardinia, and the *torri* from southern Corsica (Ugas 2005). While Iberian languages are attested in the Balearic Islands in proto-historic times, the relation of Iberian (and Basque) with the described Paleosardo substrate of Sardinian languages (Blasco Ferrer 2010) remains a controversial linguistic topic, and their shared connection may be much older.

The modern population of Ibiza, one of the Balearic Islands, shows a split from the mainland parallel to the divergence of Sardinia from mainland Italy, and a distance from modern Basques similar to that of modern Sardinians. This is not related to the Phoenician expansion, since their ancestry is not continuous with an ancient sample from Ca's Molí (ca. 260 BC), which can be modelled as an admixture of NWAN (ca. 19%) with Morocco Neolithic ancestry (ca. 81%), suggesting a recent Punic origin. Their modern Ibizan ancestry can therefore be explained by the consanguineous unions in the Island since the Catalan repopulation of the 13th century, and its population decline in the Middle Ages (Biagini et al. 2019). It probably reflects thus an ancient situation in north-east Iberia coupled with genetic drift.

viii.3.3. Palaeo-Sardinians

Ancient Sardinian individuals sit between early Neolithic Iberian and later Copper Age Iberian populations, roughly on an axis that differentiates WHG and EEF populations and embedded in a cluster that additionally includes Neolithic British individual. The most shared genetic drift of ancient Sardinians is found with Copper Age Iberia, while southern French Neolithic individuals are the most consistent with being a single source for Neolithic Sardinia (Marcus et al. 2019). In fact, ancient Sardinians harbour HG ancestry (ca. 17%) that is higher than early Neolithic mainland populations (including Iberia, ca. 8%), but lower than Copper Age Iberians (ca. 25%) and about the same as Southern French Middle-Neolithic individuals (ca. 21%).

It is not possible to reject major genetic continuity of the Neolithic population in Sardinia into the Bronze Age and Nuragic times, with a WHG proportion remaining stable (ca. 17%) throughout the three ancient time-periods. No haplogroups are reported before the Early Bronze Age, but from the late 4th millennium BC until the Nuragic period there are probably seven R1b1b-V88 samples, two G2a2a1a2a1a-L166, as well as six I2-M438 lineages shared with Neolithic and Chalcolithic populations from Iberia and the British Isles: five I2a1a2a-L161 and one I2a1a1-M26 (Marcus et al. 2019).

In samples attributed to the Nuragic period (ca. 2100–950 BC), there are seven R1b1b-V88, two I2a1a2a-L161, four G2a2a1a2a1a-L166, apart from four J2b2a1-L283, which may also be interpreted as remnants of the Neolithic expansion through the Mediterranean (Fernandes et al. 2019). The survival of I2a1a1-M423 lineages among modern Sardinians (ca. 39%) supports the continuity of this haplogroup during the Nuragic period, too (Chiang et al. 2018).

An Iron Age sample (ca. 300 BC) shows evidence of Iranian-related ancestry, which may be interpreted from the chronologically closest populations as Iberia Chalcolithic (ca. 12%) and Mycenaean ancestry (ca. 88%), with little if any ancestry from earlier Sardinians. This outlier and Late Antiquity samples from the south-east (AD 200–700), showing even higher Iranian farmer-related ancestry, are consistent with the genetic impact of Phoenician colonies in Sardinia. One of these samples (ca. AD 450) shows the first evidence of Steppe-related ancestry in Sardinia(Fernandes et al. 2019).

A connection of Paleosardo with a Basque-Iberian community may be supported thus by the survival of Neolithic farmer and pre-Neolithic hunter-gatherer ancestry in ancient Sardinians, also distinguished in modern Sardinians and shared particularly with modern Basques (Terradas et al. 2014), especially in samples from isolated populations of central and eastern regions (Chiang et al. 2018). Similarly, the presence of elevated WHG ancestry in modern southern Italian clusters (Raveane et al. 2018) supports an ancestral connection with Iron Age Basques, as remnant populations of Early European Farmers associated with Cardial pottery.

In light of the potential recent contacts between Sardinia and the north-west Mediterranean mainland, and with the Balearic Islands in particular, it is unclear if similarities of Paleosardo with Basque-Iberian languages are due to the Early Neolithic expansion or to a more recent connection, such as Middle or Late Neolithic population movements.

The presence of G2a2a1a2-L91 lineages (ca. 11.3% in Corsica, especially in the south) and G2a2a-PF3147 (xL91, xM286) subclades in present-day southern Corsica and Sardinia, apart from Tuscany (Di Cristofaro et al. 2018), may support the survival or resurgence of ancestral populations after the arrival of Bell Beakers, potentially accompanied by language replacement. More recent contacts of El Argar with Sardinia and Corsica, sharing related languages, may have allowed for the diffusion of common innovations among related cultures, even if the communities had separated much earlier. The analysis of modern mtDNA shows the typical variation of maternal haplogroups, although, interestingly, some modern subclades seem to coincide in their estimates with sampled Sardinian Bell Beaker mitogenomes (so e.g. HV0j, H3u2, K1a32, or U5b2b5), which points to the arrival of the culture as an inflection point in the genetic history of the island (Olivieri et al. 2017).

The arrival of J2a1b-M67(xM92)—a haplogroup associated with Anatolian Neolithic populations—in Sardinia, Corsica, Tuscany, and Provence (Di Cristofaro et al. 2018), may be related to Tyrsenian expansion, which has been related to the emergence of the Iolaei in the island (Ugas 2005), but also to more recent expansions of Greek or Roman settlers. Similarly, the appearance of J2a1-L26 lineages in eastern Iberia, and particularly J2a1d-M319 (found previously in Minoan samples), should probably be associated with Greek settlers, while the expansion of E1b1b1a1b1a-V13 (formed ca. 6100 BC, TMRCA ca. 2800 BC) in Sardinia and Iberia, as well as in Corsica, may be related to the Phoenician and Carthaginian occupations (Matisoo-

Smith et al. 2018), possibly related to the increased sub-Saharan admixture observed in Sardinia (Chiang et al. 2018).

VIII.4. Iberian EEBA province

VIII.4.1. Old and New Bell Beakers

The demographic or economic pressure of Yamna migrants must have been responsible for the events in Iberia before the arrival of East Bell Beakers, which brought about a reduction in the size of settlements and an increase in violence, signalled by changes in technology and organisation of metallurgy, concentration of wealth, proliferation of weapons, and displays of violence and individualised power, reflecting the synchronic economic and political transformations seen in western Europe (Blanco-González et al. 2018).

In the north, centre and west of the peninsula, the most common settlements are 'pit fields' (*campos de hoyos*), open settlements occupied temporarily or seasonally with varied structures used as silos to store grain, rubbish dumps, sites to place offerings, homes, graves, or dwellings. They were probably inhabited by dozens of people, and were probably highly autonomous in their production economy, evidenced by the tools found related to processing, storage, consumption of food, and production of pottery, stone, bone, and metal objects. Some hilltop settlements can also be seen, probably also non-permanent sites linked to seasonal exploitation of certain resources (Lull, Micó, Herrada, et al. 2013).

Their subsistence economy was based on stockbreeding, on an increasingly developed agriculture—with specialised flint working for preparation of sickle teeth—and increase in number of silos per settlement with greater storage capacity, in comparison with the Copper Age. Metallurgy also improved, with extensive extraction of ore in the centre and the north, not related to economic centres as in El Argar, but rather widely distributed locally among settlements. Pottery is dominated by plain vessels, continuing the East Bell Beaker *Begleitkeramik*, coexisting with local Bell Beaker developments (Lull, Micó, Herrada, et al. 2013).

While funerary customs do not show a clear break with the earlier collective burials, there is a trend towards reduction in size of the tombs and in the number of bodies they contained during the Chalcolithic. This tendency culminates in the practice of individual burials, especially in central and west Iberia, described as an evidence of social inequalities in these territories. Chalcolithic settlements of the south-west are abandoned, a sign of a drop in population and a change in social order, more radical and evident than in the central territories (Lull, Micó, Herrada, et al. 2013).

VIII.4.2. Meseta

In the northern Meseta, during the Bell Beaker phase (ca. 2500–1900 BC) a high degree of craftsmanship develops, with a standardised repertoire of pottery forms and decoration including incised (triangles), combed impressions, rare schematic representations, and burnished surfaces; flint for knapped blades; green stones for beads; and copper to smelt awls and flat axes. These distinctive items spread everywhere during the Bell Beaker expansion, elevated locations gain importance, sites decrease in size and are more distantly spaced, while burials in old megaliths coexist with isolated single burial pits and graves under tumuli with rich furnishings (Blanco-González et al. 2018).

Two subcultures appear in the northern Meseta: a south-western region, characterised by more labour-intensive tumuli, stone-walled and ditched sites, southern imports, and manufacture and distribution of local variscite beads; and the eastern region, featuring smaller tumuli, a lack of walled or ditched sites, and engagement in different exchange networks—including green talc beads, and characteristic pre-Beaker and Beaker pottery styles. Economic activity, rising since the Chalcolithic, peaked during this time (Blanco-González et al. 2018).

The Early Bronze appears in the north with the distinctive ‘Parpantique group’ in Soria (ca. 2100 BC), showing coarser pottery, with household wares predominating over fineware, bowls lacking careful burnished treatment, incised and figurative decorations disappearing, as flint becomes less common. Stone mining tools appear, as well as arsenical copper tools and new types of pottery, like carinated vessels, S-profile jars with flat bottoms and fingernail impressions on rims, and thumb-impressed rope design. Open-air sites predominated, with occupation of prominent hills (related to herding strategies) , but lowland pit sites continued, and some caves were also inhabited (Blanco-González et al. 2018).

In the southern Meseta ca. 2500–2000 BC, the Maritime style predominates in the initial stage, including undecorated Bell Beaker assemblages, and female burials have also been found. An abrupt change is visible particularly after ca. 2000 BC in the Tagus Valley, when agrarian landscapes became unsustainable and were transformed into diversified ones orientated to pastoralism, although a relative continuity in material culture and settlement patterns can be seen. Bronze co-smelting reached the Tagus basin ca. 1800 BC, probably from north-eastern Iberia, and exogamy dynamics are observed with immigrants from the Central System (Blanco-González et al. 2018).

A Protocogotas decorative style emerges ca. 1800/1700 BC, characterised by the application of motifs using incisions or impressions (ears of wheat, triangles) on the upper part of the vessels. Protocogotas evolves to Cogotas I ca. 1500 BC, featuring the use of geometrical motifs (garlands of concentric semicircles, wolf's teeth, rows of spikes or circles) executed by means of linear incision techniques, bouquique (dot and line decoration), 'sewn' decoration, and excision. Various vessels appear, with the emblematic pottery formed by dishes with the lower part of the body as a truncated cone shape with high carination, open platters and pots with prominent rim (Blanco-González et al. 2018).

Cogotas I pottery spreads across a large part of the peninsula, signalling the start of the Middle Bronze in different regions, coinciding with the last two centuries of the Argaric wold, although no significant archaeological change is perceived in these regions. In general, a shift of economic power is seen from the south-east to central and west Iberia with the demise of El Argar. From the Ebro to the Duero and upper Tagus regions, including the Atlantic coast, settlements continue to be divided into upland sites and ‘pit fields’ in the lowlands, with pits occasionally used as tombs for individual interment with few or no grave goods (Lull, Micó, Herrada, et al. 2013).

Before ca. 1300 BC, there seems to be no major differences in metallurgical production or any other economic aspect compared to the previous period, which suggests long-term stability. Settlements composed of a few dozen individuals, relatively high mobility, stockbreeding as the basic subsistence economy, with the relevance of agriculture and the population density being dependent on the geographical conditions (Lull, Micó, Herrada, et al. 2013).

After ca. 1300 BC there is an increase in exchange of products, particularly metal objects, connecting the Atlantic with the Mediterranean coast, suggesting a new gradual shift of economic power to the Mediterranean and the south, marking the beginning of the Late Bronze Age. In the Meseta, the Cogotas I style prevailed, with large hilltop settlements and small low-lying villages participating in the production and circulation of Atlantic bronzes. Certain central settlements seem to have dominated over surrounding territories (Lull, Micó, Herrada, et al. 2013).

VIII.4.3. Western Iberia

During the Chalcolithic (ca. 3300–2200 BC), south-west Iberia shows intense networks of contact and exchange, although there is great variability in terms of settlement and funerary rituals. Larger sites are occupied for centuries, while smaller sites seem to have a shorter life (few centuries or decades). Enclosed settlements featured round houses with stone foundations, within and outside of the walls, and evidence of metallurgical production. Distinctive ceramics, vessels with impressed acacia leaf designs, and plates with almond-shaped rim, as well as groundstone tools, grinding tools, flint blades and arrowheads, and copper items (Blanco-González et al. 2018).

The earliest Bell Beaker pottery appears ca. 2700 BC in fortified sties, of the International/Maritime, Palmela, and Incised styles. It is during this period when ditched enclosures made up of concentric rings of ditches and scattered pits, which had started ca. 3500 BC, reach their apogee, ca. 2500 BC, to disappear completely ca. 2250 BC. They showed evidence for productive activities (metallurgy), food consumption, depositional acts, and mortuary structures and rituals within the domestic space. The dead were housed collectively in *hypogea*, or in pits or reused caves and megaliths (Blanco-González et al. 2018).

The transition of the Late Chalcolithic to the Early Bronze Age (starting ca. 2250/2200) shows thus a clear discontinuity, a cultural collapse, with (Blanco-González et al. 2018):

- The end of ditch-digging and monumental negative earthworks, ca. 2250 BC.
- Monumental settlement architecture, typical of the Neolithic, disappears after ca. 2500 BC.
- Abandonment of sites, establishing new habitats, a process which had started ca. 2500 BC.
- Material culture shows an interruption in the pottery (plain pottery instead of incised wares), textiles (heavier loom weights), rarity of lithics, likely replaced by metal items.
- Iconoclastic attitude, probably related to a profound cosmogonic shift, with the disappearance of Chalcolithic figurative and geometric representations, such as engraved slate plaques, standardised astral, anthropomorphic, and zoomorphic items made in exotic materials.
- Shift from monumentalised collective burials to individualised interments in less visible tombs, beginning during the Beaker phase. Practices revolve thus around the singularisation of certain individuals in cists, with burial items associated with bodies, all in a more standardised way.

Bell Beaker graves are found in caves, *tholoi* and other megalithic tombs, showing an integration of the incoming ideology with the previous regional customs. Beaker objects found in cist burials belong to the Epi-Bell Beaker period, during the Early Bronze Age, during which individual graves were housed in separate cist burials, but were associated with objects typical of the Beaker period, such as Beaker vessels, copper daggers and wrist guards, as well as ceramics (like carinated vessels) found in the Middle Bronze Age. All this points to an archaising trend among Bell Beakers who settled in the region (Blanco-González et al. 2018).

During the Early Bronze Age (ca. 2200–1500 BC), there is thus a shift to a hybrid society which shows a semi-nomadic lifestyle, with less visible low-lying pit sites, and funerary practices involving inhumation in necropolis of cists, *covachos* and cairns, disconnected from settlements. Reuse of megaliths and natural caves has been interpreted as an appropriation of the past by these communities. The overall activity declines, showing probably a decrease in demographic density. Some hilltop settlements appear in the early 2nd millennium BC, possibly related to their more sedentary activity, such as metallurgy, and potentially under the eastern influence of El Argar settlers in the Guadalquivir River basin (Blanco-González et al. 2018).

The mining of copper and silver resources and their processing were probably the a key factor in the intensive occupation and control of the Sierra Morena Mountains during the EBA. The regional relevance of the industry is especially visible in the mines of central and eastern areas and during the Argaric Bronze Age, when the number of settlements increased compared to the previous period. Medium-sized settlements show evidence of the whole process of transforming mineral into metal, and their locations were most likely linked to territorial control, processing and distribution of the metal, and the spatial distribution and exploitation of the mines. Control over production and distribution was probably in the hands ofelites, which could have accentuated the social asymmetry seen in the so-called Alto Guadalquivir Argaric group, increasing the need for ornamental artefacts and weapons as a means of accumulating and displaying wealth and power (Arboledas-Martínez and Alarcón-García 2018).

In western Iberia, from the Low and Middle Tagus to the north, the Final Atlantic Bronze Age (from ca. 1500 BC) intensifies its contacts with the rest of the Atlantic and the British Isles, as evidenced by bronze weapons and tools, often gathered in hoards. Iron objects appear before the turn of the millennium (Blanco-González et al. 2018). The widespread anthropomorphic stelae and statue-menhirs of the west (Figure 55) may have been used as territorial markers, or formed part of funerary or commemorative practices linked to distinguished figures, maybe military leaders. They show the emergence of elite individuals who share the same symbols at a supraregional level, expanding from the lower Douro are to the south and south-east (Rodríguez-Corral 2018).

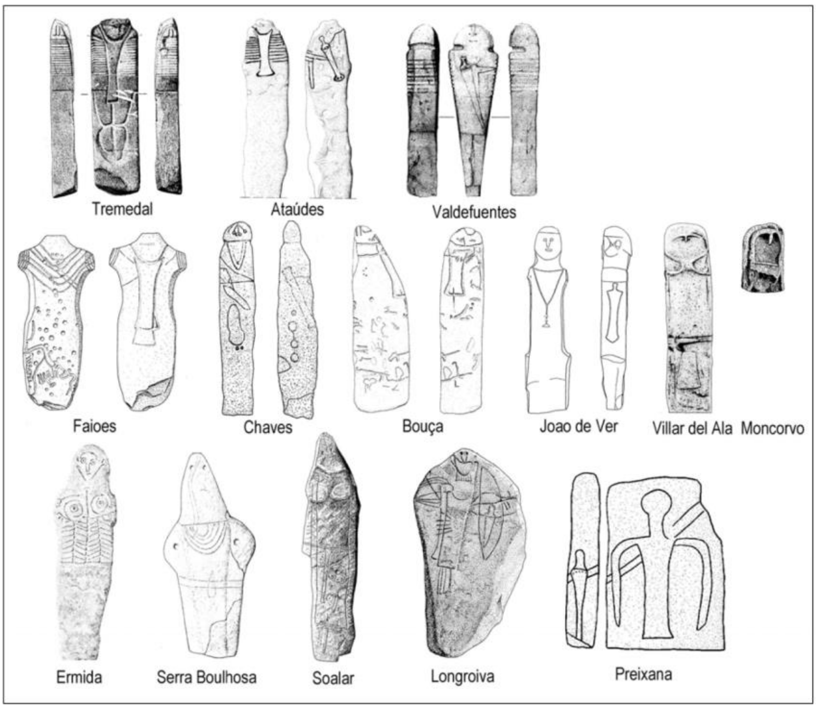

Figure 55. Stelae from the north-west Iberian group, after Bueno et al. 2005a. Image modified from Bueno Ramirez et al. (2011).

The lowest levels of human activity are reached ca. 1400 BC, increasing thereafter. Settlements in central and northern Portugal include hilltop sites between 0.05 and 1.5 ha, which reach their peak in the 10th c. BC, showing remains of intensive metallurgical production, with small communities and a subsistence economy based on agriculture, stockbreeding, acorn gathering, and limited hunting. This would give way to the Baiões-Vénat horizon at the end of the 9th to the mid–8th c. BC (Lull, Micó, Herrada, et al. 2013).

VIII.4.4. North Iberia

The prevalent decorative technique of Bell Beaker pottery in the Atlantic façade during the second half of the 3rd millennium was the shell impression using *Cerastoderma edule*, while from 2500 BC regional incised and impressed bell beakers are found in burial context throughout the region. The earliest nucleation dynamics in the north seem to have happened already by the mid–3rd millennium. Burial rites show the selective inhumation of specific individuals, often in places used since the Neolithic, such as rock-shelters and burial caves, pits within habitats, reused megaliths and small tumuli (Lull, Micó, Herrada, et al. 2013).

The northernmost regions (eastern Galicia, the Cantabrian strip, and the north-eastern sector to the north of the Ebro valley) underwent minor changes in settlement and burial practices ca. 2300 – 1900 BC, and no clear-cut cultural rupture is seen. Neolithic-like lifestyles continued, and cultural shifts happened later than in other Iberian areas, developing relatively sedentary agrarian lifestyles integrated in long-distance exchange networks since the Neolithic (Blanco-González et al. 2018).

Nevertheless, the change in decorative motifs and shapes on pottery artefacts from Cantabria, as well as the isotopic studies of diet and mobility in La Rioja, provide evidence for the movement of populations during the Late Chalcolithic and Bronze Age, with further smaller scale intra-regional movements found between the North Castilian plateau and the north, based—

among other data—on the presence of seashells in non-funerary contexts (Jones et al. 2019).

The Atlantic areas show a marked and statistically significant fall in human activity ca. 2200 BC, with a subsequent recovery ca. 1600 BC, which are matched by palaeoenvironmental proxies and a lack of known EBA sites. Asturias seems to have become the most dynamic area of northern Iberia, becoming an important metallurgical centre and trading nucleus for Iberian and Atlantic exchange, based on findings of weapons and metal goods, including mining tools. This exchange involved especially western Iberia, i.e. present-day Galicia and Portugal, while the western Pyrenées and Aquitania remained possibly isolated, based on the scarce findings from this period.

Three main mines show activity from the Bell Beaker period (ca. 2500 BC) up until ca. 1500 BC, with the mining complex of El Aramo representing one of the biggest subterranean prehistoric mining complexes in Western Europe, composed of an extensive system of galleries, pits, and wide excavations. The large-scale extraction activity from this mine (ca. 6700 tonnes extracted) can only be explained by a strong intra- and interregional demand for materials, and a shaft-hole axe from Bohuslän, Sweden (ca. 1600–1500 BC) may have originated in this mine (Reguera-Galan et al. 2018).

After a period of decline in international exchange coinciding with the exploitation of copper mines from Wales, there seems to be a poorly understood gradual change in material culture in the eastern Atlantic sector, dated around the mid–2nd millennium BC, and consisting of higher levels of agricultural production, settlement diversification, and increasing human pressure. These trends are different from the upper Ebro basin, which follows the cultural evolution of north-eastern Iberia (Lull, Micó, Herrada, et al. 2013).

viii.4. Lusitanians and Tartessians

The intrusion of steppe-related migrants represents a replacement of ca. 40% of the Chalcolithic ancestry, and near 100% of Chalcolithic male lineages in Iberia after ca. 2000 BC (Olalde et al. 2019). This replacement of old Iberian

Beakers by East Bell Beakers is seen in ancient samples almost overlapping in time (ca. 2500–2000 BC) from sites in the north, centre, south-east and south-west.

There is thus a clear population replacement marked by the arrival of Central European (Germany Beaker-like) ancestry in Iberia, with the highest values attested in the centre and north-west (around 65% to 90%), with lesser values and a wider range in the south-west (ca. 16% to 61%). The even more pronounced Y-chromosome turnover (ca. 100% of investigated Bronze Age haplogroups are R1b1a1b1a1a2-P312) point to a higher contribution of incoming males than females, also supported by a lower proportion of nonlocal ancestry on the X-chromosome, a paradigm that can be exemplified by a Bronze Age tomb from Castillejo del Bonete (ca. 1800 BC) containing a male with Steppe ancestry and a female with ancestry similar to Copper Age Iberians (Olalde et al. 2019).

The earliest Bell Beaker samples show no Steppe ancestry and predominantly haplogroup I2-M438 (at least six I2a1b1-M223 in the Meseta and the north, two I2a1a1-M26, and one I2a1a2a-L161 in the south-west), as well as one G2-P287, one F-M89, and one H2-P96. Nevertheless, Chalcolithic samples from ca. 2500–2200 BC show the intrusion of Central European Bell Beaker ancestry in central Iberia (ca. 35–100%) and north-western Iberia (ca. 63–78%), with the earliest dated R1b1a1b1a1a2-P312 sample (with ca. 63% CEU BBC ancestry) found in El Hundido, in central Iberia (ca. 2410 BC), with at least six (probably eight) over twenty-three Chalcolithic samples showing Yamna lines.

Bronze Age samples from central Iberia show variable Steppe ancestry (ca. 34–70% CEU BBC), as do the slightly later samples from the north (ca. 41–60% CEU BBC), with an evident slight resurgence of Iberian Chalcolithic ancestry over the previous period, reflected also in the better fit of Iberian Chalcolithic samples with Steppe ancestry over CEU BBC, suggesting further local admixture events within Iberia. Most reported haplogroups are

R1b1a1b1a1a2-P312, fifteen samples out of sixteen, with one I2a1b1-M223 in the Meseta (ca. 1900 BC). Most reported subclades are under R1b1a1b1a1a2a-DF27, including three under SNP ZZ12^{+}, also found in the north-east. This is in contrast with the apparently higher variability of the previous period, where two R1b1a1b1a1a2b-U152 samples are reported, one from Madrid (ca. 2500–2000 BC), and another one from Burgos, under R1b1a1b1a1a2b1-L2 (Olalde et al. 2018; Olalde et al. 2019; Martiniano et al. 2017).

The expansion of early R1b1a1b1a1a2-P312 lineages with incoming Classical Bell Beakers, like R1b1a1b1a1a2b-U152 and R1b1a1b1a1a2a-DF27 subclades, confirms a late spread of R1b1a1b1a1a2a-DF27 subclades in Iberia, estimated with studies of modern populations to have happened ca. 2200 BC (Solé-Morata et al. 2017).

Interestingly, a male outlier from Camino de las Yeseras (ca. 2473 – 2030 BC) clusters with modern and ancient North Africans in the PCA, and like 3000 BC Moroccans (see *§iv.5. Late Afrasians*) can be well modelled as having ancestry from both Late Pleistocene North Africans and Early Neolithic Europeans. His haplogroup E1b1b1a-L539 (xE1b1b1a1-M78) and the different ancestry found in near settlements confirms a recent origin in North Africa, probably related to the presence of African ivory at Iberian sites. Another similar individual is found in the Bronze Age Loma del Puerco, in southern Iberia (ca. 1815 BC), which shows ancestry related to North Africans (ca. 25%), although none of these incursions had a genetic impact on Copper and Bronze Age Iberians (Olalde et al. 2019).

In the south-west, Bronze Age samples also show a highly variable penetrance of CEU BBC ancestry, even within the same site and chronological period, like the three samples from Monte da Cabida (ca. 2200–1700 BC), which shows a female with the least Steppe-related ancestry (ca. 16%) close to a female and a male of hg. R1b1a1b1a-L51 with higher values (ca. 35%). The eight reported lineages are from Yamna lines, all probably under R1b1a1b1a1a2-P312 (Olalde et al. 2019).

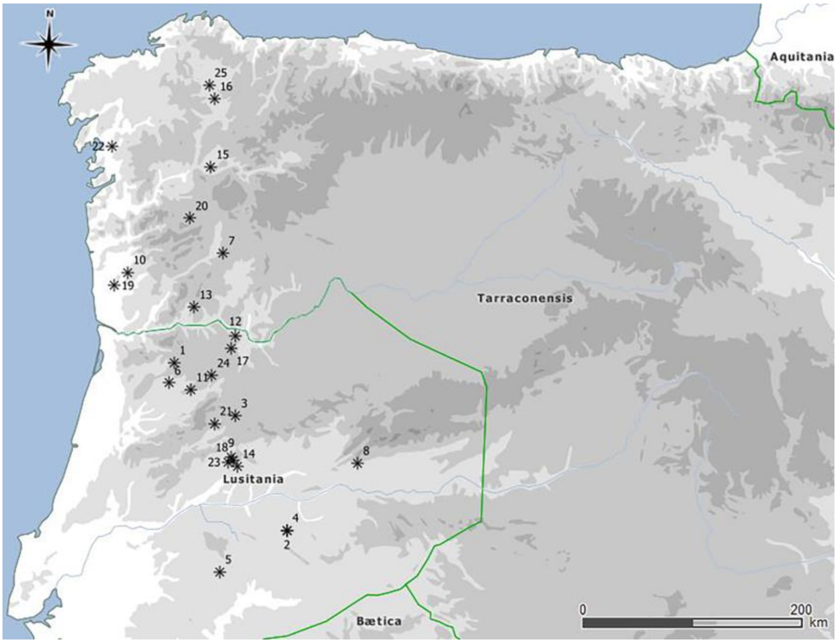

Figure 56. Distribution of Galaico-Lusitanian long and brief inscriptions. Data from Hesperia – Banco de datos de lenguas paleohispánicas, according to Vallejo (2013).

The only certain non-Celtic Indo-European language of Iberia is Lusitanian, which has been linked to a potential Galaico-Lusitanian group spread from the north-west to the central-south Iberian Peninsula, based on inscriptions, anthroponymy (Figure 56), and theonymy (Vallejo 2013). The expansion of proto-historical Lusitanian speakers may be clearly linked in archaeology to west Iberians spreading with anthropomorphic stelae from north-west Iberia during the Final Atlantic Bronze Age. There has been some discussion about the non-Celtic nature of the languages of Cantabri, Astures, Pellendones, Carpetani, and Vettones (Adrados 1998), which may be thus more or less closely associated with Lusitanian, too, as an ancestral Indo-European branch spread through the Meseta and west Iberia with Bell Beakers, before the arrival of Celts.

There are no samples from north-west Iberian Bronze Age or Iron Age groups, and it is unlikely that Lusitanian samples are ever fully assessed in genetics, due to their burial tradition of cremation. Nevertheless, Bell Beaker samples from the north-west show a radical intrusion of CEU BBC ancestry (up to 90%) and likely radical male lineage replacement, which was most likely continued until the expansion of Galaico-Lusitanian from that region to the south during the Bronze Age. Genetic isolation and thus continuity in north-western Iberia can also be inferred from the coarsest levels of genetic differentiation formed by modern Galician clusters close to the border with Portugal, representing half of the inferred clusters in all of Spain (Bycroft et al. 2018; Pimenta et al. 2019).

There is a comparatively lesser presence of R1b1a1b1a1a2a1-Z195 subclades—proper of north-central and north-east Iberians—in west Iberia, which be related to less marked Y-chromosome bottlenecks in general, and thus no episodes of radical male replacement after the Bell Beaker expansion. In particular, western Iberians show relatively high frequencies of R1b1a1b1a1a2a-DF27 (xR1b1a1b1a1a2a1-Z195) subclades (Solé-Morata et al. 2017), although the bottlenecks caused by the expansion of Celts and the Reconquista may have complicated the ancient picture (Bycroft et al. 2018).

While the position of Tartessian as Indo-European (Koch 2009) is highly doubted[24], there is some support for a borrowing of names from a "lost Indo-European language" over the course of long-term contacts (Mikhailova 2015). This is compatible with El Argar-related Proto-Iberian-speaking peoples occupying hilltop settlements and dominating over Indo-European-speaking peoples in south-west Iberian territories during the early 2nd millennium BC. Some of these territories would later form the Proto-Tartessian community, with close interactions between neighbouring Iberian- and Lusitanian-speaking peoples in south-west Iberia for centuries, before their historical attestation.

Sampled individuals attributed to the Tartessian culture from La Angorrilla in Seville (ca. 700–500 BC) show elevated Steppe-related ancestry (ca. 40–50%

---

[24] It was criticised extensively in a special section of Vol. 42 of The Journal of Indo-European Studies (No. 3 & 4, Fall/Winter 2014)

CEU BBC), with the best fit for a part of that increase (ca. 20%) showing a potential origin of the increase not related to the available Iberian BA samples, hence likely from outside Iberia, in line with the known arrival of Central European ancestry with Celts during the Urnfield period, and the likely presence of Celtic-speaking peoples neighbouring Tartessians.

VIII.5. Western EEBA province

VIII.5.1. Channel – North Sea

The Armorican Early Bronze age of north-western France is characterised by a hierarchical society, with classic groups of burial mounds similar to Wessex or Belgium. Settlements feature large houses, status symbols include daggers, halberds, and axes. Cremation cemeteries continue up to the Middle Bronze Age (Mordant 2013).

South of the IJssel, the Hilversum tradition develops, with close connections with the Channel – North Sea region, showing pottery with cord-decorated necks and very marked rim-profiles (ca. 1850–1600 BC), until this is replaced by Drakenstein pottery, ornamented with fingernail-impressed cordons. Cremation started already in the Bell Beaker period, and becomes dominant during the MBA. After 1600 BC, a regional Hoogkarspel style develops west of the Delta (Fokkens and Fontijn 2013).

Imported bronzes show a predominantly Atlantic origin. Deposits of weapons is common south of the Rhine, with swords preferentially deposited in major rivers and axes and spears in smaller bogs and streams in the near vicinity of settlements. This trend decreases drastically with the transition to the Early Iron Age, when deposition in Hallstatt chieftains' graves becomes more common (Fokkens and Fontijn 2013).

During the Middle Bronze Age, the Atlantic region shows the spread of the Deverel-Rimbury-type pottery. In the east, burial mounds become commonplace with the arrival of the Tumulus culture (pottery with excised decoration, pins, leg-rings), which spreads to the Paris Basin and the Loire Valley. Eventually, the Duffaits culture emerges from the Charente region to the Middle Loire, incorporating also Atlantic features (Mordant 2013).

In the 14th century BC, a clear east–west cultural divide is established, with the Atlantic world showing new areas of metalwork and rich bronze hoards on both sides of the Channel, evidencing the continuity of hierarchical societies. There is an increase in cremation in its funeral customs alongside more traditional burials. Rilled-ware pottery expands from the west to eastern France (Mordant 2013).

The maximum visibility of the western groups occurs ca. 1200–1000 BC with the Rhine-Switzerland-eastern France culture. The practice of cremation is established ca. 1300–1200 BC in the Paris Basin, reaching the Rhine ca. 1150–950 BC. The new period is characterised by cemeteries with highly contracted cists, and burial mounds reserved for important people, usually men, with rich hoards. Characterised by the systematic practice of cremation ('Urnfields') but also by fine incised and combed decorated pottery. This culture expands into the Rhône Valley and the Languedoc, where regional developments also continue local influences. The regions bordering the Channel continue the Channel – North Sea cultural complex until the appearance around the 9th century of smaller cultural groups and a more powerful Central France group (Mordant 2013).

VIII.5.2. British Isles

The initial Chalcolithic period (ca. 2500–2150 BC) shows the use of copper pre-dating the widespread adoption of tin–bronze. This use of copper was already present in northern France a millennium earlier, and its expansion is probably related to the arrival of Bell Beakers, supported by the synchronous appearance of Beaker pottery, stone wristguards, flint barbed and tanged arrowheads, copper daggers and gold basket ornaments. An exemplary sample comes from the Amesbury Archer (Figure 57), probably born in central Europe but buried in southern England with the earliest dated gold and copper objects in Great Britain, although older monuments also show Beaker pottery. Bell Beakers settle in south-west Ireland at least ca. 2400 BC (Roberts 2013).

The newcomers encountered the Neolithic custom of building circular or oval monuments of earth, timber, or stone, and pits with internal architectures and avenues in timber and stone emphasising the approach, and wooden palisades excluding external viewers, as exemplified in the Stonehenge monument, which has its parallels in central Europe. Burial mounds or barrows for Beaker burials in Britain, and megalithic wedge-tombs in western and northern Ireland were added to the funerary rites. These displayed striking objects in exotic materials (like gold, amber, and faience) show the influence of the Wessex culture on the whole British Isles. Local differences in burial types show an adaptation to ancient customs (Roberts 2013).

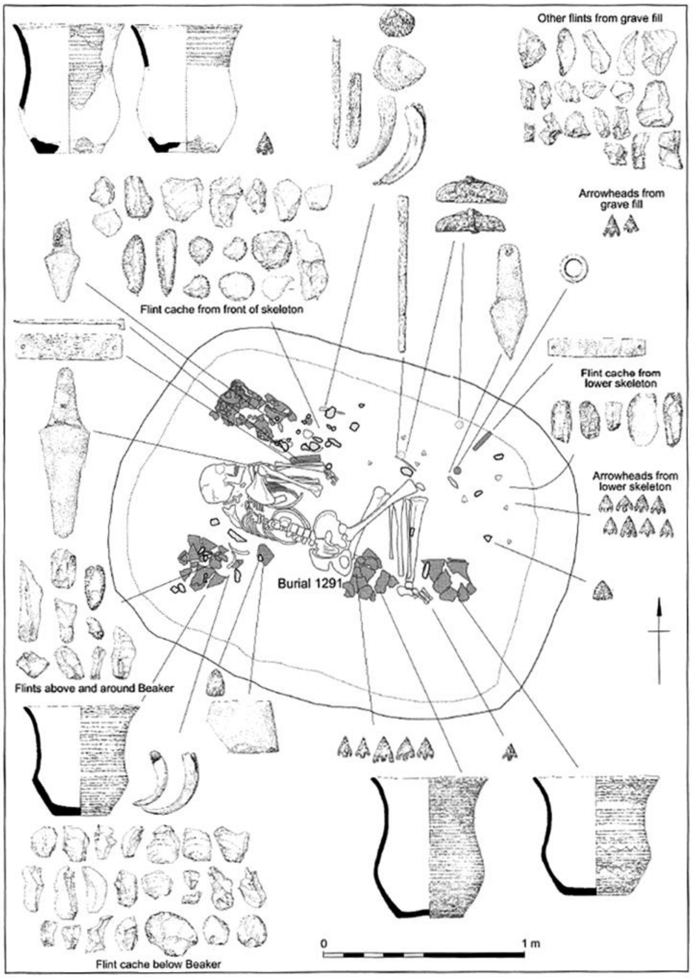

Figure 57. Plan of the burial of the Amesbury Archer with the position of the body and the artefacts, after Fitzpatrick (2011), 78, fig. 28.

Settlements show mainly short-term oval and circular structures formed by postholes and hearths, with subsistence economy pointing to a prevalence of cattle. This suggests the evolution to a mobile agropastoral economy—with adaptations of the different groups to the local environment—from the previous sedentary arable farming of wheat and barley. Navigation of waterways is evident from the similarity in architecture and artefacts between Britain and Ireland. During the subsequent whole Bronze Age period, the settlement evidence indicates dispersed population living in small communities, usually not larger than a few extended families (Roberts 2013).

Marking the transition to the EBA (ca. 2150–1600 BC), changes are seen in the increased circulation of copper in the 22nd and 21st centuries BC, topped by artefacts made of tin–bronzes in significant numbers. Following this, the accumulation of wealth and practice of hoarding begins, with exotic materials for jewellery (like amber, jet, faience and shells) found in increased quantities, and distributed over an ever-expanding area. A gradual population increase is inferred for the whole Bronze Age, compared to the previous period (Heyd 2013).

Flint and stone working flourishes at the same time as flint mines show a peak in activity, with ground and chipped axes, edge-ground knives, plano-convex knives and arrowheads, stone-perforated maceheads, axe–hammers, battle–axes, wristguards, whetstones, and moulds for metal objects. Goldworking also expands, as do dressing objects like jet spacer–plate necklaces, disk bead necklaces, V-perforated buttons and belt rings, amber spacer–plate necklaces, and faience beads and pendants. Copper mines of north-west Wales and south-west Ireland begin to be exploited using similar technology, as are tine ores from south-west England, to create the common flat axes, halberds, daggers, and later spears (Roberts 2013).

Cremation, which had coexisted with inhumation, becomes prevalent during the EBA. The placing of the dead overlaps with the everyday life, demonstrated by the extensive stone monuments constructed and reworked in Britan and Ireland. Funerary monuments include stone circles, standing stones, and ring–cairns, which are found in distinct layers also including settlements.

Hoards include bronze axes and halberds, which reveals a rapid expansion in the scale, diversity, and technique of craftsmanship in metal, ceramics, flint, stone, and exotic materials during the EBA (Roberts 2013).

During the MBA (ca. 1500 – 1150 BC), stone, flint, exotic organic and inorganic craftsmanship declines, as evidenced by a reduced quality, although they continue to be widely used. Metal tools, on the other hand, show more quantity and diversity, even though copper ore mining almost stops, which implies recycling and imports from the continent. There is a deliberate separation of copper and gold objects, and deposits can be seen: of shields in rivers and bogs; spears and swords in rivers, river valleys, and along the edges of wetlands; ornaments and tools in hoards in the landscape. Decorated and plain Barrel and Bucket urns become widespread in Britain and Ireland, coexisting with earlier forms and showing regional differences (Roberts 2013).

First a custom of building rectilinear field systems appears (especially to the south and east), probably related to intensification of farming economy, substituting previous communal efforts of building monuments, especially in river valleys, coastal lowlands, and the edges of wetlands. These fields needed the digging of ditches, erection of hedges and fences, building of gates, and placing of trackways. Flocks of sheep rather than herds of cattle become common, and the introduction of wells can be seen in agriculture, as well as a change in crop species (Yates 2007).

Only later is a widespread construction of circular settlements or roundhouses in timber or stone seen. Concentrations into villages is not common, and a pattern of abandonment and rebuilding of new settlements nearby can be seen, with offerings related to their foundation and abandonment. In England, cremation of the body and burial in flat cemeteries close to settlements is widespread, often accompanied only by pottery. In Ireland, cremation burials with Cordoned Urns continues, as does the construction of burial mounds or barrows until the 1st millennium BC. Nevertheless, deposition of cremated remains accompanied by plain coarse pottery vessels gradually increases (Roberts 2013).

The transition from MBA to LBA (ca. 1150 – 800/600 BC) is marked a reduction in upland settlements and an increase in settlements surrounded by banks, ditches, and wooden palisades in prominent places. This is possibly linked to colder temperatures and wetter conditions, in turn related to shortening of the growing season, increased consumption of dairy products (and decreased size and age ranges of sheep), and increased pressure on subsistence. Large accumulations of food consumption, animal management and craft production in middens is seen in southern Britain and south Wales during the early 1st millennium BC, overlapping with the peak intensity of bronze deposition throughout Britain and Ireland, which collapses 800 BC. New types of communal gathering-places emerge, such as middens of southern Britain, timber platforms, and the early hilltop enclosures of the north and west (Brück and Davies 2018).

VIII.5.3. Western and central Alps

The Rhône culture (ca. 2300/2200 BC) includes the Rhône Valley and part of the Massif Central, with its metallurgy and pottery reaching across eastern and central France and the Rhône corridor. Also included in western Bell Beaker groups are probably the Saône group from the Swiss and French Jura, and the Adlerberg group on the Upper Rhine. Its material culture recalls Late Copper Age assemblages, e.g. from Sion–Petit Chasseur I (of early Bell Beaker groups), including the first metal items such as decorated racket-head pins. Wetlands and lakeshores—offering open space, proximity of woodlands, agricultural soils, and aquatic resources, as well as defence and communication routes—remain the favourite locations for settlements on the Swiss Plateau and in the Alpine foothills. The economy shows innovations such as introduction of new cereals, and a grassland economy with intensified cattle breeding (della Casa 2013).

Supra-regional connections are evident from metal resources of the western Alps found in western regions—such as Armorican materials—during the late part of the Early Bronze Age, as well as from EBA *Überausstattungen* (‘over-endowed graves’) known across the continent, from Únětice to Wessex. Small burial mounds are the most common funerary ritual, but cists, caves, and megalithic monuments remain in use. Grave goods are also evidence of long-distance relations, to the ore-producing zones of the north-eastern Alps (Mordant 2013).

During the Middle Bronze Age (from ca. 1550 BC), metallurgy shows an increase in large-scale production, with technical innovations reaching areas like the Seine Valley, the Saône Valley, and the Middle Loire, at the heart of the new trading networks. With the arrival of the Tumulus culture, northern Alpine groups influence the development of local Rhodanian elements. Alpine settlements increase gradually, including sheltered camps and stone-built structures, with seasonal use of Alpine meadows in the context of an agropastoral economy. Possibly since the EBA, mining and production of Alpine copper is an important part of the economy, which increases in importance especially during the LBA and EIA (della Casa 2013).

There is abundant evidence for the use of ‘sacred’ natural places for ritual activities and depositions, especially flowing waters, lakes, and ponds, as well as mountain and pass regions. Alpine burnt-offering places are understood as an old, Bronze Age tradition which survives into the Iron Age, with the oldest findings showing calcined domestic animal bones and pottery. Gender subdivision is evident since the Copper Age, with female inhumations showing costume and ornament elements, and male inhumations featuring weapons, mainly daggers, in grave assemblages. Elite graves help support the existence of social structures during the MBA, and spatial clusters probably reflect kinship groups (della Casa 2013).

During the LBA, the Rhin-Suisse-France orientale group of the Urnfield culture develops, including the western Alps. Settlements increase in size, with quasi-proto-urban nature and complex structures, including defensive devices. Naturally defended sites such as promontories and hilltops are preferred for settlements in Alpine valleys and Prealps lowlands during the whole Bronze Age. The Inner Alps remained exposed to influences from the south, north and east. Urnfield swords, knives, bracelets, pins, and pottery are commonplace, as well as cremation burials, with regional variations in pottery and bronzes. Vertical social structures are marked by wealth of bronze objects, as well as sets of drinking vessels (della Casa 2013).

viii.5. Pre-Celts and Basques

viii.5.1. Pre-Celts

Most sampled British Neolithic individuals from Scotland, England, and Wales (ca. 3800–2500 BC), before the arrival of East Bell Beakers, form a close cluster, with their ancestry represented by NWAN (ca. 85%) and WHG (ca. 15%), except for three outliers with significantly more WHG ancestry. All Neolithic individuals show I2-M438 subclades, among them fourteen I2a1b-M436 subclades, at least five of them I2a1b1a1a1-L1195 (formed ca. 5100 BC, TMRCA ca. 3600 BC), and thirteen I2a1a2-M423, possibly all I2a1a2a-L161.

All British Bell Beakers, whether associated with Maritime or ‘All-Over-Cord’ Beaker pottery, show large amounts of Steppe ancestry, with strong similarities with central European Beaker-associated individuals, especially with those sampled from Oostwoud in the Netherlands, which supports the migration of Bell Beakers from a population close to the lower Rhine (see *§viii.7. Germanic peoples*). During the initial period (ca. 2450–2000 BC) ancestry proportions were highly variable, consistent with migrant communities just beginning to mix with the indigenous population, either before or after the arrival in the island (Olalde et al. 2018). Some samples with minimal British Neolithic ancestry further support a recent origin of the newcomers from continental Europe (Hoole et al. 2018).

There is a population turnover of ca. 90% of the local population, with Yamna lineages representing more than 90% of the haplogroups of individuals in Copper and Bronze Age Britain, and new mtDNA haplogroups such as I, R1a, and U4 being previously present among Bell Beakers from central Europe, but not among British Neolithic individuals. This supports the proposed considerable degree of mobility in Britain during this period, with little difference between male and female migration (Parker Pearson et al. 2016), rather than an exchange of female marriage partners (Brodie 2001) or inter-cultural contact consolidation (Vander Linden 2007), as previously proposed for the expansion of the culture.

A single source for most British Beakers is also supported by the Y-chromosome bottleneck of R1b1a1b1a1a2c-S461 lineages, whose presence among modern populations along the Atlantic façade possibly supports the original source of British Beakers near the lower Rhine, most likely south of the Rhine–Meuse–Scheldt delta. However, historical interactions of British populations with the Atlantic region may have introduced many of these subclades in the region at a later date. Most further reported subclades from the British Chalcolithic and Bronze Age are R1b1a1b1a1a2c1-L21[25] (TMRCA ca. 2200 BC), with only three specifically reported as R1b1a1b1a1a2-P312 (xR1b1a1b1a1a2c-S461), and one individual from the Roman period in England showing the rare subclade R1b1a1b1a1a2c1b-DF63 (Martiniano et al. 2016).

On the other hand, the investigation of Bell Beakers from Ireland suggests a potentially bimodal migration of East Bell Beaker migrants to the island, from both southern and northern European sources, with south-western individuals showing inflated levels of Neolithic ancestry relative to individualised burials from the north and east (Cassidy 2018). This is compatible with the migration of Bell Beakers from south-eastern France with increased Neolithic ancestry and mainly R1b1a1b1a1a2a-DF27 subclades, probably accompanying the Maritime style, while the rest of the Island would

[25] The Amesbury archer's reported hg. R1b1a1b1a1a-L151 may also be R1b1a1b1a1a2c-S461, an SNP call tentatively obtained with Yleaf from the petrous sample, from Wang et al. (2019) supplementary materials.

have been populated by migrants from Britain, mainly of R1b1a1b1a1a2c1-L21 lineages and increased Steppe ancestry, as reflected in the Bronze Age samples from the Rathlin Islands (Cassidy et al. 2016) and the reported genetic continuity with modern populations (Gilbert et al. 2017).

Increased Steppe ancestry is found in the Netherlands (ca. 60%), similar to some British groups (ca. 31-62%), most likely due to the admixture with Corded Ware groups (see *§vii.1. Western and Eastern Uralians*), as reflected also in the 'northern' shift in the PCA, with British Bell Beakers clustering closer to Corded Ware samples than earlier central European groups. There is higher Steppe ancestry (ca. 50%) from northern mainland sites, with samples from the Haut-Rhin (ca. 2500–2200 BC) and Moselle (ca. 2430–2130 BC), both of hg. R1b1a1b1a1a2-P312. Samples to the west of the Danube, from Sion–Petit Chasseur (ca. 2500–2000 BC), show less Steppe ancestry (ca. 34%), and both reported haplogroups are R1b1a1b-M269, including one R1b1a1b1a-L51. The increased EEF ancestry in southern French and north Iberian samples also support this interpretation of Steppe ancestry acquired in northern groups through admixture (Olalde et al. 2018).

Samples from England evolve with an increase in Steppe ancestry: from ca. 50% in England and Wales Chalcolithic and England MBA, to ca. 66% in Wales MBA, and ca. 56% in one LBA sample from England. On the other hand, samples from Scotland show a steady decrease, from ca. 54% in the Chalcolithic, to ca. 52% in the MBA, and ca. 46% in the LBA, suggesting different gene flows (or genetic drift) affecting the different groups (Olalde et al. 2018).

The controversial non-Indo-European substrate of Goidelic (Schrijver 2000, 2005) could be thus speculatively related to the previous intrusion of Megalithic groups, or even to the migration of Bell Beakers from the southern Atlantic façade, of elevated Neolithic ancestry. However, it could also mean the survival of Neolithic vocabulary as substrate of the North-West Indo-European dialects spoken by Bell Beaker groups migrating to Britain and

Ireland. Potential Vasconic substrate loanwords in Proto-Celtic (Matasović 2009), some traceable to North-West Indo-European, support their adoption before the arrival of Celts in the British Isles.

The few words of likely Indo-European and non-Celtic origin in Pritenic (Rhys 2015), the language of the Picts in Scotland, may reflect the Indo-European dialects brought by peoples of mainly R1b1a1b1a1a2c-S461 lineages across the Channel. Few useful phonetic data can be extracted from the fragmentary evidence, and it seems that the older Pictish inscriptions, dating to ca. AD 3rd–4th centuries (centuries earlier than previously thought), are composed essentially of non-alphabetic symbols, probably in reaction to contacts with Roman and Mediterranean cultures and scripts, and as a public form of display concerned with prestige and high-status identities and activities (Noble, Goldberg, and Hamilton 2018).

The peak of R1b1a1b1a1a2a-DF27 lineages among modern populations of the lower Rhine, close to the old Nordwestblock cultural region, may also hypothetically represent this lost Indo-European branch (or branches) of West Bell Beakers, of non-Celtic and non-Germanic nature (Kuhn, Hachmann, and Kossack 1986), although the evidence cited has been contested as Germanic, Celtic, or as of Old European or non-Indo-European substrate (Udolph 1994).

viii.5.1. Basques

Modern Basques, like other non-Vasconic-speaking modern Northern Spaniards and Southern French peoples from more isolated regions around the Pyrenees and the Atlantic façade, harbour increased NWAN-related ancestry, which links their language—like Iberian or Paleosardo (see *§vii.6. Basque-Iberians*)—to the resurgence of farming communities expanded from Anatolia (Gunther et al. 2015). Nevertheless, based on the modern Basque population as a proxy for the Vasconic-speaking Iron Age community, Pre-Basques to the north of the western Pyrenées before the Iron Age may have been different from neighbouring populations in their extra hunter-gatherer ancestry (Mathieson et al. 2015)[26].

It would be thus conceivable but highly controversial (Prósper 2013) to give credit to the nature of Proto-Basque as of Pre-Indo-European substratum (Forni 2013), or even as forming part of a Proto-Indo-European–Euskarian macro-family (Blevins 2018), beyond the known pre- and post-Roman Indo-European superstrata (Koch 2013). This could be nevertheless supported using genetic research by the presence of increased hunter-gatherer ancestry from the Villabruna cluster, including the presence of typical Villabruna-related R1b1b-V88 lineages in north-east Iberia and Sardinia since the Early Neolithic in the late 6th millennium BC (Haak et al. 2015) up to early Proto-Beakers in the late 3rd millennium BC (Olalde et al. 2018), continuing in Sardinia during the Bronze Age and Nuragic period (Marcus et al. 2019).

The modern population from historical Basque-speaking regions shows predominantly Yamna-derived lineages (ca. 90%), especially R1b1a1b1a1a2a-DF27 subclades, with its diversity suggesting a rather early infiltration of Bell Beaker lineages among the dwindling Chalcolithic-like population of the Atlantic façade to the north of the Pyrenees, as well as later Y-chromosome bottlenecks during their periods expansion.

Founder effects may have happened among Vasconic speakers during the Roman presence in Iberia, due to the Cantabrian Sea region’s isolation from further Eurasian gene flows. Modern Basques show a close similarity with Celtiberian individuals from La Hoya in the modern Basque Country region (ca. 400–200 BC), who show high CEU BBC ancestry (ca. 53–70%), with the highest relative contribution of a ‘foreign’ central European source (ca. 35%) compared to other Iron Age samples from Iberia. This also which the likely arrival of Celtic-speaking peoples in northern Iberia during the Late Bronze Age, related to central European ancestry, hence possibly associated to the

[26] Remark made by Iosif Lazaridis on Twitter (2018).

introduction of the Urnfield tradition. The only reported haplogroup is I2a1a1a-M26 (Olalde et al. 2019).

Figure 58. Aquitani and neighbouring tribes around the Cantabrian Sea, as described by the Romans (ca. 1st c. BC). The Basque language likely expanded south and west of the Pyrenees into Indo-European-speaking territories during the Roman period. The term 'Vascones' only became applied to Basque-speaking tribes in medieval times. Map modified from image by Sémhur at Wikipedia.

This confirms that the expansion of a Proto-Basque-speaking community—isolated in the Atlantic Coast north of the Pyrenees, roughly coincident with the Roman province of Aquitania—into modern Basque-speaking territories south of the Pyrenees happened only during the Roman Iron Age, since Basque toponyms in the area are only attested from the Roman period on (Villar Liébana 2014).

One such bottleneck may be found in the recent expansion in north-central Iberia (north Meseta, Cantabrian region) of R1b1a1b1a1a2a1a-Z272 subclade R1b1a1b1a1a2a1a1a1-Z278 (formed ca. 2500 BC, TMRCA ca. 1200 BC), particularly its subclade R1b1a1b1a1a2a1a1a1a1-M153 (formed ca. 900 BC, TMRCA ca. 600 BC), almost exclusively present among modern Basques (Solé-Morata et al. 2017).

VIII.6. Central EEBA province

VIII.6.1. Danubian Early Bronze Age

The Danubian EBA complex, starting ca. 2200–2150 BC, comprises cultures from regions north of the Alps, along the upper and middle Danube corridor, from Switzerland to western Hungary, with most eastern groups having the Danube as a northern boundary. They showed continuity from the later phases (Begleitkeramik) of the East Bell Beaker group, most apparent in the jars/cups and bowls/plates and the changing details of pottery shapes and their decorations during their transitional stage. Multiple centres of gravity have led researchers to define regional groups: Singen and central Swiss, the Neckar group, Straubing, Linz, Unterwölbing, Leitha. Pitvaros/Maros, an exclave on the western bank of the Tisza river, possibly represents an early eastward migration at the beginning of the culture complex (Bertemes and Heyd 2015).

They formed a supra-regional interconnection, showed mainly gender-differentiated burials with individual inhumations in oval to slightly rectangular grave–pits, orientated north–south with varying depths, with side-crouched rite, men laid on their left side and heads towards the north, women on the right and head towards the south, and both genders facing east, probably towards the rising sun. Based on the many cemeteries and thousands of graves found, it seems that the Danube corridor was a demographic centre in Europe. Big cemeteries evidence the continuity of their use, e.g. Franzhausen I and II with ca. 500 years or 17 generations and around 1000 graves (Bertemes and Heyd 2015).

Danubian groups were distinguished by innovation and ideas: in their shared pottery and metal/bonework, metal processing technology, costume components, jewellery and personal adornments, weapons, and tools, apart from hoarding traditions. Sources for these innovations were drawn mainly from the south-east along the Danube river: pottery, weapons, jewellery, dress fittings, and the new dress code as a whole were drawn from the Carpathian

Basin and the Balkans. From the south, the Alps (and northern Italy beyond) were a model for halberds and dress pins, particularly the most popular form 'rudder-head' and 'roll-head' pins (Ruderkopf- and Rollenkopfnadeln). Other striking similarities in jewellery, dress fittings, burial customs, and pottery may be due to shared late Bell Beaker heritage. (Bertemes and Heyd 2015).

The Danube corridor became a hotspot for EBA Europe, connecting cultural norms and major copper ores, like those on the eastern Alps. Their settlements consisted of a few individual farmsteads featuring longhouses close to graveyards, which have an origin in Bell Beaker longhouses (like those known from Hungary, eastern France and the Netherlands). The basic village structure shows around five houses ca. 20–25 m long and 6-10 m wide, uniformly orientated (north–south), distributed over 2 ha, with postholes for their timber uprights. Later, the typical late European EBA fortified hilltop settlements and hoards with large quantities of metal appear, especially in the east (Bertemes and Heyd 2015).

Their burial rites and funeral equipments are rooted in the East Bell Beaker group—unlike e.g. the Adlerberg or Rhône groups in the west, which are based on a western European Bell Beaker substrate—and their pottery distinguished the Danubian EBA complex especially from Únětice, Nagyrév, and Polada. Unlike Únětice, who deliberately broke with gender distinction, they preserved the specific and strict bipolar gender position of the deceased along a north–south axis, which suggests that fundamental aspects of religious beliefs and concepts of the afterlife remained the same as in Bell Beakers. On the other hand, there is a clear discontinuity with Bell Beaker cemeteries in Danubian EBA, a trait shared with Únětice and Mierzanowice/Nitra (Bertemes and Heyd 2015).

Burial sites in Straubing and Unterwölbling, for example, had 30 to 70 graves, and lay close to settlements. Gender differentiation was strictly observed, and the way graves are fitted out shows a highly standardised composition. Women were orientated south–north, crouched, on their right side and facing east; men were orientated north–south, crouched, on their left side and also facing east. Bodies were placed in wooden coffins from hollowed-out tree trunks, linked with stones or stone slabs. Usual assemblages are richer furnishings than in neighbouring EBA cultures, with numerous objects made of sheet bronze (Jiráň, Salaš, and Krenn-Leeb 2013).

To the east, gender distinction is found up to the Wieselburg culture (also Gáta or Mosony culture), where bodies are buried in the crouched position, with women lying orientated south–west – north–east, on their right side and facing east, whereas men lie on their left side facing west. Graves are lined with stones, burials were made in tree–trunk coffins, and social status was accentuated by the provision of weapons, prestigious metal, glass, and amber objects, as well as by the number of pots (Jiráň, Salaš, and Krenn-Leeb 2013).

The most typical shape of Unterwölbling is the long-necked jug-like cups, with frequent decorative moulding running through them. Wieselburg pottery shows more moulding and incised decoration, and typical handles in the shape of hourglasses on jugs and amphorae. The Drassburg group, which coexists with Wieselburg and partially follows it at the end of the EBA, represents the north-west part of the Pannonian complex of Encrusted Pottery (Jiráň, Salaš, and Krenn-Leeb 2013).

The Pitvaros (Beba Veche/Óbéba–Pitvaros) culture was probably introduced by migrants from the south (northern Balkans), and spread to the lower Tisza Basin. It introduced the rite of gender-differentiated crouched inhumation with north–south orientation and rich goods to the area. Personal ornaments include objects made of copper or bronze, gold, tin, or faience (Marková and Ilon 2013).

The Maros (Periam/Perjámos-Szőreg, also Pécska, Mokrin or Maros/Mureş/Moriš) culture lived mostly on the same territory as the Pitvaros culture but it gave rise to its own settlements, suggesting a wave of migrants. Settlements were tells, with post-built houses with floor and hearth arranged in narrow lanes. Material culture evidences long-distance contacts, and burial rite consists of inhumations – with occasional cremation also found –, with bodies buried in crouched or sitting position (Marková and Ilon 2013). Social stratification with gender differences are especially marked in a late more standardised phase, with females on their right side and head towards the south, males on the left side with their head towards the north, both facing east towards the rising sun. Rich grave goods show women's dress with bronze or copper head ornaments, bone and faience beads, plain torcs and spiral bracelets. Men show weapons like daggers and axes as status symbols, while pottery is common in all graves (Teržan and Karavanić 2013).

The Danubian continuity with Bell Beaker traditions extended to the social and economic system, based on extended families with a common practice of exogamy, patrilineality, and first-born privileges to forge alliances with peer neighbours and inherit possessions and claims. Only gradually becomes the society more vertically stratified and horizontally complex in its transition to the European Bronze Age, while mixed farming system continues, land use intensifies, and settlements and cemeteries become bigger. Graveyards were probably shared by many farmsteads or villages, or both (Bertemes and Heyd 2015).

Most late Bell Beaker symbols of prestige, social status and power remain in place, and are still found in graves: copper tanged daggers (replaced with the triangular riveted dagger through technical innovations), conical V-perforated bone/antler buttons (shifting through technique and fashion to embossed copper tutuli), as well as arc-shaped bone or tusk pendants, copper awls, and metallic Noppenringe; sets of flint arrowheads and stone wrist-guards begin to lose their symbolic importance. The typical weaponry consisted eventually, in its most elaborated form, of the panoply of riveted triangular daggers, flanged axes, and halberds (Bertemes and Heyd 2015).

They formed exchange networks with other EBA cultures of the end of the 3rd millennium: the Rhône and Adlerberg groups (based on western Bell Beaker traditions) in the southwest to northwest; the Únětice Culture with its regional groups in the north and north-east; the early Mierzanowice and Veselé/Nitra groups (based on Epi-Corded Ware groups) in the northeast; the Nagyrév group in the east; and the Polada group in the south across the Alps. Other Epi-Corded Ware groups, such as Pot-Beaker and Riesenbecher groups; and Epi-Bell Beaker groups, such as the Veluwe group, were found farther to the north (Bertemes and Heyd 2015).

Unlike cultures north of the Danube, which underwent more technological and social innovations, Bertemes and Heyd (2015) believe that eastern Bell Beaker groups might have established a well performing economical and religious network along the Danube before 2200 BC, which had thus no incentive for radical changes.

VIII.6.2. Únětice period (EBA)

The Moravian Bell Beaker, with 1500 to 2000 sites, represents the greatest province of the East Bell Beaker group. Supraregional contacts of the group include the Moravian Corded Ware (a regional group of the Central European Corded Ware) and Makó/Kosihý–Čaka, as well as Somogyvár–Vinkovci and Early Nagyrév. Developments in common with the Moravian Corded Ware group pointed in the past to their parallel development into Proto-Únětice, but more recent assessments show that it was more precisely the CWC-related forerunners of the Makó/Kosihý–Čaka culture those who developed similar ewer shapes in parallel with Moravian Bell Beakers (Bertemes and Heyd 2002).

Similar to the Danubian Early Bronze Age, Proto-Únětice/Old Únětice is born ca. 2300/2200 BC as an intermediate phase between Bell Beaker and Early Bronze Age in the Moravian and Silesian region, and is the result of mainly early Bell Beaker culture plus few Corded Ware traditions plus innovations from the Carpathian basin. Distinct from Danubian EBA, however, is the relevance of Makó/Kosihý–Čaka (related to previous Corded Ware groups) in its foundation, which seems parallelled by the genesis of the Early Nagyrév culture, also influenced by early Bell Beaker in its origin (Bertemes and Heyd 2002).

Proto-Únětice shows developments in common with the South Danube region (Oggau-Wipfing horizon), and maintains close contacts with south German and Csepel late Bell Beakers, although it emerges as culturally disconnected from neighbouring Bell Beaker groups, a kind of cultural melting pot connecting different cultures and periods. This culture largely lacks metal, and a sudden expansion of Proto-Únětice is seen to the north-west into Bohemia and central Germany, and to the north in Silesia. Early pottery shows a limited range of shapes, including jugs, pots with horizontal handles, little amphorae, and bows of various shapes. These types evolve without much change into later stages of Únětice pottery, which tend to have perfectly smooth surfaces, often with a 'metallic' sheen, a preference shared with the Věteřov culture (Jiráň, Salaš, and Krenn-Leeb 2013).

The main difference between north and south of the Danube in this period (ca. 2200 BC) is reflected in the burial customs, with northern groups showing innovations probably due to the incorporation of cultural traits from central European cultures. Funerary rites of the Lower Austrian Únětice group are more likely to bury connected people together—including sororities, 'brothers-in-arms', and especially women and children—which can be interpreted as having a more personal quality, emphasising family relationships and emotive connections. On the other hand, individuals south of the Danube are almost always awarded individual graves, and categorisation as man or woman is central to the ritual, with personal relations fading into the background (Rebay-Salisbury 2019), which is reminiscent of the Yamna and classical Bell Beaker ritual.

The later stage of the Early Bronze Age is marked by the oldest classical Únětice bronze objects appearing in northern and central Germany and in the Polish Plains, still with Carpathian traits. The classical phase of Únětice is characterised by its distinctive pottery forms, and by the increase in grave goods made of copper alloy unusual for its higher tin content. Metal objects showing the specific Únětice style begin to be manufactured using local ore deposits from the Harz Mountains of the eastern Alps, to the south-west of the culture's region (Czebreszuk 2013).

A new core develops ca. 2000 BC, in the northern periphery of the classical Úněticean Cultural Circle (Northern European Lowlands, between the Elbe and the Oder rivers), which controls important trade routes and becomes the dominant cultural factor in a broadly understood central Europe, exerting a strong influence on the development of cultural groups of southern England (Wessex), southern Scandinavia (beginnings of the Nordic Circle), and in Iberia (including El Argar). Emulations or imports of Únětice daggers are found as far as Greece and Anatolia (Bertemes and Heyd 2002).

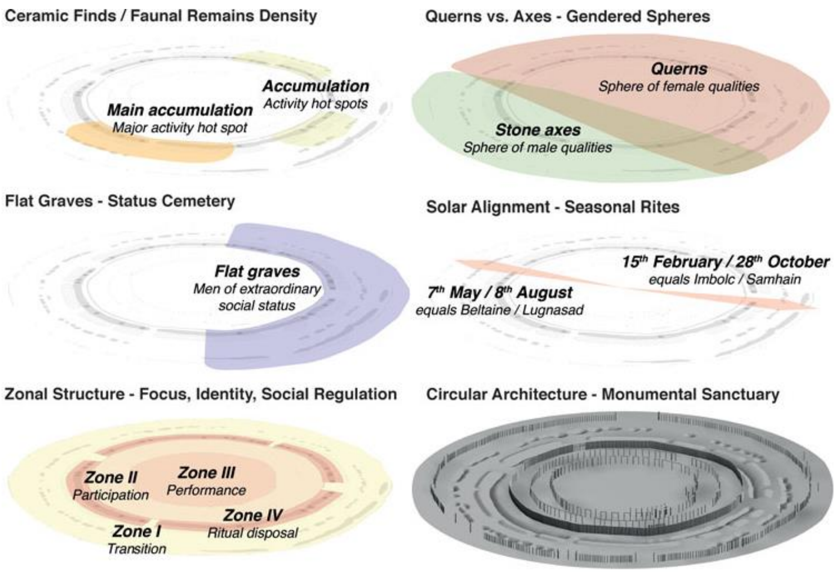

Figure 59. Layers of meaning of the Pömmelte enclosure as deduced from the archaeological record (design by André Spatzier). Image from Spatzier and Bertemes (2018).

The smooth transition seen from Bell Beakers (ca. 2300-2150) into Únětice (ca. 2200-2150 BC on) in the Pömmelte enclosure (Figure 59) is broken probably with this power shift (ca. 2050 BC), with the deconstruction of the enclosure and the definitive absence of Bell Beaker finds, although stone axes and 'formal' graves indicate the continuation of the spatial concepts until the 20^{th}–19^{th} c. BC. New features are added to it, with sporadic re-use until is abandonment probably ca. 1600-1500 BC. The overall structure of the enclosure, divided into three distinct layers divided by a semi-translucent post border (zone I) and a wooden wall (zones II-III) facilitated the experience of entering and leaving the monument as reflecting the three stages of ‘rites of passage’ (separation, liminality, and incorporation). This sanctuary reflected thus the *Weltanschauung* of the people who built and used it (Spatzier and Bertemes 2018).

This Northern Únětice group is characterised by the unequal distribution of the right to burial, granted mainly to members of the upper class, which suggests a greater social stratification in the north than in the south. They also show a daily use of amber objects, including large quantities of stunning disc-shaped artefacts and kurgans with many imported objects, gold, complex wood and stone constructions. To the south, amber products are represented by beads as part of composite necklaces, frequently with coiled copper–wire ornaments (Czebreszuk 2013).

The classical Únětice standard shows cemeteries on level ground, expanding the previous early EBA custom of Moravia, northern Bohemia and adjacent parts of Austria, contrasting with neighbouring groups which used preferently mounds, even though the arrangement of the pit suggests an effort to create an insulated space for the dead, with sides (and sometimes floor) walled with stones, and the use of wooden coffins. Chambers of tombs were hollow, covered with beams or stone slabs (Jiráň, Salaš, and Krenn-Leeb 2013).

Single burials are more common, although two, three or more bodies could be buried, either simultaneously or subsequently. The body was buried in clothing, placed lying on its right side in a crouched position, or supine and with legs turned sideways, orientated south–north irrespective of the gender. Grave assemblages included mainly pottery, but also personal ornaments, and sometimes weapons (daggers, axes, and axe–hammers); certain individuals showed prestige artefacts (Jiráň, Salaš, and Krenn-Leeb 2013).

Burial structures and grave goods reflect a strictly hierarchical society from as early as 2000 BC. At the top of the hierarchy are the ‘princely graves’ (such as those of Leubingen and Helmsdorf, or comparable tumuli at Łęki Małe), which feature bodies in a supine position, in contrast to the usual crouched burials. Standard assemblages include mainly gold jewellery (hair-rings, pins, a bracelet), but also, especially in later burials, some bronze or golden weapons (daggers, halberds as a pan-European weapon, axes). Social stratification explains the difference between princely graves and the generally modestly furnished flat graves common in Únětice, while their concentration around copper deposits and potential trade routes point to the origin of their power (Jockenhövel 2013).

A particularly high-level burial was found at Bornhöck, with a mound ca. 20 m in height and 90 m in diameter (ca. 65 m in the EBA, enlarged in later periods), with a 18m-diameter stone core (similar to princely graves) of boulders surrounding a tent-like chamber constructed of oak boards. Hoards in the surrounding region yielded 150 kg of bronze, and more than 1 kg of gold, dating to ca. 1950–1650 BC, which imply that this was a centre of power over several centuries, probably until ca. 1600–1550 BC. Its longevity and size suggest that this ruling class was at the top of the social pyramid, representing a kind of king among the elite. The lack of fortifications in the region further suggests the presence of a well-organised, professional army that could keep peace both internally and externally (Meller 2017).

Hoarded weapons near princely graves probably represented actual ‘soldiers’ and ‘military units’ garrisoned in what has been called a “men’s house”. The death of the prince would have then caused the groups of soldiers to deposit the weapons as a sacrifice in front of their ritual building. The number of each type of weapon may reflect systems of military order, whereby 30 axes or soldiers would have been led by a halberd-bearer; 60 soldiers would have been under the command of a dagger-bearer; and the largest combat unit of 120 soldiers would have been led by a double axe-bearer (Meller 2017).

Above-ground houses with upright posts predominate in settlements. The most striking feature of houses is their length, commonly around 20 m in length and 7 m in width, with the longest one found in Březno, Bohemia, measuring 32 m (Pleinerová 1992). Finds of mass deposits of human remains in pits is common at the edge of settlements, where manufacturing and storage areas were located. This custom continues into the Tumulus culture and the Urnfield period (Jockenhövel 2013).

The Únětice culture has been cited as a pan-European cultural phenomenon, whose influence covered large areas due to intensive exchange (Pokutta 2013), with Únětice pottery and bronze artefacts found from Ireland to Scandinavia, the Italian Peninsula, and the Balkans. It was only after 2000 BC that large-scale mining operations and production which required specialised metallurgical and organisational know-how began in a few centres, and they reached distant regions as far as Northern Scandinavia. And only from 1750/1700 BC began the actual pan-European tradition of metal work until its consolidation ca. 1600 BC, with different regions in Europe producing their own products, most specially the cultures of the Carpathian basin (Kristiansen and Larsson 2005).

The contacts of Únětice with Carpathian territories are constant, e.g. in the Únětice–Nitra and Únětice–Hatva horizons, where settlement microregions and relationships are difficult to assess. Únětice elites controlled trade routes from the Baltic Sea shores to Aegean Sea artisans. Úněticean daggers are found all over Europe and in Anatolia, and the nature of weapons and metal work suggest a chronic state of warfare and the emergence of a warrior class until its demise. The downfall of the structures of the Únětice culture began probably prior to 1700 BC, and is associated with the culture-making role being taken over in Central Europe by the Füzesabony culture (of rather Aegean than Central European character); with the conditions allowing the emergence of the Tumulus circle from the Danubian region; and with the expansion of the Trzciniec culture into occupied Mierzanowice areas that gave way to its classic phase (Bertemes and Heyd 2002).

Before the eventual collapse of the Únětice culture (ca. 1600 BC), amber was contained within its territory and that of its trading partners in the Alpine region. After its internal system broke down, first amber disappeared from Bohemia, and appeared in the Mad'arovce–Věteřov cultural complex of the Carpathian Basin instead; at the same time, amber suddenly began to arrive in distant regions, including western Germany, Italy, or Mycenaean Greece. The development of the Nordic Bronze Age—largely reliant on unlimited supply of copper from the south via Central Europe—also occurred after the collapse of Únětice (Meller 2017).

At the end of the Únětice culture, during the transition to the Middle Bronze Age, fortifications or small hill forts emerge, showing strong connections to the Middle Danube area. This connection is also seen in the increase in the range of metalwork, with new artefacts such as knives, sickles, razors, tweezers, as well as ornamentation and production techniques (clay-core casting, recasting). The shape of these artefacts is clearly linked to the Middle Danube and the Carpathian basin (Jiráň, Salaš, and Krenn-Leeb 2013).

The Nebra 'Sky Disc' (Figure 60) is traditionally associated with Únětice, given the use that had been given to it—and the many reworked objects—for generations before being interred, with grave materials found around the disc dated ca. 1600–1560 BC. Its location near Sögel–Wohlde materials suggest the (at least partial) replacement of the particular religious worldview represented by the disc with the arrival of Tumulus and Sögel–Wohlde cultures to the region. It depicts astral symbols (sun, moon, stars), a boat (?) and two 'horizon arcs, being the oldest concrete representation of the heavens, and a kind of calendar – also presumed for later gold 'hats' during the MBA (Jockenhövel 2013).

Figure 60. The Nebra Ski disk, from Mittelberg. Image from Wikipedia.

VIII.6.3. Tumulus period (MBA)

At the end of the Únětice period, during the transition to the Middle Bronze Age, fortifications or small hill forts emerge, showing strong connections to the Middle Danube area. This connection is also seen in the increase in the range of metalwork, with new artefacts such as knives, sickles, razors, tweezers, as well as ornamentation and production techniques (clay-core casting, recasting). The shape of these artefacts is clearly linked to the Middle Danube and the Carpathian basin (Jiráň, Salaš, and Krenn-Leeb 2013).

Amber beads, characteristic of southern Únětice groups, become the main amber product in the Middle Bronze Age until the Hallstatt period, when they become especially widespread, further supporting the cultural shift from a northern lowland to a southern, Middle Danube centre of influence. Hoards of bronze objects become common throughout the Bronze Age probably due to the pan-European influence of the Tumulus culture (Czebreszuk 2013).

The appearance of the Tumulus culture (ca. 1600 BC) marks the beginning of the MBA in central Europe. The new burial rite features inhumations beneath large roundish-oval mounds, about 1–2 m high, most often made of heaped rocks. Kurgans were grouped together in cemeteries that range in size from fairly small to quite large, with up to dozens of burials. Rich graves accompany burial mounds, which are built of soil, sand, turf, stone, or a combination of these materials, and are often bound by a stone setting, a ring ditch, or rings of wooden posts in the lower Rhine and the Low Lands. Grave goods reveal only slight social ranking, and a largely egalitarian or homogenous society can be inferred (Jockenhövel 2013).

Single burials predominate initially, with each mound belonging to a small family group. The body is usually buried prone and orientated north–south or east–west, in graves often protected by stones or burial chambers with wooden fittings. Assemblages included weapons (dagger, sword) and ornaments (tools, gold spirals, less often razors, pins) for men, and rich dress decoration, ornaments, necklaces, and pairs of pins for women, with amber ornaments (spacer plates) being very popular, more than in Nordic Bronze Age graves. The central burial is eventually joined by additional burials, usually on higher levels in the mound, sometimes with flat graves between the mounds. Cremations begin and increase during the MBA (Jockenhövel 2013).

The Tumulus tradition is presented as a warrior society which expanded with new chiefdoms eastward into the Carpathian Basin (up to the river Tisza), and northward into Polish and central European and Únětice territories, with dispersed settlements centred on fortified structures. Innovations spread quickly during this time, including weapons—swords (from influences of the Danube region), spears (socketed spearheads), and small axes (flanged axes) —and tools—two-edged razors, tweezers, knives, and sickles. Horses become particularly significant as a transport animal, for wagons and battle chariots, evidenced by bridle or cheek-pieces made from antler and bone (Jockenhövel 2013). Regional groups are distinguished based on metal fittings worn on their clothing, with a basic difference seen e.g. between groups south of the Mittelgebirge and the Lüneburg groups to the north (with features of the Nordic Bronze Age), and the western groups in the lower Rhine, closer to the Low Lands.

Grave goods reveal only slight social ranking, and a largely egalitarian or homogenous society can be inferred. In the subsequent period of crisis, it developed into bands of raiders and mercenaries, and took control of peasant societies, as happened in several regions during the Urnfield and La Tène periods, and similar to the society of mercenaries and warring city states in the Celtic period. This warring state is coupled with exogamous and endogamous strategies, and variable distances of marriage exchanges to maintain alliances, the so-called *fremde Frauen* phenomenon (Kristiansen 2000).

Settlements consisted probably of a few houses or just a single farmstead, with hill forts seen at the beginning and end of the period. The economy probably relied on regional transhumance, as well as mining of local copper (unproven) and salt production. This is therefore a time of settlement expansion into fertile lowlands and productive loess soils—characteristic of an agropastoralist society—together with defensive higher areas and hill sites. This expansion coincides with the wide settlement of the Alps and the beginning of a system similar to mountain pasture economy, as well as Alpine copper mining in the Inn Valley in Austria (Jockenhövel 2013).

Pottery is represented by small amphorae, with or without a foot, footed bowls, and small jugs. The Tumulus tradition shows preference for ornament, whether incised or plastic, in contrast to the smooth pottery typical of the Únětice period. The main ornament types are triangles, ladder-like bands, fig tree-like ornaments, and concentric or multiple circles. In the later period of the culture, the preference was again smooth surfaces and knobs (outlined with circular or horseshoe-shaped grooves), coexisting with various kinds of plastic protrusions (Jiráň, Salaš, and Krenn-Leeb 2013).

During the MBA, the north Alpine forelands show a tradition related to the Tumulus culture, visible in grave assemblages displaying pins with perforated shaft and spiral sheet ornaments. This influence on the region persists into the LBA, with a noticeable increase of bronze objects in hoards and graves, found also in northern Italy and the Ticino. The strongest affinities in south Alpine valleys is found at the end of the LBA, with the Canegrate group of the Po plain, and the subsequent Protogolasecca facies, with typical carinated, grooved, and smoothed black ware and the first bow fibulae (della Casa 2013).

In the south-east, the Maďarovce–Věteřov–Böheimkirchen cultural complex (Slovakia, Moravia, and Austria) shows an unbroken evolution from the Únětice culture. It features open settlements on level ground, frequent fortified settlements, and sporadic tells. A new range of ornament forms appears along with a new bronze implement (the sickle) and weapons (socketed spearheads and short swords). Casting technology with tin–bronze shows that the ores used were from the eastern Alps. Inhumation is the main funerary rite, with tumuli and cremation burials seen at the end. Towards the end of the period, the culture participated in long-distance exchange networks, with many findings belonging to North Pannonian and Ottomány cultures, evidence of its nature as a north–south intermediary in amber trade (from Lesser Poland to the Iron Gates), and an east–west trade network evidenced by *Brotlaibidole* (‘loaf-of-bread’ idols). The culture disappeared at the time of increasing exchange and mobility, replaced by the Urnfield culture (Marková and Ilon 2013).

The European world ca. 1450–1100 BC has been compared to the Viking Age, with population pressure and lack of land for young sons with no inheritance leading to war-bands that engage in seasonal raiding, trading, and piracy. This was followed up by more massive colonising ventures and migrations, and a political economy based on a chiefdom form of society where free farmers were the dominant class, with commoners and slaves as dependent groups (Heyd 2007; Kristiansen 2016).

At the end of this period, ca. 1200 BC, a great battle seems to have happened in the Tollense valley in north-eastern Germany, at the confluence between Nordic, Tumulus, and Lusatian cultures (see *§viii.8. Balto-Slavs*). It is estimated that more than 4,000 warriors took part, based on the hundred and thirty bodies and five horses found in Tollense riverbank, and the likely hundreds more which remain unexcavated, accounting for one in five participants killed and left on the battlefield. Body armour, shields, helmet, and corselet used may have needed training and specialised groups of warriors, with their organisation being a display of military force (Jantzen et al. 2017).

According to Kristiansen (Curry 2016), this battle is therefore unlike any other known conflict of this period north of the Alps – circumscribed to raids by small groups of young men –, and may have heralded a radical change in the north, from individual farmsteads and a low population density to heavily fortified settlements. This period is coincident with the time of the mythical battle of Troy, with the collapse of the Mycenaean civilisation, and with the raids of Sea People in Egypt and the collapse of the Hittites.

VIII.6.4. Urnfield

The Urnfield culture (ca. 1300–750 BC) marks the beginning of the LBA, and shows the increasing acceptance of cremation, already present during the MBA, which is initially variable in its ritual burial. The gradual disappearance of burial mounds and inhumation represents probably a change in religious beliefs, based on social status and identity, burial rites, and a new range of symbols (water birds). The dead were burnt on a pyre, and remains of their bones and ashes were picked out, scattered in graves, or interred in clay pots (Jockenhövel 2013).

The earliest hill forts lie in the south-eastern Urnfield group. The Piliny culture represents the earliest Urnfield culture in central Europe, if we ignore earlier cremation burials from the Vatya and Hatvan cultures. The Piliny tradition survived the expansion of the Tumulus culture as a continuation into the EBA of the Ottomány and Hatvan cultures in the Pannonian Basin. There are open-land and high-altitude settlements surrounded by ditches and ramparts, with large settlement agglomerations forming in both upland and lowland sites, and serving apparently as administrative and economic centres. Notable are its swords of Riegsee-Ragály type with elaborated ornamented hilts and pommels, also appearing to the north in Lusatian areas (Marková and Ilon 2013).

The ritual becomes homogenised ca. 1100 BC (Hallstatt A2) with the urn burial in southern Germany. The urn is placed in the grave together with other clay vessels (Figure 61). Most graves are of adult men, described as chieftains, warrior elites equipped with swords (both flange-hilted and solid-hilted), spears, and armour (helmet, breastplate, greave, shield). The wealthiest ones contain larger weapons (swords and spearheads), bronze drinking vessels, wagon parts, or high-quality bronze and gold ornaments. Female graves show rich ornaments and dress fittings, and are generally less richly furnished. The size of the graves and urns reflect the age and sex differences. Hundreds of hoards show the continuity of this tradition from the Tumulus culture to the Urnfield culture (Jockenhövel 2013).

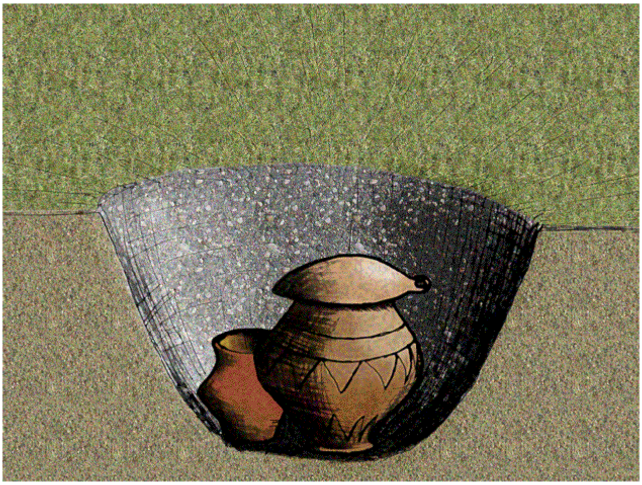

Figure 61. Typical burial of cremation urn, by José Manuel Benito Álvarez.

Urns contain not just burnt human bones, but also burnt animal bones. While personal ornaments passed through the fire of the pyre, tools—knives and razors—and other bronze goods were added to the bodily remains after cremation. The first metal vessels and armour (helmets, corslets, greaves) date from this period, suggesting a peak in the production and use of bronze objects. The sun-bird-boat (*Sonnenvogelbark*) identified on sword grips, greaves, diadems, belt-plates, and bronze vessels, is a prevalent religious motif that expands into the Nordic Bronze Age (Jiráň, Salaš, and Krenn-Leeb 2013).

The emergence of the Urnfield culture is thus associated with the rise of a new warrior elite, and the formation of new farming settlements and their urnfields. In some areas there is continuity from Tumulus to Urnfield culture, with narrowing and concentration of settlements on the fertile soils and along the river valleys, with proof of a very dense settlement and wide-ranging migrations. Above-ground post-built houses remain common during the MBA and LBA, orientated north–south, and in this period they are usually smaller, although sizes are variable (Jockenhövel 2013).

Settlements are larger, with villages of ca. 10–20 ha, but not very intensively occupied. Hearths appear outside the houses, probably shared by several families. Most settlements show no protection, although some evidence of fences suggests they were used to divide settlements in enclosed compounds. In the FBA, typical settlements took the form of independent farmsteads (Jiráň, Salaš, and Krenn-Leeb 2013).

The LBA shows therefore a great degree of standardisation following the cultural divisions of the MBA, with many metal forms (weapons and tools) distributed across large areas. The warrior now has a spear for throwing or thrusting at his side, with spear shafts made of ash, and arrows with specially shaped heads used as projectiles or for hunting. The new swords with leaf-shaped blades are used to cut or slash, while earlier blades were used as thrusting weapons (Jockenhövel 2013).

Pottery include biconical vessels, amphorae, storage vessels, mugs, jugs, bowls, cups, and beakers. Regional variations in shapes, typology and ornamentation of pottery allow for the division into local groups within the largely homogeneous Urnfield tradition (Jockenhövel 2013):

- Alpine groups to the south: north-eastern Bavarian, Lower Main–Swabian, north-western Transdanubian.
- Central or Bohemian groups: from west to east Rhenish-Swiss, Unstrut, Milavce, Knovíz, and Suciu de Sus.
- Lower Rhine groups to the west in close contact with the Low Countries: Lower Hessian, North Netherlands–Westphalian, North-West group in the Rhine Delta.
- Middle Danube groups to the east: Velatice–Baierdorf, Čaka, Gáva, Piliny, Kyjatice, and Makó cultures.
- The closely related Lusatian fringe group to the north-east is also distinguished by other features (see *§VIII.8. Eastern EEBA province*).

Typical of the LBA is thus the reappearance of heavily fortified settlements (which were common in the EBA in the Middle Danube culture), those in the east belonging mostly to the early and middle phase of the Urnfield period, and those in the west to the late phase, which may suggest the regions of increased external conflict during each period. Massive ramparts were constructed using a variety of techniques, depending on the terrain and the specific demands of the site, and were frequently accompanied by deep ditches. Fortified settlements were often divided into subareas according to their economic or social purpose, indicating a variety of functions and occasionally depicting a specialisation of the site, from power and interregional trade centres to ritual sites (Jiráň, Salaš, and Krenn-Leeb 2013).

In the Alpine region, settlements in exposed locations are often constructed close to sites of mineral extraction. The overall settlement structure reflects that they were tied to a system that provided for processing and transportation of raw materials, and for interregional exchange. At the end of the LBA, a particular form of settlement begins in southern Bavaria, with a single farmstead inside a rectangular system of palisades and ditches, the forerunners of the leader's compound (*Herrenhof*), a popular Iron Age settlement form (Jockenhövel 2013).

At the end of the period, Pre-Scythian (Cimmerian) influences are seen in the east up to the Hungarian steppe belt, displacing Urnfield and Lusatian groups to the west and north. Changes are seen in inhumation graves, with remains of horse harness in bronze and iron, bone plates with typical ornamentation, and cattle and sheep bones. Increasing influence is felt in metal production, warfare, horse harness, animal breeding, religion, and long-distance trade. West of the Tisza, hoards of Románd type show this influence, before being eventually replaced by the eastern provinces of the Hallstatt culture (Marková and Ilon 2013).

VIII.6.5. Hallstatt – La Tène

From the early Urnfield culture expanded the Hallstatt culture (ca. 1200–450 BC). During the first period (ca. 1200–800 BC), there are several regional cultures under the Hallstatt sphere of influence, with differences appearing in funerary rite and settlement. Cremation is the dominant rite, with ashes and calcined bone, small vessels, and personal items placed into large biconical urns before burial in (occasionally vast) Urnfield cemeteries. Settlements included post-built structures within stockade and fortified compounds, with fortifications and wooden palisades increasingly used (Malin-Boyce 2004).

The true Hallstatt Iron Age (ca. 800–450 BC) is characterised as a period of extraordinary cultural flourishing everywhere in continental Celtic Europe, with elaborate burials including rich assemblages, often called chiefly or princely graves, and also hill fort settlements. Tombs and enclosed fortified hilltops signal the transformation of social organisation to a political economy that controlled the movement of luxury goods. Distribution of goods such as Massiliot amphorae that contained wine shows that western and eastern Hallstatt were included in the Mediterranean trading and gift exchange. The site of Halllstatt is positioned between the broadly defined eastern and western Hallstatt traditions, which shows influences from different neighbouring regions and their distribution networks, such as salt mining, Baltic amber, African ivory, Slovenian glass, Hungarian battle–axes, Venetian knives and brooches, and Etruscan drinking paraphernalia (Malin-Boyce 2004).

The Hallstatt culture represents a significant population growth continuing a Late Bronze Age trend, with networks of microregions or stable rural communities (composed of multiple villages) forming in many regions, particulary in the east. It continues in part the previous amber route from the Gdańsk area, although from the Moravian Gate it extended now to the eastern Alps and the Caput Adria, finishing in central Italy, which is supported by the synchronic finds of house–urns and face–urns in the Gdańsk area and in Italy (Czebreszuk 2013). European wagon graves – with a direct origin probably in the Carpathian basin – peak during the Hallstatt and La Tène periods (Boroffka 2013).

The later expansion of La Tène culture (ca. 480–15 BC) from certain core Hallstatt regions—valleys of Marne and Moselle and neighbouring Rhineland in the west, and a Moravian zone in the east—has been linked to the spread of Common Celtic languages, as described in classical sources. The transformation of late Hallstatt to La Tène is associated with changes in burial rite, from large tumuli to flat inhumation graves, although aspects of the tumulus burial tradition continued in parts of the Alpine and surrounding regions. This period is coincident with the Golasecca material culture in northern Italy, and with the appearance of the ‘early style’, of Etruscan influences, with the compass becoming a design tool for bronze vessels, ornamental metal disks, and even ceramic vessels (Malin-Boyce 2004).

Most elevated and fortified settlements were abandoned, and the apparent centres of power collapsed, at the same time as rich burials continued, showing a shift of power northward to the Hunsrück-Eifel region along the Moselle River. Settlements and burials become thus smaller than in the previous period, suggesting a more dispersed population and decentralised social and political power. The migration or expansion of Celtic peoples is usually associated with the depopulation ca. 400 BC of Marne, Champagne, Bohemia, and possibly Bavaria, signalled by a decrease in warrior graves and adult male burials in general, with less weapons in the remaining graves, and a different ceramic burial assemblage. During this period, less labour-intensive internment begins as the dominant rite, flat inhumation without grave markers (Malin-Boyce 2004).

Figure 62. Reconstruction of a late La Tène period (2nd/1st century BC) settlement in Havranok, Slovakia. Photo by Marek Novotnak.

Middle La Tène (ca. 280–125 BC) sees the appearance of oppida, proto-urban settlements signalling a consolidation of power and reorganisation of the social and economic structure of Celtic societies. Migration and expansion, disruption and settlement are all probably part of this period, with inhumation burials disappearing as cremation fully replacing it. Possibly, the impact of agglomerated settlements caused this shift to the disposal of the dead, which affected also the social and political elite. The Graeco-Italic ‘vegetal style’ (appearing ca. 320 BC), including stylised palmettes and lotus patterns becomes the main motif in bowls, helmets and scabbards. Late La Tène (ca. 125–15 BC) is linked to the rise of the Roman colonial expansion and its impact on neighbouring population. This period is characterised by the abandonment of the oppida in the west (ca. 80–40 BC), and later – coinciding with the Germanic expansions – in east-central Europe (Figure 62).

viii.6. Celts

Clear patterns of patrilocality and female exogamy have been found in the Upper Danube, apart from a continuing kinship relation in the transition of the Chalcolithic to the Bronze Age. There is evidence of continuing traditions from the Bell Beaker cultures to Early Bronze Age cultures in the region, with female mobility as a force for regional and supraregional communication and exchange (Knipper et al. 2017).

There is a variable contribution of Steppe ancestry in early Bell Beaker samples (ca. 2500–2000 BC), consistent with a period of constant migrations: Bavaria shows a decrease in Steppe ancestry (ca. 44%), including samples from the Lech Valley (ca. 52%), compared to previous Corded Ware groups (ca 65%) (Mittnik, Massy, et al. 2018); similarly, central European samples near the Rhine (ca. 51%) and from Esperstedt in Saxony-Anhalt (ca. 48%) show a decrease compared to previous samples from the area (ca. 71%), whereas in Bohemia Bell Beakers represent a slight increase (ca. 45%) over the previous late Corded Ware groups (ca. 40%), possibly due to the closeness of this territory with the East Bell Beaker homeland, and to the previous resurgence of Neolithic ancestry in the area (Olalde et al. 2018).

Almost 100% Y-DNA haplogroups among the approximately fifty reported (of more than a hundred samples from central Europe) belong to Yamna R1b1a1b1-L23 lineages, safe for one G2a2a1a2a1a-L166 subclade from Augsburg (ca. 2350 BC), representing an almost full replacement of male lines among buried individuals, although the later resurgence of Neolithic lineages in the area suggests the survival of groups absent from the archaeological record. Twenty-eight samples are of R1b1a1b1a1a2b-U152 lineages, among them R1b1a1b1a1a2b1-L2 subclade is reported for twenty individuals from Bohemia and six from Bavaria. Apart from these, there is a sample of hg.

R1b1a1b1a1a2-P312 (ZZ11+, DF27 equivalent) from Quedlinburg, and another possibly of hg. R1b1a1b1a1a1-U106[27] from Radovesice, supporting the initial variability of expanding groups before subsequent Y-chromosome bottlenecks.

Later samples from the Maros culture, from Szöreg (ca. 2100–1600 BC), show an ancestry in common with Carpathian Bell Beakers and cultures derived from an admixture with Yamna settlers. Interestingly, one sample clusters close to the available Early Celtic group formed by Celtiberians (likely of Urnfield origin) and Hallstatt samples, with the other two Maros samples appearing within the range of Hungarian EBA and later Roman samples, suggesting that the Danubian EBA represented at least part of the common population that spoke Italo-Celtic. One individual is of hg. G2a2a1a2a-Z6488, a haplogroup also found in a previous central European Bell Beaker, in the Vučedol Tell, and earlier in Ötzi the Iceman (Allentoft et al. 2015).

The pan-European nature of Únětice makes it the best candidate for a late community connecting a *continuum* of already separated dialects: Pre-Celtic near the lower Danube, Pre-Italic south of the Alps, Pre-Germanic to the north around Scandinavia, and Pre-Balto-Slavic to the east, probably represented in this period by either the North-Eastern EBA province or Mierzanowice-Nitra. Particularly strong may have been the connection between Pre-Germanic and Pre-Balto-Slavic with the shift to a northern centre of gravity represented by the Classical Únětice stage, and the emergence of Trzciniec potentially allowing for the spread of certain innovations and vocabulary (Kortlandt 2016), although an earlier link through the Northern European Plains with the spread of R1b1a1b1a1a1-U106 lineages may offer a better explanation for the shared

[27] Originally reported as R1b1a1b-M269, also assigned to this haplogroup with Yleaf in (Wang et al. 2019) supplementary materials. Further subclade R1b1a1a2a1a1c2b2-Z9 reported by Richard Rocca. Nevertheless, Alex Williamson reports this SNP call as potentially the result of deamination, and bad coverage cannot help distinguish even within the R1b1a1b1a1a2-P312 or R1b1a1b1a1a1-U106 trees.

substrate (see *§vii.1. Western and Eastern Uralians* and *§viii.7. Germanic peoples*).

Thought to have evolved from the admixture of Bell Beakers with late Corded Ware groups, Únětice shows similar Steppe ancestry in samples from Saxony-Anhalt (ca. 54%) and Bohemia (ca. 50%), consistent with a common origin in the south-east and some degree of demic diffusion to the north into early Bell Beaker groups and other indigenous groups derived from late Corded Ware. There is at least a partial resurge of hunter-gatherer ancestry in Únětice, although only a slightly lesser genetic affinity to Yamna than in Bell Beaker groups (Haak et al. 2015). A resurgence of the previous male lines is observed directly from one of the oldest individuals attributed to Proto-Únětice groups, one Łęki Małe (ca. 2300–2050 BC), of hg. R1a1a1-M417 (Allentoft et al. 2015); three from Czech Proto-Únětice or Old Únětice from Moravská Nová Ves (ca. 2300–1900 BC), two of hg. R1-M173, one of hg. G2a2a1a-PF3177; and among those of Únětice proper, of typical Neolithic I2-M438 and Yamna R1b1a1b1-L23 lineages:

Central European samples (ca. 2140–1940 BC) include one I2-M438 from Eulau, one I2a1b2-Y10705 and one I2a2-L596 from Esperstedt (Mathieson et al. 2015; Haak et al. 2015); samples from Bohemia (ca. 2200–1700 BC) include one I2a1a-P37.2, and one I2a2a-S6635, apart from three of hg. R1-M173, one of them of hg. R1b1a1b1a1a1-U106 (subclade R1b1a1b1a1a1c1a-S497, formed ca. 2200 BC, TMRCA ca. 2200 BC), and another of hg. R1b1a1b1a1a2-P312 (Olalde et al. 2018).

This resurgence of Neolithic I2-M438 and typical CWC R1a1a1-M417 haplogroups is probably related to the loss of internal coherence among Bell Beaker groups, suggested by the emergence of Proto-Únětice as an amalgam of Bell Beaker and local traditions. This interpretation is supported by similar resurgence events of local haplogroups, e.g. of I2-M438 in late Corded Ware groups from the central European areas, as the CWC grip weakened against the expansion of Yamna and Bell Beakers, and the centre of gravity shifted to the east (see *§vii.1. Western and Eastern Uralians*); as well as in late Bell Beaker groups from the Carpathian Basin (see *§viii.10. Carpathian Bell Beakers*).

On the periphery of the Únětice territory, a sample from Untermeitingen (ca. 1600 BC) shows hg. R1b1a1b1a1a-L151 (xR1b1a1b1a1a2-P312), before the shift of power that accompanied the emergence of the Tumulus culture from Upper Danube groups (Allentoft et al. 2015). Samples from the Lech Valley show continued patrilocality, in spite of the steady increase in Neolithic ancestry, with Steppe ancestry dropping from ca. 42% during the Bell Beaker period to ca. 38% during the EBA, and to ca. 26% during the MBA (Mittnik, Massy, et al. 2018).

Scarce samples from the Urnfield culture, all from a north-eastern territory in modern Saxony, near groups of the Lusatian culture, show a mixture of lineages, suggesting continuity with earlier Únětice groups of the area: a sample from Halberstadt (ca. 1085 BC) shows hg. R1a1a1b1a2-Z280 (Lipson et al. 2017), and among the reported haplogroups from the Lichtenstein cave (ca. 1000 BC) there are eight I2a1b2a-L38, one R1b-M343, and two possibly R1a1-M459[28] (Schilz 2006).

The Hallstatt culture has been traditionally associated with the Proto-Celtic expansion (Chadwick 1970). Two inhumated individuals of the Hallstatt culture from Lovosice, Bohemia (ca. 840–690 BC), hypothesised to correspond to immigrant nobility among cremated individuals, cluster among central European populations, but apparently with some Scythian-like contributions, proper of Balkan populations to the east (de Barros Damgaard, Marchi, et al. 2018). One of them is of hg. R1b1a1b1a1a2b-U152^{+}, while another sample from Mitterkirchen (ca. 700 BC) shows hg. G2a2b2a1b-L497 (Kiesslich et al. 2004), which supports the origin of Urnfield and especially Hallstatt among southern groups of central Europe.

[28] Haplogroup R reported respectively as Ri and Ri?

The Mainz research project of bio-archaeometric identification of mobility has not proven to date a mass migration of Celtic peoples in central Europe ca. 4th–3rd centuries BC, i.e. precisely in a period where textual evidence informs of large migratory movements (Scheeres 2014). La Tène material culture points to far-reaching interregional contacts and cultural transfers (Burmeister 2016), which may suggest that the sociocultural phenomenon associated with the expansion of La Tène culture (and Common Celtic-speaking peoples) is different from previous expansions, and closer to later ones, based on alliances and confederation-like multi-ethnic groups.

Nevertheless, the arrival of Celts in Iberia was likely marked by the increase in Steppe-related ancestry in all sampled Iron Age populations. The best fits for the source population vary between groups, but for Celtiberians from La Hoya in the modern Basque Country region (ca. 400–200 BC), showing the highest relative contribution of a ‘foreign’ source (ca. 35%), it is likely a central European source, and Pre-Iberian and Iberian samples from the north-east show up to 98% of CEU BBC-related ancestry (Olalde et al. 2019). In the British Isles, this expansion probably corresponds to an ‘eastern’ shift observed in the PCA of Roman Iron Age samples (ca. AD 250) from England (Martiniano et al. 2016) compared to previous Chalcolithic and Bronze Age ones (Olalde et al. 2018). At least in Iberia, this admixture is estimated to have occurred likely corresponding with the arrival of the Urnfield tradition.

This arrival of Celts was most likely related to the spread of, among others, late R1b1a1b1a1a2b-U152 and R1b1a1b1a1a2a-DF27 lineages—shared with central European or northern Italian populations—into Iron Age Britain and Iberia, possibly associated with the expansion of variants involved in lactase persistence and skin depigmentation, in spite of the described general genetic continuity between EBA and modern populations in Ireland and Great Britain (Cassidy 2018). The only reported haplogroup among three sampled Celtiberians is I2a1a1a-M26.

It is unclear which precise R1b1a1b1a1a2b-U152 subclades may correspond to the expansion of Celts and which ones to Roman peoples, without ancient DNA samples. In fact, I2a1b1a1a-M284 lineages concentrated in Great Britain (with mutational divergence suggesting its foundation ca. 300 BC) provide “some tentative evidence of ancient flow with eastern areas that could support the idea that the La Tène culture was accompanied by some migration” (McEvoy and Bradley 2010).

Similarly, the spread of R1b1a1b1a1a2a1b1a1-M167/SRY2627 (TMRCA ca. 1500 BC), with subclades Z202 and Z206 peaking in modern eastern Iberian populations (Solé-Morata et al. 2017), but also found widespread in France and southern Germany, may represent the expansion of Celtic peoples with these lineages, originally probably associated with the Urnfield or Mailhacien cultures in northern Iberia.

Later samples from north-east Iberian Iron Age, from the Greek colony of Emporion (ca. 500–100 BC), show at least one haplogroup R1b1a1b1a1a2a1b2-L165 (formed ca. 2500 BC, TMRCA ca. 2200 BC), subclade of R1b1a1b1a1a2a1b-S228, from which R1b1a1b1a1a2a1b1a1-M167 ultimately derives; and R1b1a1b1a1a2b1-L2^{+}, a subclade of R1b1a1b1a1a2b-U152 (Olalde et al. 2019). Both attest to an earlier presence in Iberia than the Roman invasion, and thus support their potential arrival with incoming Celts, if not from earlier migrations.

VIII.7. Northern EEBA province

VIII.7.1. Rhenish / Dutch groups

The clearest prehistorical natural division in the region is marked by the wide river areas of the Rhine, Meuse and Ijssel, constituting a permanent border between a Nordic network to the north and east, and an Atlantic network to the south and west. In the early Neolithic, loess soils were inhabited by farmers of the Linearbandkeramik culture and related groups, while the delta was occupied by farmer-hunter-fishers of the Swifterbant culture, and later the late Vlaardingen culture. The Single Grave culture was widely distributed as successor to the Funnel Beaker culture, and its barrows are seen from ca. 2900 BC onwards, replacing the earlier megalithic tradition. Until 2500 BC, the Stein group dominated the areas of the Meuse region down to the Belgian border (Fokkens and Fontijn 2013).

Shortly after 2500 BC the first Bell Beaker traits appeared in the north, possibly through the south-western German province along the Rhine, with influence under the early Mittelelbe–Saale province—closely related, like the Danubian EBA and North Italian province, to the early expanding East Bell Beaker group—with a core development in the Lower Rhine / Low Lands area. The earliest use of metal in the region date to the late phase of the Bell Beaker culture (ca. 2300–2000 BC), with evidence of local metalworking replacing stone as the dominant material for the production of axes (Fokkens and Fontijn 2013).

The Rhenish / Dutch Bell Beaker province, although not part of the East Bell Beaker core, had an important role as transmitter of impulses for the north, similar to the role that the North Italian core had for the south. Although Bell Beakers and their immediate cultural successor EBA Barbed Wire Beaker groups appear as a coherent tradition, this homogeneity is only apparent from similarities in building monumental barrows (lasting until ca. 1400 BC), and by the common developments, like the addition of tin–bronzes to metalworking ca. 2000–1800 BC, in common with adjacent western Germany and northern France. Traditional cultural divisions marked by geography probably persisted, though (Fokkens and Fontijn 2013).

The Riesenbecher group appears between the lower Rhine and the Elbe, with their twisted cord-decorated pottery (*Wickelschnurkeramik*), in the transition to the Middle Bronze Age. The region shows leaf-shaped flint daggers, like those of the Nordic Bronze Age, and imports from other neighbouring regions, and especially from the British Isles, which puts the lower Rhine region together with the Low Lands as intermediaries between Atlantic and central European traditions (Fokkens and Fontijn 2013).

At the end of the EBA (ca. 1850 BC), this division becomes evident in archaeology again: north and east of the rivers Ijssel and Vecht, the Elp tradition shows plain, undecorated pottery tempered with broken quartz. Longhouses, typical of the lowlands and Scandinavia since the Late Neolithic, must have gradually increased during the EBA, and are dominant since ca. 1500 BC over a much larger area in north-west Europe (in low-lying areas).

This house type was probably related to the expansion of mixed farming combined with cattle-stalling and collecting of manure, and may have inhabited by extended families. Settlements appear to be formed by one or two farmsteads, and repeated use of settlements and periods of abandonment can be seen. Outbuildings probably show granaries, and circular ditches and pit circles probably functioned as grain-storage facilities, similar to low-lying areas of Denmark. In north-west Germany, the typical settlement consisted of a long *Wohnstallhaus* (house-and-barn) with small ancillary buildings, protected by simple fences. They represent largely self-sufficient farmsteads, with five to eight families, which lasted maximum three or four generations. No fortified settlements are found in the area (Fokkens and Fontijn 2013).

The subsistence economy includes stock rearing and arable farming, with the system of ‘Celtic’ fields being developed from the MBA, and probably reaching full development during the LBA, although probably only during the Iron Age were large continuous fields present around farms. Wide banks around the fields have been explained as evidence of mixing depleted topsoil from the fields approximately every five years with dung from stables, and then bringing the enriched soil back onto the field. Bronze production increases during this period, with axes, spearheads, arrowheads, knives and ornaments locally made, while flint remained in use (Fokkens and Fontijn 2013).

The tradition during the Bronze Age (until ca. 1200 BC) is inhumation, with dead laid out stretched on their back, sometimes accompanied by grave gifts, rarely bronzes and pottery. Bronze Age barrows are more modest than those of the Nordic Bronze Age (ca. 15 m) —their size not representing the status of the dead—and they are occasionally surrounded by wooden posts. Chieftain burials show a set of weapons and standardised tools, and may represent an idealised way to bury important ancestors, with barrows often built on older ones. Imports from the Atlantic region show maritime connections linking the Channel coasts to north German and Danish areas. Occasional Nordic imports also support these trade connections. Atlantic and continental contacts shift during the Middle and Late Bronze Age, probably representing shifts in the main centres of trade (Fokkens and Fontijn 2013).

After 1200 BC, Urnfield pottery appears in the Ems group north and east of the Ijssel, while the southern regions are under the influence of the Lower Rhine Urnfield culture, in contact with the Rhin–Suisse–France Oriental tradition and their marked forms and incised decoration. Cremation becomes the dominant treatment of the dead, and urnfields develop first with monumental barrows on the same spots (which points to long traditions of intermittent use), with pottery featuring prominently in cemeteries. After 1000 BC all urnfield barrows show the same form, small barrows surrounded by a shallow ditch and a causeway in the south-east (Fokkens and Fontijn 2013).

During the Late Bronze Age (1000–800 BC), the longhouse disappears, and a new, smaller type dominates during the Early Iron Age, possibly connected to a change in social structure into single family groups, also seen in the transition from barrows to urnfields. More people are buried visibly in this period. Based on the small number of families represented in urnfields, communities probably consisted usually of three or four farmsteads (Fokkens and Fontijn 2013).

VIII.7.2. Nordic Late Neolithic

In Scandinavia, farming communities had already abandoned their subsistence strategy for the development of transhumance (Jensen 2003). With the latest Middle Neolithic phase (ca. 2800–2400 BC), Corded Ware/Battle Axe groups appear in Norway, but the extent of their influence is unclear, and seems constrained to some limited "islands" or groups in the east, probably interacting with late Funnel Beaker and hunter-gatherer groups (Prescott 2012).

The Corded Ware migration was the result of small-scale immigration, which brought about changes in subsistence economy in the new small settlement patches mainly concentrated in southern Scandinavia. The arrival of Corded Ware settlers did not represent a significant change from older traditions, with migrants having a more pronounced terrestrial bearing, targeting pastures and hunting grounds rather than waterways. They did not trigger any substantial regional change (Prescott, Sand-Eriksen, and Austvoll 2018).

A migration of Bell Beaker groups to Jutland during the mid–3rd millennium BC seems to have brought skills in mining and sailing, introducing mass production of flint daggers, as well as the first metal daggers (an imitation of copper and bronze prototypes). This Dagger Period of the Late Nordic Neolithic also represents the introduction of a more ranked social organisation, and a new ideology, with a farm institution (longhouses and fields), and an economy based on agropastoralism, integrating the diverse previous cultural traditions into a single south Scandinavian cultural sphere (Kristiansen 2009).

Bell Beaker settlers, probably from northern Jutland, migrated thus to western Scandinavia, evidenced by the appearance of bifacial tanged–and–barbed points ("Bell Beaker points") in the early Bell Beaker period ca. 2400 BC. Their coastal distribution in northern Scandinavia and limited inland expansion underscores the maritime nature of the initial Bell Beaker expansion. The new settlers were probably attracted by hunting products, political power, pastures, and most especially metals (Prescott, Sand-Eriksen, and Austvoll 2018).

A massive transfer of knowledge, institutions and practices—accompanied by a massive movement of peoples—happened thus ca. 2400–2350 BC in the coasts of northern Scandinavia, with some of the first migrants probably disembarking at or near the harbour discovered in Slettabø. Southern immigrants occupied environments similar to their territories in Jutland. Metal prospecting would explain the initial exploration along the western coast and the fjords, reaching as far north as Mjeltehaugen, possibly as 'scouts' (Anthony 1990). These prospectors eventually established permanent settlements on the coast, and long-term links with neighbouring indigenous groups, opening thus new territories, and having a significant transformative impact during the following generations by controlling the maritime network (Prescott, Sand-Eriksen, and Austvoll 2018). They eventually established a new coastal elite (Sand-Eriksen 2017).

The rapid adaptation of new practices to such hostile environments indicate the active participation of people with long traditions in the region. Such migratory movements "were probably related to the inherently expansive pastoral ideology, bolstered by a male warrior ideal, wanderlust, ideologically encouraged travelling/knowledge seeking, but also resource prospecting in a world rapidly embracing metallurgy and trade in exotica" (Prescott 2012).

A long transition follows the arrival of Bell Beakers, from around 2200 BC to 1700–1600 BC, which continues in part Late Neolithic traditions—such as longhouses, flintwork, metalwork and burial rites—and incorporates them to the new culture (Figure 63). The Dagger Period integrated the diverse cultural traditions of the previous period into a single south Scandinavian cultural sphere under the influence of Bell Beakers (Prescott 2009), which suggests the formation of “a shared Nordic language based upon the frequent interaction that followed from the distribution of flint daggers” (Kristiansen 2009).

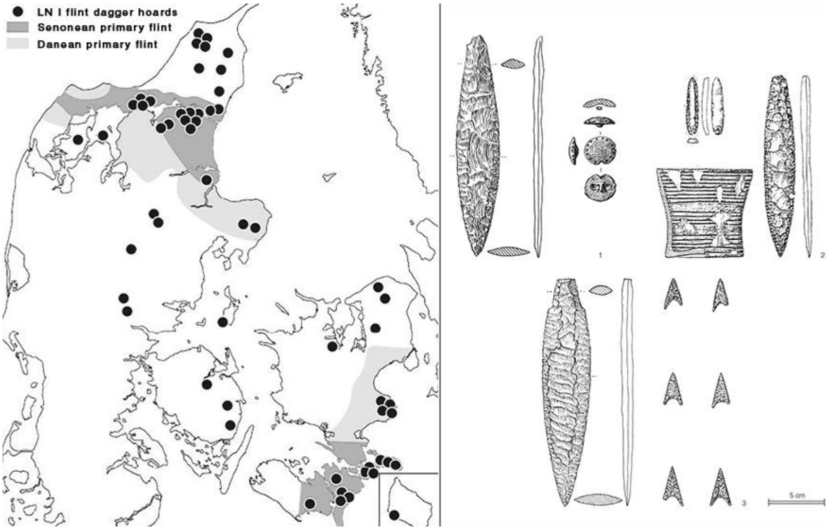

Figure 63. Left: Hoards of type 1 flint daggers and sources of flint, coinciding with the concentration of Beaker material in northern Jutland (Prescott 2009). Right: Beaker burials from northern Jutland including type I flint daggers. Images from (Vandkilde 2005).

This regional continuity is seen in the thousands of flint daggers (hence the ‘Dagger Period’), while the European connection is evident from metal finds, particularly flat axes and flanged axes, first imported from central and western Europe (Anglo-Irish axes), but gradually increasing in native forms with a different craft tradition; metal supply was dependent on central European ores; and rich metal hoards show close contact zones between the Únětice culture of central Germany and the EBA in Mecklenburg. (Jockenhövel 2013).

Such a direct strong cultural connection was possible thanks to communications through the strait of Skagerrak between northern Jutland and southern Norway. This, and the superior attractiveness of the Bell Beaker culture—apart from its military expansiveness—provided the necessary unifying conditions and infrastructure for the expansion and linguistic unification of Scandinavia quickly during the following Late Neolithic and early Bronze Age period (Prescott 2012).

To a certain extent, taking the example mentioned by Prescott (2012), the previous Corded Ware and the following Bell Beaker cultures could be compared with explorations of Sparta and Athens: Sparta and Corded Ware represent terrestrial brutal force, while Athens and Bell Beaker represent maritime mobility and trade, and an appealing ideology.

VIII.7.3. Northern EBA – MBA

During the Bronze Age, at least two social spheres can be described in Scandinavia: one of agriculture and husbandry related to the inland; and one of maritime nature, forming a decentralised social organisation led by warriors focused on seaborne transport, trade, and raids, related to the sea and the coastal rocks (as well as to rock art, barrows, and burial cairns). Unlike in the previous Neolithic period, certain parts of the elite invested in the maritime forces of production and controlling long-distance trade, establishing chiefdoms from coastal settlements close to agropastoral production areas (Earle et al. 2015; Ling, Cornell, and Kristiansen 2017; Prøsch-Danielsen, Prescott , and Holst 2018).

Geography defines long-lasting cultural divisions: southern Scandinavia (Jutland and southern and western Swedish coasts) shows best conditions for agriculture; central parts of Sweden and southern Norway (as far north as Trondheim) show arable zones along the sea and near Swedish lakes, but with pine forest dominant to the north; the north and the inland mountain zone shows limited potential for agriculture, and thus continuing Mesolithic economy with hunting and fishing as main components (Thrane 2013).

Southern Scandinavia, with its participation in the larger European network of bronze exchange, may have acted as the periphery of European Bronze Age societies. A more complex distinction may be more precisely made on a regional scale between southern, central and northern Scandinavia, with centre–periphery relationships based on the dynamics of regional cycles of production and alliances. Rock carvings define a common culture concentrated especially in western Sweden and south Norway, and help at the same time determine influence zones. A northern Neolithic tradition of hunters shows big game and fish motifs, located on rocks in the north and along inland rivers; a farmers' or southern tradition is mainly represented by ship depictions, but cattle and other domestic motifs also occur (Thrane 2013).

The longhouse, which continues a Neolithic tradition as two-aisled, changes to a three-aisled structure, an innovation that connected the region with the south and the western Baltic. The orientation is nearly always west–east, with entrance on the long side, and living quarters in the west. In central Scandinavia and the northern coasts, small huts—resulting from seasonal settlements—are also seen. Subsistence economy included cereal cultivation (mainly barley, also emmer and spelt), cattle and sheep herding, with farms described as mobile, evidenced by shifting settlements over small territories (Thrane 2013).

Hemispherical burial mounds predominate as funerary rituals, with turves in the south and cairns formed of boulders in the north. Both tend to form lines along land routes and coasts, with clusters indicating centres of population (Johansen, Laursen, and Holst 2004). Initially conceived for single burials, barrows could be subsequently enlarged to accommodate more burials. Their relative number (a hundred thousand mounds in the south, thirty thousand cairns in the north) may give an approximate idea of the relative population density of those who shared a similar culture (Thrane 2013).

Burials show wooden coffins, with the body extended on its back, head to the west (changing in the MBA to a north–south orientation). Pottery shows scarce decoration and continuity with Late Neolithic *Kummerkeramik*. Tumulus and Lusatian pottery influences local pottery with new types—small amphorae with two small handles—and a smoother appearance (Thrane 2013).

At the beginning of the central European MBA (ca. 1450 BC), tin–bronze becomes established initially marked by widely distributed flanged axes, early spearheads, and pins with perforated spherical head, from south German and Swiss culture areas. Influences from central Europe are seen in all Bronze Age stages: early in Apa-type swords, the first spearheads, and the spiral ornamentation, together with local forms. Bronzes were often cast with little reforging. Some assemblages are reminiscent of Mycenaean, Near Eastern, and Egyptian models, with findings of Baltic amber in the eastern Mediterranean pointing to indirect connections with the region via land or sea (Jockenhövel 2013).

Swords become the emblem of the Bronze Age, and are especially numerous in south Scandinavia. Imported Apa-type swords from south-east and central Europe reach as far as Uppland (eastern Sweden). To the south, in north Germany, short swords of the Sögel–Wohlde culture (ca. 1450–1100 BC), apparent heir of the earliest Nordic Bronze Age in southern Jutland, are found in the eastern lowlands, from the Rhine in the west to the Elbe in the east, and to Jutland to the north. It features inhumations in large burial mounds—unlike the contemporaneous Tumulus culture of central Europe—with male-only stone cist graves (Jockenhövel 2013). In the north, the Valsømagle long sword represents the start of solid-hilted swords in few regional workshops. Octogonal-hilted and flage-hilted swords of the type of the Tumulus culture are also imported. Spearheads are also characteristic of the whole Nordic BA, as are different axe types. Flintwork remains in sue but gradually decreases in quality (Thrane 2013).

Southern groups can be identified by specific weapon combinations: the West Holstein group (sword, spearhead), the Segeberg group (sword, plastave, like the Stade group), and the West Mecklenburg group (sword, palstave, dagger). In central Scandinavia, groups are defined by local environment, such as the segmented fjord landscapes of Norway, along the big rivers and lakes of Sweden, inland and coastal settlements of Sweden. Male burials show an emphasis on fighting, and settlements are isolated farmsteads—formed by house–and–barn buildings, and a byre provided for cattle—near the burial mounds. Hence chiefs and warriors represented a prosperous rural community.

Population density seems to have been limited, and settlements unstable, compared to other European regions (Jockenhövel 2013).

Figure 64. The gilded side of the Trundholm sun chariot, possibly of Danubian influence because of its early date (ca. 1400 BC). Image modified from original of Nationalmusset at <http://samlinger.natmus.dk/DO/2613>.

Mounds may contain several graves, often a man and a woman placed together, and possibly successively showing a distinction between generations. Graves are identified by their goods: short swords or daggers, flanged axes, heart-shaped flint arrowheads, pins, and occasionally small spiral-shaped gold rings. The mound can thus be viewed as a family burial site of an egalitarian society, belonging to an agriculturally-orientated single farm (Jockenhövel 2013). Annual imports of metal in the region—that began during the EBA—require regular and well-organised long-distance trade expeditions. Similarly, woollen textiles, whether finished or semi-finished, were also imported, with a market of Baltic amber (as found in Iberia, especially concentrated in Catalonia) cited as one potential north–south trade network established that justifies the presence of Iberian metals in Scandinavia from at least ca. 1200 BC (Radivojević et al. 2018).

During the late phase of the Central European MBA, other regions are incorporated into the Nordic BA, especially Mecklenburg–Vorpommern, in an expansion that remains unclear in archaeological terms, with the first imports from the Danube–Moravia–Bohemia region appearing and giving rise to local imitations (Figure 64). The new central European religious movement reaches the north, bringing cauldron–wagons, bird symbolism, and a change from inhumation to cremation (which becomes the only burial rite in the LBA). Cemeteries contain up to several hundred urn burials (urnfields), as in central Europe (Jockenhövel 2013).

VIII.7.4. Nordic LBA

The Nordic LBA (from ca. 1100 BC) brings thus pots used as containers for cremated remains more often than before, but without reaching the variety of central Europe or the Lusatian culture. The region north of the Mittelgebirge zone, between the lower Rhine and the Saale and Elbe, which already showed pottery and bronzes with less differentiation during the Urnfield period, become increasingly influenced by the later Nordic Bronze Age from around 1000 BC (Jockenhövel 2013).

Cultural and political influences characteristic of the north—single-bladed razor-knives, often with boat decoration, tweezers, brooches, and cast bronze bowls—are spread in burials and hoards across the European lowlands from the Rhine to Pomerania, with certain richly equipped graves among the common modest graves showing a social evolution similar to contemporaneous central European trends. The Urnfield *Vogelsonnenbark* (bird-sun-boat) is copied from imported bronze vessels (Thrane 2013).

Graves become smaller because of the cremation rite, and large artefacts are no longer found in assemblages. During this period, urns take over as containers of the dead, although stone cists and cremation pits are also found. Most cremation burials do not show metal objects. The decline in swords used as grave goods coincides with a more limited import of swords from the Urnfield culture, and a development of local types with kidney and horned pommels, and a monotype with reinforced tip. Socketed axes dominate during the whole LBA, in increasingly small versions (Thrane 2013).

In the early phase (ca. 900–700 BC), cross-regional communication becomes evident between the Danube region and the Elbe and Oder, with cultural links reaching as far as the Pyrenées. Herzsprung-type round shields appear probably first as wooden shields in Ireland, and then expand as leather or bronze shields to the Nordic Bronze Age and up to the eastern Mediterranean (Thrane 2013).

VIII.7.5. Pre-Roman Iron Age

The transition to the Iron Age shows continuity (e.g. longhouses and hoard deposition) with new Hallstatt elements (such as new types of pin, razors, and absence of native weapons) marking a break with the previous period. The appearance of the Jastorf culture (ca. 600–550 BC) east of the Rhine signals the end of the Bronze Age in the region. It contrasts in material culture, especially metal ornaments and pottery, with the La Tène style to the south and west, and shows the clearest connection to Germanic tribes mentioned in ancient sources during the first century BC (Jockenhövel 2013).

The Pre-Roman Iron Age in Scandinavia spans the period ca. 500–1 BC, when bronze was replaced by iron in most tools and weapons. While the technology was introduced from central Europe, iron ores were readily available as raw materials in Scandinavian territory, and efficient techniques were developed to extract serviceable iron from the many impurities contained in local sources. The society was organised by ranks, and neck rings were a marker of elite status. Bog offerings continue during this period, while human sacrifice becomes widespread only from ca. 1st century BC (Perdikaris 2004).

The Pre-Roman Iron Age is considered a regression period, with continuity in settlement patterns—with site types correlated with soil types—but materials evidencing a decline in the population, possibly due in part to a wetter and colder climate that caused deciduous trees to disappear and glaciers to re-form on high grounds. This trend lasted 260 years, starting ca. 600 BC, with further fluctuations seen ca. 300 BC and then close to 1 AD. This affected farming, with woodlands expanding at the expense of pastures and arable land, possibly also due to a concentration of settlements in permanent farms and villages. In Jutland, longhouses become much smaller, with room for one family household, but many clustering together to form villages (Perdikaris 2004).

During the period ca. 200 BC – AD 200, a generally warm, dry climate was favourable for cereal cultivation, which marked the development of the agricultural landscape (with coexisting intensive and extensive strategies), and also the economic and social landscape. ‘Mobile villages’ point to the formation of so-called Celtic fields—in common with central Europe—and evidence of fences from ca. 300 BC, to protect villages and cattle, eventually surrounding each farmstead or building complex. Economic activities included cattle breeding, crop raising, and some blacksmithing, pottery making, weaving, and spinning (Perdikaris 2004).

During the 3rd to mid–2nd c. BC, the last enclaves of the Lusatian culture and mainstream Pomeranian culture disappeared under cultural influences in their western territories. Along the Oder river, Pomeranian societies were replaced by so-called *Pit Grave* groups under the influence of expanding Proto-Germanic Jastorf culture, probably from migrations from its cradle in Jutland and northern Germany. The Przeworsk culture emerged in central Poland (see *§VIII.8.5. Pomeranian and West Baltic Kurgans culture*), while the strongest impact was seen in the north, where the Oksywie culture formed in the lower Vistula region. Women and men were buried according to distinct rites. Cremated female bones were put in simple pits, males were buried in urns. Stone covers or standing stelae are characteristic of these graves. This culture gave rise eventually to the Wielbark culture, identified with the Goths (Perdikaris 2004).

viii.7. Germanic peoples

The Bell Beaker period is the only reasonable candidate for the spread and final entrenchment of a common Indo-European language throughout Scandinavia, and particularly Norway (Prescott and Walderhaug 1995). The best candidate for an original homeland of the Pre-Germanic dialect of North-West Indo-European migrating into Scandinavia is the Beaker culture of the Low Countries and the western part of the Northern European Plain (Kristiansen 2009). Samples of Bell Beakers and Barbed Wire Beakers from Oostwoud in the Netherlands (ca. 2500–1900 BC) show elevated Steppe ancestry (ca. 58%) and R1b1a1b1a1a2-P312 lineages, compatible with the admixture of Yamna lineages with local Corded Ware peoples.

Dutch–German lowland areas share cultural roots with the southern Scandinavian area (Butler, Arnoldussen, and Steegstra 2011/2012), which predate technological and economic exchanges between Urnfield and Northern Bronze Age Scandinavia (Kristiansen and Suchowska-Ducke 2015). Samples of the Bronze Age Elp culture from Oostwoud (ca. 1900–1600 BC) show Steppe ancestry (ca. 51%), and hg. R1b1a1b1a1a1-U106, which is consistent with the apparent Y-chromosome bottleneck of Scandinavian Bell Beakers, and thus with the development of a Pre-Germanic community first around Jutland.

Nordic Middle Neolithic samples include an individual from Kyndelöse (ca. 2900–2500 BC), of hg. R1a1a1b1a3a-Z284, subclade R1a1a1b1a3a2a1-Z281/CTS2243^{+} (Allentoft et al. 2015), and a Late Neolithic sample from Ölsund, central-east Sweden (ca. 2600–2150 BC) shows hg R1a1a1b-Z645 (Mittnik, Wang, et al. 2018), both lineages related to Corded Ware settlers. A replacement of male lines is observed already during the Dagger Period, with two samples reported from Skåne, one from Lilla Bedinge (ca. 2150 BC) of hg. R1b1a1b1a1a1-U106^{+}, typical of incoming Bell Beakers, and another from Abbekås (ca. 1900 BC) of hg. I1-M253, proper of Neolithic Scandinavia. Dubious is the subclade of a sample from Marbjerg, Denmark (ca. 2080 BC), of hg. R1-M173 (Allentoft et al. 2015), although—based on later samples—probably also R1b1a1b1a1a1-U106.

There is continuity in southern Scandinavia during the Bronze Age (ca. 1500–1100 BC), with three samples from Skåne showing hg. I-M170 (probably all I1-M253), and one from Denmark showing hg. R1b1a1b-M269 (xR1b1a1b1a1a2-P312), i.e. likely R1b1a1b1a1a1-U106 (Allentoft et al. 2015). An LBA sample from Trundholm also shows hg. R1b1a1b1a1a-L151, clustering closer to central European BA compared to the previous samples from Scandinavia, which clustered between central European Corded Ware and Bell Beaker samples (Mittnik, Wang, et al. 2018).

These scarce samples probably reflect thus the expansion of Pre-Germanic-speaking R1b1a1b1a1a1-U106 lineages from the Northern European Lowlands into southern Scandinavia, replacing previous Corded Ware/Battle Axe R1a1a1b1a3a-Z284 lineages in Jutland and the northern Scandinavian coastal areas around the Skagerrak strait, or displacing them to the inland. The close interaction of the newcomers with the Battle Axe culture in Scandinavia (characterised by the Y-chromosome bottleneck of R1a1a1b1a3a-Z284 lineages), connected with the eastern Baltic (see *§viii.16. Saami and Baltic Finns*), is evidenced by the evolution of a North-West Indo-European-like Pre-Germanic phonology to a Proto-Germanic stage with strong phonetic Uralisms, which is compatible with long-term Finno-Samic–Germanic bilingualism and with Finno-Samic bilingual speakers eventually becoming monolingual speakers of Germanic (Kallio 2001; Schrijver 2014).

Haplogroup I1-M253 was reported previously only in a hunter-gatherer (ca. 7000 BC) from Gotland (Günther et al. 2017), and it is not clear the extent of its expansion when migrants occupied Scandinavia, first with the Corded Ware culture, and later with the Bell Beaker culture. TRB and Pitted Ware (PWC) cultures coexisted ca. 3300–2800 BC in Gotland (Fraser, Sanchez-Quinto, et al. 2018), while CWC migrated into the PWC area around 2800 BC, and both CWC and PWC lasted until their replacement by the Late Neolithic ca. 2300

BC (Vanhanen et al. 2019). A replacement of ca. 50% mtDNA haplogroups by steppe lineages during the EBA (ca. 1700–1100 BC) has been reported (Fraser, Sjödin, et al. 2018). Both facts suggest that I1-M253 lineages had a strong presence in southern Sweden at least before the arrival of Bell Beakers, and thrived once integrated into the new emerging Scandinavian Late Neolithic social structure, probably spreading to Jutland through the Kattegat sea area already mixed in different tribes with R1b1a1b1a1a1-U106 lineages, before the migration period.

During the migration period, the Baiuvarii, Alamannic peoples who settled in modern-day Bavaria, show in two sampled sites (AD 460–530) that men resembled closely modern northern and central Europeans, whereas women exhibited a high genetic heterogeneity, including signals of genetic ancestry ranging from Europe to East Asia, among them women with artificial skull deformations, whose genetic ancestry suggests an origin in south-eastern Europe (Veeramah et al. 2018). The Y-chromosome haplogroup reported for six individuals is R1b1a1b1a1a1-U106^{+}, including two R1b1a1b1a1a1c1-S264^{+} subclades (formed ca. 2700 BC, TMRCA ca. 2200 BC), which suggests an overwhelming majority of R1b1a1b1a1a1-U106 subclades among the Alemanni.

Longobard migrants from Szólád (AD 412–604) and from the Longobard Kingdom in Collegno (AD 580–630) also show typical northern/central European ancestry (Amorim et al. 2018), compatible with their described origin in southern Scandinavia. Among reported haplogroups clearly associated with Scandinavia, there are two I1a3-Z63 (formed ca. 2600 BC, TMRCA ca. 2500 BC), one I1a1b1-L22 (formed ca. 2000 BC, TMRCA ca. 1800 BC), one R1a1a1b1a3a-Z284, and five R1b1a1b1a1a1-U106, one of them R1b1a1b1a1a1b-Z19 (TMRCA ca. 1600 BC) and the other four R1b1a1b1a1a1c-S263 (TMRCA ca. 2700 BC), including one R1b1a1b1a1a1c2b2a1b1a-Z8 (formed ca. 1800 BC, TMRCA ca. 1000 BC), and another R1b1a1b1a1a1c2b2a1b1a1-Z11 (formed ca. 1400 BC, TMRCA ca. 1400 BC).

Wielbark culture cemeteries east (Kowalewko) and west (Masłomęcz) of the Vistula have been reported as showing changes consistent with migrations during the 3rd–6th centuries AD, in terms of mtDNA (Stolarek et al. 2018), and in terms of their small genetic distance with Jutland Iron Age individuals, supporting the arrival of Goths from Scandinavia. The presence of varied haplogroups, including one I1a3a1a1-Y6626, one I2a1b1a2b1-L801, and two G2a2b-L30, compared to the uniform genetic structure of West Germanic tribes, supports the multi-ethnic nature of the East Germanic expansion (Stolarek et al. 2019).

In the north Pontic steppe, the transition from Scythian domination to the Chernyakhiv culture (ca. 200 BC – AD 300) shows a clear genetic shift to Bronze Age / Iron Age Europeans, lacking the Altaian component entirely and showing an increase in Near Eastern ancestry, which is compatible with the Ostrogothic origin of the culture. Its multi-ethnic mix may be seen in the wide cluster formed by the three reported females (ca. AD 250–550), which cluster among eastern Europeans, central Europeans, and south-eastern Europeans respectively, showing a 'central European' shift relative to the wide cluster formed by western Scythians (Järve et al. 2019).

In Iberia, samples from the Visigothic site of Pla de l'Horta in the north-east (ca. AD 500–600) are shifted to the northern and central Europe, bringing Asian mtDNA C4a1a also found in Early Medieval Bavaria. Haplogroups related to the arrival of Visigoths likely include one I-M170, R1b1a1b1a1a-L151, and a later R1b1a1b1a1a1c1a-U106 sample of a Christian interred in Sant Julià de Ramis (around the 9th c.), likely a remnant of the previous incursion. Interestingly, one sample is of E1b1b1a1b1-L618 lineage, a haplogroup also found in one Scythian from Glinoe, in a Longobard sample from Szólád, and later among early Slavs (see *§viii.8. Balto-Slavs*), and subclade E1b1b1a1b1a-L540 is found in two medieval samples from south-east Iberia (ca. AD 1000–1300). Another Visigoth is of hg. J2a1-PF4610, whose origin is difficut to classify as Mediterranean or East Germanic without further subclades (Olalde et al. 2019).

Vikings from Iceland (AD 10th–11th century) and later Icelandic individuals show six samples of hg. R1a1a1b1a3a-Z284, one of them R1a1a1b1a3a2-Z287 (formed ca. 2300 BC, TMRCA ca. 2100 BC), three of hg. R1a1a1b1a3a1-L448 (formed ca. 1200 BC, TMRCA ca 800 BC), one of which shows R1a1a1b1a3a1a-CTS4179 (TMRCA ca. 300 BC); six samples of hg. I1-M253, one of them I1b-Z131 (formed ca. 2400 BC, TMRCA ca. 2000 BC), two I1a1b1-L22, one I1a2a1a-Z62 (formed ca. 2300 BC, TMRCA ca. 2300 BC); and nine samples of hg. R1b1a1b1a-L51, at least one of them R1b1a1b1a1a1b-Z19, three unclear, and five of hg. R1b1a1b1a1a2-P312, one showing the rare subclade R1b1a1b1a1a2d-L238 (TMRCA ca. 2500 BC), found mainly among modern Scandinavian peoples, and four R1b1a1b1a1a2c1-L21, with an ancestry close to modern Welsh peoples, probably related to slaves imported from Britain (Ebenesersdóttir et al. 2018).

Late Vikings from the town of Sigtuna, in east–central Sweden (AD 10th–12th century), show varied Y-chromosome haplogroups and high genetic diversity, compatible with the intense international contacts and the Christian character of the culture (Krzewińska, Kjellström, et al. 2018). This particular sampling also shows the first haplogroup N1a1a1a1a-L392 in Sweden, found in an individual of local origin based on strontium isotope analysis and genetic structure, hence probably an integrated Proto-Germanic lineage related to earlier migrations of Iron Age Akozino warior-traders (see *§VIII.15.3. Ananyino and Akozino* and *§viii.16.2. Baltic Finns*).

While it is clear that the Y-chromosome bottleneck of R1b1a1b1a1a1-U106 lineages in northern Europe—and thus their successful expansion with certain clans into Scandinavia—is responsible for the creation of a Pre-Germanic community at the turn of the 2nd–1st millennium BC, it is unclear where exactly the Proto-Germanic community expanded from: i.e. whether it was a recent expansion of certain tribes over the whole Nordic Bronze Age territory (unifying their language before the Iron Age), or their evolution can be described as one of divergence and convergence trends between related dialects, similar to the history of the Modern German language.

Figure 65. Distribution map of 'Wedel' toponyms in Europe. This is one of the traditional reasons adduced to propose an expansion from Jutland to the south. This must be rejected, though, because of its younger distribution north of the Elbe, which supports a south–north expansion direction. Modified from Karte 71 in Udolph (1994).

The Jastorf culture can be directly connected to previous groups of southern Jutland and Northern European Lowlands, and its expansion to the spread of Germanic groups, but it is unclear to what extent this influence reached northern Scandinavia, which speaks in favour of at least some degree of long-term convergence of closely related dialects in north Scandinavia. Nevertheless, onomastic data points to the Northern European Plains between the Weser and the Oder (particularly the Weser–Elbe interfluve) as the most likely Common Germanic homeland (Figure 65), with Scandinavia as a region of late expansion with a clear non-Indo-European substrate (Udolph 1994; Kuhn, Hachmann, and Kossack 1986), which is consistent with the traditional description of Fennoscandia as Uralic-speaking (Dolukhanov 1989; Wiik 1997; Künnap 1997; Schrijver 2014).

The available data from the Barbarian invasions suggest an overwhelming majority of R1b1a1b1a1a1-U106 subclades among Elbe Germanic tribes, like the Alemanni, and probably even more so among Weser–Rhine Germanic tribes, like the Franks, based on modern populations from the western Germanic-speaking areas. North Sea Germanic tribes, like Longobards, were possibly more admixed with I1-M253 lineages in Jutland, although the mixture of Longobards with Goths incoming from the east makes the original situation less clear. North Germanic tribes, based on data from Vikings, show I1-M253 and also R1a1a1b1a3a-Z284 lineages, apart from R1b1a1b1a1a1-U106, which is probably to be expected among East Germanic tribes, too, deemed to have migrated from northern Scandinavian territories.

The association of West Germanic tribes with hg. R1b1a1b1a1a1-U106 is further supported by samples during and after the medieval *Ostsiedlung*, showing a west–east cline of R1b1a1b1a1a1-U106 (including also I1-M253) vs. R1a1a1b-Z645 (xR1a1a1b1a3a-Z284) compatible with the Germanisation of Slavs to the east of the Elbe. Although modern population samples from eastern Europe are difficult to assess without genealogical information, due to the expulsion of Germans after World War II, medieval samples from Podlažice (ca. 1180 AD) in Bohemia, as well as Nicolaus Copernicus' family origin from Koperniki near Nysa in Silesia before the 14th century (Bogdanowicz et al. 2009), seem to support the expansion of R1b1a1b1a1a1-U106 lineages associated with German settlers of the Holy Roman Empire east of the Elbe.

VIII.8. Eastern EEBA province

VIII.8.1. Mierzanowice–Nitra

The East Early Bronze Age refers specifically to the Chłopice–Veselé and Mierzanowice cultures, spanning from north-east Moravia to Lesser Poland. It represents the south-eastern periphery of the Bell Beaker culture, and is characterised by vessels and ceramic technique, including cord decoration: horizontal bands on the upper part in Proto-Mierzanowice (ca. 2350/2300–2200 BC) and with supplementary bands in the bottom half in Early Mierzanowice (ca. 2200–2050 BC). Nitra appears later, after ca. 2050 BC, with the classic phase of Mierzanowice (during its eastward expansion), probably as part of the Chłopice–Veselé culture (coincident with Proto- and Early Mierzanowice) under Únětice influence (Bertemes and Heyd 2002).

The Epi-Corded Ware Chłopice–Veselé culture represents a southern expansion of late Corded Ware groups, from Lesser Poland into the Carpathian Mountains, where they formed a border culture with influences from Pannonian cultures. The appearance of Bell Beaker communities of Silesia (ca. 2350 BC) occurred simultaneously with the transformation of the Chłopice–Veselé culture, with Bell Beaker cultural patterns influencing its transition from late CWC, evidenced by mixed materials found in Upper Silesian settlements ca. 2300–2200 BC (Furmanek et al. 2015).

Chłopice–Veselé shows flat inhumation graves with funerary ritual inherited from the Corded Ware culture and cord ornamentation, as well as copper–wire artefacts and willow–leaf ornaments, proper of the eastern regions. Bell Beaker materials disappear from Upper Silesia ca. 2150 BC. Another part of the Epi-Corded Ware complex is the Košťany culture in the north-eastern Carpathians, known from inhumation graves in flat cemeteries and similar material culture (Furmanek et al. 2015).

Proto-Mierzanowice appears with the arrival of Bell Beakers in the west part of Lesser Poland (ca. 2400–2300 BC), possibly representing an infiltration of groups rather than a massive migration. In the Proto-Mierzanowice phase, only scattered graves and short-lived settlements are found, and their distribution pattern is similar to the previous Corded Ware settlements. These small groups were very mobile, with traces found from Moravia to Volhynia. One of the important signs of change associated with BBC in this period is the position of the deceased—inverted with respect to the characteristic Corded Ware tradition—and the nature of the deposited grave goods (Bertemes and Heyd 2002).

The early phase lasts probably no more than three generations, with dynamic internal processes of indeterminate nature resulting in a stabilisation of the settlement, the establishment of large permanent settlements (like those at Mierzanowice and Iwanowice), sudden demographic development and accompanying changes in economy (animal husbandry replaced by agriculture) and society (dominant family groups replaced by local or village groups). This evolution period ca. 2300–2200 BC is coincident with the increasing advantage gained by the Únětice cultural model to the west (Włodarczak 2017), which may have triggered this reaction (Bertemes and Heyd 2002).

An adaptation to Corded Ware ideas is seen in the following period (ca. 2200–2050 BC), represented by a 'weak' acculturation and evolution of a local ethnic identity, marked by the increasing frequency in cord ornaments and the growing elaboration of decorative motifs made with the technique of cord impressions. The Mierzanowice culture gradually cut its contacts with the west, and after ca. 2000 BC the upper Oder and Vistula rivers became a real cultural barrier among Mierzanowice (to the south), Únětice (to the west), and the developing Trzciniec culture (to the north).

Similar to the Proto-Únětice evolution, Mierzanowice does not follow Corded Ware cultural traits directly during this development (like the usually proposed Kraków–Sandomierz Corded Ware group of Lesser Poland), but rather Epi-Corded Ware cultures from the Carpathian Basin over a Bell Beaker culture (Figure 66): in the stable network of large and long-lasting head settlements, the consistency in observing strict rules of funerary rites, and organisation based on sex. Such Epi-Corded Ware groups of south-east Europe include north-western Makó/Kosihý–Čaka; south-eastern Ljubljana; central Early Nagýrev, Pitvaros(–Maros); north-eastern Ada; central and southern Transdanubian Somogyvár–Vinkovci, Vučedol; southern Balkans Belotić–Bela Crkva (Włodarczak 2017).

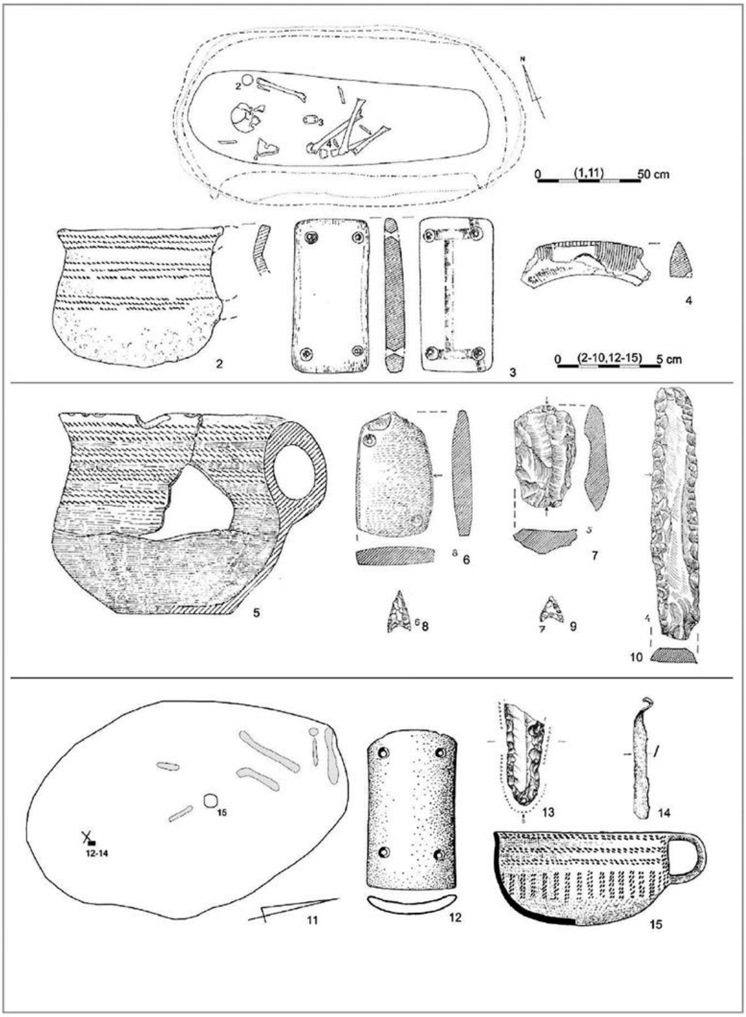

Figure 66. Grave of the Mierzanowice culture with wristguards. Modified from Jarosz et al. (2011).

The Nitra culture was also formed under the influence of Chłopice–Veselé, Makó/Kosihý–Čaka, and Bell Beaker cultures, although the gradual decrease of elements of eastern origin—such as copper willow–leaf ornaments, chipped stone in the form of shouldered points, and aspect s of funeral rite—suggest a greater western EBA influence of the culture. Bodies are in the crouched bipolar position, with a basic east–west orientation. Grave pits and pot-built houses indicate social ranking, with graves of hunters, medicine men and craftsmen identified among them. The Únětice culture expands coinciding with the end of the Nitra culture, although the tradition of bipolar west–east and east–west orientation usually survives in graves of Nitra tradition (Marková and Ilon 2013).

In the three late phases of Mierzanowice (2200–1600 BC), settlements appear in certain areas that develop stable microregional structures, centred on the Lesser Poland territory, while some groups—more numerous during the older period (ca. 2300–2200 BC)—continue the mobile settlement model. At the end of the millennium, a dense network of small settlements (having just a few homesteads) was established within the fertile loess areas. The stabilisation of the settlement pattern is seen especially after 2000 BC, coinciding with the classic phase of the development of the Únětice culture; until that point, the development of groups correlated with the late phase of Bell Beaker culture, e.g. the Dobre group in Kuyavia, or the Lower Oder group in Western Pomorze (Włodarczak 2017).

Main, long-lasting settlements and regions of constant occupation with stable households appear, always in higher regions, and always accompanied by cemeteries, alongside short-term settlements linked to certain economic activities. The burial rite, although remaining entrenched in the Corded Ware tradition and symbolism—like gender-differentiated burials with a predominance of males—shows a reaction against the previous beliefs in the avoidance of kurgan building and the use of communal graves. The position of the lower limbs was clearly less flexed, and at the same time more bodies appeared in a lateral position, which led to the crystallisation of a new tradition (as in cemeteries of the Strzyżów culture) of dead interred in a slightly flexed or extended position (Włodarczak 2017).

The social structure is based on the family unit, which inhabits a farmstead. Multiple farmsteads and a cemetery form a village, and a settlement microregion is formed by various local groups. Economic autarchy and cultural homogeneity of local groups point to their ethnic unity, but only in the latest stage would a common language be needed, because of the intense exchange contacts. Due to the homogeneity in decoration, female exogamy was probably restricted to the own culture. In the three earlier phases, Mierzanowice was a fully egalitarian society, but there was gender-based asymmetry (as in the previous Neolithic and Corded Ware cultures of the region), and also some interest in imitating prestige goods of western cultural centres, from local raw materials (Kadrow 2007).

Microregions had an area of few to 10 km^2, and some of them existed for the whole timespan of the culture. Agriculture played an important role in its subsistence economy, as did pastures at some distance of the settlements, for relatively big herds of cattle and sheep. Each settlement had 5–20 farmsteads, each with at least 200 m^2 and probably multiple buildings, including a cellar. Most settlements had less than 150–200 inhabitants, with only a few (like Mierzanowice and Wojciechowice) having more (Kadrow 2007).

Interestingly, microregions of western Lesser Poland (including the Iwanowice settlement), the Sandomierz-Opatów Upland, and the Upper Bug, appear to have suffered ca. 2050 BC a conflict and disruption of the moral order, with ‘a return to the roots’, reflected in the abandonment of cord ornamentation on ceramic vessels, and in the predominance of undecorated pots with knobs on their necks or rims. Similar forms were used at the beginning of the Mierzanowice culture, and also in Bell Beaker settlements over vast areas in Europe, e.g. in late groups from nearby Moravia. This process has been described as a likely rebellion whose leader would have acquired certain features of a traditionalistic ruler, invocating the ‘sanctioned’ Bell Beaker tradition, in order to assume power more securely, a power structure that could be maintained until ca. 1850/1800 BC (Kadrow 2017).

Before 1900 BC, there is no proof of long-distance exchange, with mostly local raw materials. The circulation of imports begins in the latest phase, and includes stone sickles, faience pearls, and rarely metal objects, at the same time as foreign influence is noticed in the local pottery production. Until then, all microregions had shown a great unity in style and typology, in spite of specific local elements. A ranked society appears in this latest phase marked by rich graves, signalling the elevated social position of some males and females, and putting an end of the gender-asymmetry (Kadrow 2007).

In the earliest phase, there were two main regions: a western one, with corded and incision ornamentation, and an eastern one, with only corded decoration. In the classic phase, the Nitra group/culture appeared in the south-west, and the Strzyżów culture in the north-east. While violence from close combat with axe–hammers is evidenced in human remains, the use of archery and related war culture proper of Bell Beaker and Únětice peoples also continue in these groups (Kaňáková, Bátora, and Nosek 2019). In the latest phase, the Mierzanowice style—initially appearing on mugs, jugs, and amphorae, and later on jars—was fragmented into four distinct local groups based on their different regional styles: Giebułtów, Szarbia, Pleszów, and Samborzec groups (Kadrow 2007).

VIII.8.2. North-Eastern province – Iwno

Before 2500 BC, the Single Grave culture had reached from Jutland to Mecklenburg and to the Polish Lowlands, through a stable network of long-range contacts that had been created in the Corded Ware A-horizon, and which followed previous similar routes of Mesolithic and Neolithic expansions, facilitated by the geographical low plains connecting the coastlines of the North Sea and the Baltic Sea. Within that framework, the Northern European Plain was connected from Dutch Beakers in the west to Jutland and to the

Polish Lowlands in the east, creating a distinct north group in the pan-European Bell Beaker network. Bell Beakers from Jutland and north-eastern Germany were the source of Pomeranian and Kuyavian Bell Beakers (Czebreszuk 2013).

The special character that distinguish them is that Bell Beaker traits are found chiefly in domestic contexts, and to a much lesser extent in burials, which manifests as secondary burials in older communal graves. Pottery shows a specific ornamentation, initially using a knurling technique for patterns, (including cord impressions or incisions), then evolving from slender beakers to shorter and squattier vases (using mainly the incision technique), and eventually developing in the latest stage barbed wire ornament, in the south-west Baltic (Czebreszuk and Szmyt 2011).

From 2400 BC, a change in the Polish Lowlands is seen with domestic sites showing signs of stabilisation towards a network of permanent territorial communities, as the result of a new system of social organisation. Larger encampments change into settlements, with occasional buildings for economic and sometimes domestic purposes, culminating in the Bronze Age. Economically, it would mean a decreased or modified role of animal husbandry (from nomadic to semi-nomadic, then to sedentary), as well as a shift to dependence on the ‘politics’ and local natural environment in respect to stable, farming communities, with a social system still marked by social differentiation (Czebreszuk and Szmyt 2011).

Cereal cultivation appears abundantly only after 2400 BC, first recorded in Kornice, the first Bell Beaker settlement in southern Poland, with settlements in Lesser Poland showing an increasingly important role of cultivation dated to the final Eneolithic or beginnings of the Bronze Age (Kośko 1979).

In contrast to the previous Corded Ware package, the Bell Beaker package in the Polish Plains and the south-west Baltic is recorded (from ca. 2500–2400 BC) mainly in materials from settlements and encampments, less often in funeral complexes, and is superimposed to the earlier elements without replacing them, such as ornamentation with typical Bell Beaker patterns (of fundamental significance is the bell beaker with zone and metopic-zone ornamentation, made with knurl technique or engraved), as well as stone archer's wrist guards and dagger (Czebreszuk and Szmyt 2011). The main features of this north-eastern Bell Beaker border region are thus:

- Genuine Bell Beakers.
- Zone-metope decoration.
- Application of comb–stamp decoration technique.
- Zonal decoration in general.
- Wristguards.
- Bifacial flint daggers (along with copper daggers).
- A variety of small finds, such as the V-shaped buttons.

The south-eastern Baltic centre was included in the new interregional network of exchange, with amber products becoming a widespread feature of Bell Beaker graves overall in Europe, one of the determinants of the Bell Beaker package in different regions. It can be assumed that communities living in the southern shores of the Gdańsk Bay were the main producers and distributors of amber ornaments from the turn of the 4th-3rd millennium BC until the Early Bronze Age (Włodarczak 2017).

In its western area, the eastern Bell Beaker province paved the way ca. 2300/2250 BC for the earliest traces of the Únětice culture (in its Proto-Únětice phase), in Silesia, and later in the Polish Lowlands and in the Lower Oder. The latest dates of bell beakers ca. 1800 BC are characteristic of the Iwno culture, a "syncretistic culture" where the original traits had become increasingly transformed under the influence of the Únětice culture, in a region on the route between the Únětice and the rich amber deposits on the Gulf of Gdańsk.

In the final phase of the Final Eneolithic, in north-eastern Poland, Kuyavia and Greater Poland—at the settlements of Iwno and Masuria cultures—pig rearing regained importance, which had been lost with the arrival of Corded Ware settlers (Włodarczak 2017). Since the EBA, cattle were the chief livestock, whereas pig and sheep–goats were of secondary importance, and of comparable quantity until the Late Bronze Age/Hallstatt period (Włodarczak 2017).

In the eastern area of the Polish Lowlands and Greater Poland, the late Bell Beaker stage, in combination with local post-Corded Ware and Neman groups, marked the inception of a sequence of changes that led to the so-called Trzciniec horizon, from the Warta drainage as far as the middle Dnieper (Czebreszuk and Szmyt 2012). This culture may be also related to the adoption or imitation of Bell Beaker in marginal influence zones, such as the isolated finds of comb–stamp decoration or flint daggers in the eastern Baltic, Finland and Belarus (Włodarczak 2017).

The littoral zone from the Oder delta to the Vistula delta kept a particular character, distinct from the EBA and MBA cultures developing in the area related to central Europe, because of the diverse ecological niche of the coastline and the abundant deposits of amber, a commodity in Europe during the Bronze Age. It shows stable settlements and an extensive network of cultural exchanges from the Baltic shore to the North Sea in the west, with one stable seaway connecting the lower Vistula region, Pomerania, and Mecklenburg with Jutland, and further away with the North Sea, the British Isles and Atlantic Europe (Czebreszuk 2013).

At least in the Polish Lowlands, GAC groups coexisted ca. 2400–2200 BC with little cultural interaction with Bell Beakers, which suggests a significant cultural barrier between both groups. Later, clear cooperation is seen between Bell Beaker and Únětice, while isolation of GAC groups continued, despite the absence of geographical barriers among these cultures (Włodarczak 2017).

The BBC concentration of Silesia (giving rise to proto-Únětice) was more closely connected to the Bohemian Basin, and the Lesser Poland enclave more closely connected to Moravia, both communities being therefore part of the core East Bell Beaker migration, contrasting with the northern Bell Beaker groups of the Polish Lowlands, which mixed with groups heir of the Single

Grave group of the CWC to form eventually the Trzciniec horizon (Włodarczak 2017).

VIII.8.3. Trzciniec

During the EBA, para-Neolithic societies still survived in north-eastern Poland, with pottery showing contacts with north-eastern Bell Beakers, but their way of life depending on gathering and fishing, with agriculture representing only a small part of their subsistence economy. After ca. 2000 BC, the Trzciniec culture continued Bell Beaker traditions of the North-Eastern BBC province (Czebreszuk 2001), and began to spread from the west (Kuyavia and Great Poland), to the east (Masovia, Podolia, Volhynia), incorporating these para-Neolithic groups, where it eventually developed into its distinct archaeological form east of the Vistula. It expanded later—during its classic phase—to the south, into Lesser Poland.

Pottery in Pomerania, Masuria and Masovia followed a different course from those to the west and south, with less stability and inferior craftsmanship. The most characteristic trait of the culture is the pottery of the Riesenbecher type, featuring a small bottom and S-shaped profile. This specific type may have had its origin during the decline of the Neolithic, with sinuous-profile pots decorated with the so-called barbed wire ornament, also known as the ornament of “a cord wound around a flint flake” (a decorative strip running from the neck of the pot across the body), which connected together the vast territories of the Northern European Plain, from England to the mouth of the Rhine, northern Germany, Denmark, and well into east Europe (Kadrow 1998).

The first similar Riesenbecher types are found in Únětice on the lower Elbe, and in the late Bell Beaker (or Barbed Wire Beaker) groups of north-west Germany and Jutland, and from Iwno centres (with many significant ornamentation patterns), which points to its expansion through the Northern Lowlands during the Early Bronze Age. The Trzciniec pot prototypes appeared in the Kuyavia region rather early (before 2300 BC), accompanied by the kurling technique, which connects it with the Bell Beaker tradition. Its expansion with migrants is evidenced by their appearance in Lesser Poland ca. 1900 BC, expanding then to the south, into the Carpathians and Ukraine (Figure 67) in the mid–2nd millennium BC (Czebreszuk 1998).

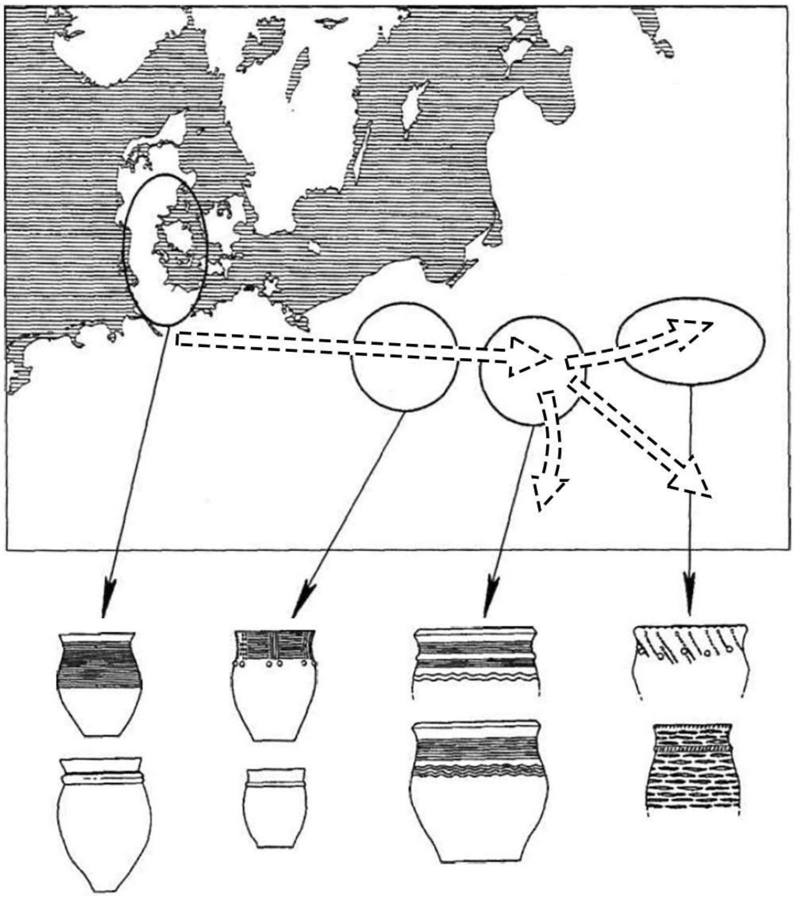

Figure 67. The dynamics of stylistic changes of the form of the "Trzciniec pot" in the lowland regions of Central Europe, and spreading routes of the Trzciniec package in Central Europe. Modified from Czebreszuk (1998).

The emergence of Trzciniec in Mierzanowice territory has been described by Jacek Górski and Sławomir Kadrow as follows (Czebreszuk 1998):

1. Migration of "Trzciniec" population from the Lowlands.
2. Initially the migrants occupy in the south only those ecological niches which they know from the Lowlands, i.e. the sandy oecumene.

3. The migrants come into contact with local settled farmers, represented by the Mierzanowice culture, which was then in a crisis; they adopt traits that will enable them to exploit loess niches.
4. Finally, the Trzciniec package is shared also by the communities of settled farmers of loess areas.

The Trzciniec culture is divided in an early phase (2000–1600 BC, coincident with the Mierzanowice culture), a classic phase (1600–1400 BC, coincident with the Tumulus culture), and a late phase (1400–1200 BC, coincident with the Lusatian culture).

The borderland nature of the *stabilised* Trzciniec culture from ca. 1900 BC makes it difficult to know the exact rates and directions of the Early Bronze Age transformations that affected its emergence. Apparently, these societies adopted more stable cultural standards only after their migration from their northern lowland enclave, when they encountered the EBA traditions of the Circum-Carpathian zone. Among 'eastern' traditions, they show cremation, proper of the Sofievka–Middle Dnieper cremation centre (Klochko and Kośko 1998).

The traditional "expansive" view holds that the Trzciniec Cultural circle (TCC), also "Trzciniec–Komarów", was a borderline community that formed a great cultural–historical province, comprising different cultural groups like Pre-Lusatian in the west, Abashevo in the east, and probably cultures of the eastern Baltic to the north. This would have been a 'phenomenon' or a 'process of cultural integration' (under a "Trzciniec package") of a society centred around the potential deposits of copper in Volhynia, and located among three large culture-making Early Bronze Age centres: Únětice–South German (related to Pre-Lusatian), Carpathian–Danube (related to the Multi-Cordoned Ware or Babino culture in the borderland), and Volga–Ural (related to Abashevo and Srubna cultures). This phenomenon would have been made up of different relatively highly autonomous groups, connecting the Carpathians to the Balkans, Anatolia and the Mediterranean. This wide TCC community would have developed into the Noua–Sabatinovka and eastern Trzciniec in the west, and Late Srubna and Sosnytsa in the east (Klochko and Kośko 1998).

Nevertheless, the Trzciniec culture proper (ca. 1700–1200 BC) formed its core area apparently on the drainages of the Lower and Middle Vistula, the Neman, and the Upper Pripyat, and in the taiga in the western part of the Dnieper's drainage, and expanded to the south-west and south, generating the loess groups and the Komarow culture. This area was apparently inhabited by sub-Neolithic forest or East European groups, characterised by Comb-like and Stroked Pottery culture represented by Linin-type pottery. A high density of settlement sites on the lowlands may indicate that the main reason for the population movement to the south was the increasing overpopulation of areas of poor soil between the middle Vistula, the Upper Pripyat and the Middle Neman rivers, and a resultant ecological crisis (Makarowicz 2010).

The Trzciniec culture connected the amber trade between the Baltic coast and the Carpathian Basin. The first amber route (first half of the 2^{nd} millennium BC) ran from the Bay of Gdańsk through Kuyavia, Great Poland, Silesia, and the Carpathian Mountains through the Moravian gate, connecting with representatives of the Ottomány-Füzesabony and Mad'arovce cultures, as well as (slightly later) Piliny, Suciu de Sus, as well as Middle Danubian and Carpathian groups of the Tumulus culture. This route was further connected to the Adriatic and to the Peloponnese (Czebreszuk 2013).

A significant permeation of artefacts of southern features is observed in this area, starting only with the emergence of the Trzciniec culture. While many non-ceramic objects may be attributed to imports, due to the formation of local elites in western Lesser Poland acting as intermediaries, the imitation of vessels points to an admixture of population with that of Krakow and the Carpathian zone (and to the south), which has been suggested as the product of exogamy from around 1650/1600 BC (Górski 2012).

These increased population movements happened at roughly the same time as other European expansions, namely the Nordic culture in western Pomerania (after ca. 1700 BC), and the Tumulus culture in Lower Silesia and Lesser Poland, probably after ca. 1600 BC, both maintaining strong cultural contacts and remaining part of a unitary cultural sphere that included kurgans and hoards of metal objects (Czebreszuk 2013).

Kurgans were only one among a great variety of elements of the burial rite found in different Trzciniec communities. A common misconception is that Trzciniec *continues* the Corded Ware tradition of building kurgans over graves, because Bell Beaker and Corded Ware cultural patterns can be seen e.g. in Mazovia and in north-eastern Poland as late as the 2nd millennium BC (Włodarczak 2017). However, the appearance of a general burial rite including barrows took place only in the classic phase (ca. 1800 BC at the earliest), in the upland belt of its central and eastern European territory, between the Upper Vistula and the Upper Dniester, and on the Podolia and Volhynia uplands.

Before this period, there was a clear decline in the number of settlement sites, both in the upland and in the lowland zones, and small-sized, short-term 'campsites' in the valleys of large rivers seem to represent most settlements, evidencing a mobile economy with a pastoral or nomadic way of life since ca. 2200 BC. Only at the beginning of the 2nd millennium appear the first (rare) kurgans in the Strzyżów culture, which usually continues flat necropolis similar to the late-stage Mierzanowice tradition. These first kurgans have a different form than earlier ones, with ca. 12 m in diameter, and ca. 1.5 m. in height, containing as many as four individual graves, arranged as three graves surrounding one in the centre. This suggests a custom of honouring some people with a special type of burial that required a substantial effort in the erection of a mound (Włodarczak 2017).

There is, therefore, a gap of 200–400 years between the complete demise of late Corded Ware groups and the emergence of early Trzciniec societies in the area, and still more until their appearance in the eastern Komarow territory, so no direct borrowing or *continuation* was possible (Czebreszuk 1998; Włodarczak 2017). It is thus more likely that they adopted the tradition from autochthonous groups at the core of the culture's origin in Lesser Poland (such as Strzyżów), or from contacts with neighbouring western Bronze Age communities during their origin and expansion, such as late Bell Beaker, Únětice, Iwno, or even expanding Nordic and Tumulus cultures.

During the first half of the 2nd millennium BC, a further transition in burial customs is seen, to a less contracted burial position. A change of the Corded Ware (and 'reversed' Bell Beaker) tradition in body positioning is seen, with bodies placed supine with the legs slightly flexed. Strzyżów also continues the Kraków–Sandomierz group tradition of egalitarian necropolis (Włodarczak 2017).

A compelling argument against this adoption from neighbouring cultures is the lack of interest of the immediate predecessor of Trzciniec in the region, the Mierzanowice culture (which they replaced), in raising mounds. On the other hand, Mierzanowice was an egalitarian society organised along territorial patterns, living in large settlements and using communal cemeteries, whereas Trzciniec communities were organised in kinship groups or lineages and mobile settlements, which may have favoured the adoption of this single grave symbolism, with functions related to the identity, integrity, funerary rites, and spatial behaviour of human groups. Especially important was then the role of grave fields as stable points for the new microregional structures, in contrast to the settlements of the previous period (Makarowicz 2010).

It has been suggested that Trzciniec colonisers adopted the custom of raising barrows—usually bigger than those of the Corded Ware culture, and on the highest elevations of any given area—by imitating those seen in the landscape, as the material embodiment of a new foundation myth. This would have allowed the newcomers to take root in the new environment, among Mierzanowice populations organised in territorial communities, in an attempt to incorporate the "pre-Mierzanowice past" by legitimising their own claims to the occupied territories (Makarowicz 2010).

The colonisers would have thus won arguments sanctioned by tradition, which carried more weight with illiterate societies, while possibly Mierzanowice peoples had not raised barrows precisely to distinguish themselves from the previous Corded Ware communities. The fact that barrows were built in linear arrangements on deforested watershed hilltops may indicate communication trails following watersheds, conducive to the movement of people, animals, goods, and possibly wagons (Makarowicz 2010).

Trzciniec settlements were often inhabited by a single family, and settlers of a microregion—using common lands for burials—were probably related by kinship and organised into clans. Subsistence strategies depended upon the specific territory, and the later phase shows also metallurgy with its own style, in contrast to previous periods of scarce imports from the west (Tumulus culture) or the south (Kadrow 2007).

Eventually, the different autonomous regions of the Central European Plain or the eastern European taiga adapted to different technical, utility and ideological patterns generated by elitist societies of the south, as well as to the expanding groups from the west and east, and the so-called Trzciniec Cultural circle gradually disappeared ca. 1300–1200 BC (Klochko and Kośko 1998).

VIII.8.4. Lusatian culture

The Proto-Lusatian culture emerges as a fringe group of the central European Urnfield culture, acquiring cultural independence at the start of the LBA (ca. 1400 BC), and showing a period of uninterrupted prosperity lasting for almost a thousand years. It spans the great river systems from the Elbe, Oder, and Vistula, and acts as a mediator between south and north. Different regional groups show influences from their neighbours, but there is a strong ideological or political structure that unifies them (Jockenhövel 2013).

The Pre-Lusatian period (ca. 1700–1400 BC) represents an evolution of Úněticean groups originally located between the Elbe and Oder basins, under the strong influence of the Tumulus culture. The area around Bruszczewo, from the Bruszczewo-Łęki Małe group (ca. 2100–1600 BC), may serve as an example of the various local disasters that could have led to this cultural division in eastern Europe: steady and intensive occupation of the land caused the depletion of trees; farming and cattle grazing which led to the degradation of the top humus layer and intensified erosion; changes in water composition including algae, eggs of human and animal parasites, and coprophilous fungi. It is very likely that the destruction of the environment ended with the demise of the group and the abandonment of the Bruszczewo settlement (Czebreszuk 2013).

Nevertheless, continuity is seen in pottery and cemeteries from the oldest period, supporting the long-term stability of the Lusatian culture in the western region. So, for example, the Kietrz cemetery, featuring approximately four thousand excavated graves in Upper Silesia, is among the largest in the entire Urnfield zone, and was used continuously from the Tumulus period up to the later stages of La Tène. Similarly, the high technological standard and specific ornamentation of knobbed ware—with knobs applied to the surface or shaped as protrusions from inside the body of the vessel—emerges during the late Tumulus and early Lusatian period. Similarities to the Eastern EBA province include the Lusatian pottery, greatly divergent from western technological standards and stylistic patterns (Czebreszuk 2013).

The western Lusatian group, between the Elbe and the Oder, can be divided into subgroups—Saale Mouth, Unstrut, and Elmsdorf or Elb–Havel groups—based on differences in burial features, pot styles and costume habits, potentially showing impediments to the spread of material culture. Urnfield groups in contact with Lusatian groups include the Middle Danubian group and the Knovíz culture to the south (in the Upper Danube) which belonged to the sphere of influence of southern Urnfield territory; whereas the Lusatian tradition belonged to the cultural orbit of northern Urnfield groups (Jiráň, Salaš, and Krenn-Leeb 2013).

During the MBA, the Lusatian tradition expanded (ca. 1400/300–500 BC) to the south-east into territories of the late Věteřov culture (heir of Únětice in

Moravia and Bohemia) forming the Moravian group. It also spread to the east into territories of previous Trzciniec culture, with a more complex expansion: in Lesser Poland, a gradual migration from Silesia is seen from ca. 1300 BC, breaking the traditional cultural barrier between the Upper Oder and Upper Vistula. In north-eastern Poland, the expansion of the culture differed from the more standard groups of Lower Silesia, Great Poland, Kuyavia, and Lesser Poland; whereas bronze objects are more abundant, population density is lower. In south-eastern Poland, the Tarnobrzeg group constituted a distinct cultural sphere, with influences from Carpathian Ruthenia to the south and the steppes to the east (Czebreszuk 2013).

The Lusatian tradition features typically large urnfields, containing thousands of graves, occupied over many generations. In contrast to Knovíz and the Middle Danubian Urnfield, where inhumation is occasionally seen, in Lusatian and Silesia–Platěnice cultures cremation is universal, and vessels are especially numerous in burial assemblages. Grave goods comprise almost exclusively large numbers of pots, with few and small metal objects. There are no graves with weapons and rich ornaments, except for the Elbe–Saale region, which functions as corridor between the Danube and the western Baltic, so the social hierarchy remains obscure (Jockenhövel 2013).

Pottery shows strong similarities in shape, typology, and ornamentation with the Urnfield culture, but differences in the evolutionary pattern can be observed, also internally among regions (Jiráň, Salaš, and Krenn-Leeb 2013):

- Initially they used decorative plastic knobs outlined with channels or grooves (heir of Tumulus culture traditions, see *§VIII.6.3. Tumulus period (MBA)*).
- In later periods, it shows continuous vertical striation, and later still these are broken into 'bundles'. There is a clear division of cooking ware and table ware, with a high technological level. In terms of shape, vessels evolve from sharply contoured forms toward soft, flowing profiles and a reduction in the height of certain forms. The great

variety of pot types include zoomorphic and miniature vessels, rattles, and shoe-shaped containers.

- During the FBA, the Silesian phase of Lusatian and the Silesia–Platěnice culture show vessels with well-smoothed surfaces and finely polished or graphited, as well as richly ornamented rattles and so-called drinking horns.

The Lusatian culture brought the stabilisation of settlement, with societies inhabiting particular microregions permanently. A dense network of fortified settlements appeared, as in central Europe, preferentially on high ground and hilly terrain, on marshlands and islands, apparently avoiding flat open country. Settlements concentrated on brown soils and their variants, and provided probably a safe haven to guard communication routes and important microregions. In the FBA, settlements moved to chernozems, which had a steppe character during this warmer and drier period, and were thus more suitable for stockbreeding, the main activity of the culture (Marková and Ilon 2013).

Fortifications likely represented for the surrounding microregions the centres of political, social, economic and religious life of the local community, with special emphasis on metallurgy, where bronzeworkers enjoyed high standing. They were probably adjacent to unfortified agrarian settlements that belonged to their sphere of influence. Unlike in the neighbouring Urnfield culture, where fortified settlements are limited to certain regions (adjacent to different cultures) and early periods, Lusatian forts continue into the earlier Iron Age, with many being built during this period. (Jockenhövel 2013).

A possible origin of its characteristic fortified settlements—potentially in common with the Urnfield culture—can be found during the early 2nd millennium BC in Bruszczewo in Great Poland, and in the Carpathian foreland strongholds of the Ottomány-Füzesabony culture. The regions of Kuyavia and Greater Poland show a complex of fortified settlements (Figure 68)—formed by compact groups of a dozen rows of houses, each row containing a dozen houses—while Silesia shows some isolated fortified settlements (Czebreszuk 2013), all probably pointing to a western fortified zone in the border regions with Nordic and Urnfield cultures. After a formative phase, the Lusatian culture shows an increase in settlement density and in production of bronzes.

Figure 68. Reconstructed gate and wall of Lusatian settlement from Biskupin. Photo by Fazer.

The Lusatian culture came to an end ca. 500–400 BC, coinciding with an increase in fortified settlements suggesting intertribal conflict, probably because of worsening climatic conditions, soil erosion, indigenous and exogenous factors, and the emergence of iron technology. After 800 BC, traces of the Hallstatt culture are felt in the west, mainly in Lower Silesia, but also scattered from Greater Poland to Kuyavia. From the east, expanding Scythians or other mounted nomads, whose evidence is found as far away as the Oder, also contributed to the Lusatian culture's demise (Jockenhövel 2013).

VIII.8.5. Pomeranian and West Baltic Kurgans culture

In the Baltic region, low population density at the turn of the 2nd/1st millennium BC changes after ca. 900 BC, evidenced by the substantial deforestation that happened over the next 500 years, and by the new necropolises and settlements, as well as numerous hoards, associated with the Pomeranian culture in its Władysławowo phase. Settlements appear in previously uninhabited territories, such as the coastal areas in Kashubia and the Gdańsk Bay, and a dense network of new villages and burial grounds grow in microregions, located at the edges of river and lake valleys, usually on level sections of slopes, but also on hilltops. Settlements feature a dense layout of structures, suggesting an intensification of food production, especially concentrated in several clusters. The majority of dwellings were, similar to Lusatian, aboveground structures with a log-frame construction, attesting a certain degree of carpentry skill (Dzięgielewski 2017).

The oecumene appears to have gradually expanded from the Oder to the east during the Warzenko and Siemirowice phases (ca. 1300–900 BC), concentrating on the upland and strips of land along the Baltic coast and the Gdańsk Bay, with severe deforestation starting only at the end of this phase. In the Władysławowo phase (ca. 900–600 BC) there is a a settlement expansion towards the coast, especially the Gdańsk Bay, and into the great river valleys, with strong internal colonisation of moraine uplands, with development of exchange relationships and long-range trade routes and bronze metallurgy (Dzięgielewski 2017).

A metallurgical centre in the lower Vistula basin produced many original forms, despite remaining under the influence of bronze-casting workshops of the Nordic circle. Imports from the north are common, while less numerous artefacts from south-central Europe are also found, with Rhine or western European findings being the least numerous. Intense contacts with Baltic cultures continues from the Bronze Age, at the same time as the western Baltic area becomes increasingly homogeneous in style of pottery and bronze metallurgy. Regions around the Baltic sea constituted a kind of communicative community, but symbols and imagery demonstrate they remained different worlds: the Nordic world, with motif of boats in bronze decoration and on rock carvings, and the Pomeranian world, with Urnfield ornitomorphic motifs (Dzięgielewski 2017).

Fortified settlements appear usually marking micro- and mesoregional clusters, without a clear defensive role, given their location outside of densely populated areas and far from the borders of the culture. They reflected thus the emergence of social differentiation, signalling the start of a strictly kinship-based chiefdom system in the area. There are no ‘centres’ of regional power similar to those of southern Scandinavia, though. Burial practices in certain regions also point to limited practices of polygyny and extended exogamy (sign of increasing social stratification), probably continuing from the Bronze Age Lusatian culture based on indirect data such as votive hoards. This could have eventually led to increased mobility of young males without prospects, especially in the later, Karczemki phase, which justifies in part the culture’s progressive colonisation of the northern area and eventual expansion to the south, possibly also triggered by the desire to control trade routes, like those developed by the Pomeranian amber exports, e.g. along the Vistula and Warta rivers (Dzięgielewski 2017).

The old tumulus necropolises disappear ca. 1000–900 BC, and ‘flat’ burial ground emerge ca. 900 BC at the earliest, most of them appearing only after ca. 800/750 BC. Nevertheless, ‘Tumulus’ communities appear to have been at the foundation of the demographic growth observable during the Władysławowo phase. Flat graves included some construction elements (cobbles and linings), and contained rectangular or polygonal stone cists, each containing one, two, or rarely several units. Deposited vessels found in funerary and settlement contexts were all produced in accordance with the ‘Urnfield canon’, and included middle-sized pots or, less frequently, large pots with two handles or vases with a round body and a narrowing neck used as urns (Dzięgielewski 2017).

The Karczemki phase of the Pomeranian culture (ca. 650–400 BC) represents the latest expansion phase, and the eventual change to alternative economic strategies, such as transhumance based on sheep–goat herds and cattle, because of dwindling resources. There is a decrease in the number of large agricultural settlements, and settlements became smaller and more scattered, with the establishment of small, clan cemeteries. Amber trade probably allowed for certain groups to survive, leading to concentration of assets in some regions, and to the increase polygyny and thus the chance for the reproductive success of some clans (Dzięgielewski 2017).

Culturally, this phase is characterised by the presence of Hallstatt-style items alongside local forms of pottery and ornaments. Remarkable is the sudden appearance of face urns only in funerary contexts, geographically limited to the west, and with a likely origin in simpler Władysławowo phase depictions, with similar anthropomorphic models of urn decoration found in Jutland and Germany by the end of the 2nd millennium BC, and in Etruscan Canopic jars in Italy. Pomeranian culture expanded to the south ca. 500–400 BC, to almost all regions of the Polish Lowland, during a period corresponding to the La Tène period north of the Alps (Dzięgielewski 2017).

At the same time as the Pomeranian culture retreated and expanded east and south following the expansion of the Jastorf and Hallstatt/La Tène cultures, the West Baltic culture of cairns (ca. 650–150 BC) also expanded in the east, evolving from the previous Lusatian culture. Further complex population movements were caused by the pressure from Germanic migrations to the south and east from Scandinavia and the German lowlands, represented by Oksywie (2nd c. BC – 1st c. AD) and later Wielbark (1st c. AD – 4th c. AD) cultures in eastern Pomerania.

The Przeworsk culture (3rd c. BC – 5th c. AD) shows continuity in its roots with the preceding Pomeranian culture, but its extension north from the Vistula to the Oder, and south toward the middle Danube from the Dniester to the Tisza valley was accompanied by significant influences from La Tène and Jastorf cultures. The subsequent absorption into the Wielbark culture—related to the East Germanic expansion—makes its precise ethnolinguistic association difficult, and it is sometimes viewed as an amalgam of a series of localised cultures (Mallory and Adams 1997), although it was likely an East Germanic-dominated culture.

East of the main Przeworsk zone was the Zarubinets culture (3rd c. BC – 2st c. AD), traditionally considered a part of the Przeworsk complex (Mallory and Adams 1997), located between the upper and middle Dnieper and Pripyat rivers. Early Slavic hydronyms are found in the area, and the prototypical examples of Prague-type pottery later originated there (Curta 2001). It is therefore the most likely culture to be identified as ancestral to Proto-Slavic (Kobyliński 2005).

Zarubinets came to an end with the migration of its population, linked to the increasingly arid climate. By the AD 3rd century, western parts of Zarubinets had been integrated into the Wielbark culture, and some Zarubinets groups had moved southward into river valleys, moving closer to Sarmatian and Thracian-Celtic groups of the Don region, forming the Chernoles culture. Central late Zarubinets sites gradually turned into the Kyiv culture (ca. 3rd-5th c.), widely considered the first identifiable Slavic archaeological culture, from which the Prague–Korchak culture—traditionally identified with the expansion of Common Slavic (Mallory and Adams 1997)—descended about the 5th c.

viii.8. Balto-Slavs

Sampled Bell Beakers of the Silesian group (ca. 2450–2050 BC) show a mean of ca. 43% Steppe ancestry: two samples from Kornice, one of hg. R1b1a1b-M269; one from Jordanów Śląski, of hg. R1b1a1b1a1a2b-U152; one from Żerniki Wielkie; and one of Strachów. Three Bell Beakers of the Vistula group from Samborzec (ca. 2450–2150 BC) have ca. 46% Steppe ancestry, all showing hg. R1b1a1b-M269, one of them R1b1a1b1a1a-L151, and one R1b1a1b1b-Z2103 subclade (Olalde et al. 2018). The influence of Mierzanowice–Nitra (with strong Carpathian influence) in the later formation of Trzciniec and Lusatian groups may justify the existence of stronger Balkan-related influences in Proto-Balto-Slavic compared to other North-West Indo-European dialects (see *§viii.11. Thracians and Albanians*). The presence of hg. R1b1a1b1b-Z2103 in the area before the emergence of the likely Proto-Balto-Slavic community further attests to such interaction around the Carpathians.

This period of dominance of R1b1a1b-M269 lineages with Bell Beakers was partially interrupted by the resurgence of previous lineages and Steppe ancestry (ca. 57%) during the Bronze Age in Upper Silesia (ca. 2290–2040 BC), in the previous area of the Bell Beaker Silesian groups: one sample from Dzielnica, of hg. R1a1a-M198, corresponds to the cultural transformation from Bell Beaker into the Chłopice–Veselé culture; one sample of the Chłopice–Veselé culture from Racibórz-Stara Wieś, near Kornice, of hg. R1b1a1b1a-L51; and a female from Iwiny (Olalde et al. 2018).

An EBA sample from Gustorzyn in the Kuyavian area (ca. 2015–1775 BC), belonging to the Iwno or Proto-Trzciniec stage, clusters closely with previous late Corded Ware samples from the area (Fernandes et al. 2018), and shows haplogroup R1a1a1b1a2-Z280, subclade R1a1a1b1a2c-S24902⁺ (formed ca. 2600 BC, TMRCA ca. 2400 BC). The wide distribution of this subclade from west to east Europe points to its expansion earlier with Corded Ware groups, as suggested by its early split.

Samples from the Turlojiškė complex in south-west Lithuania, tentatively attributed to the late Trzciniec culture (common range ca. 1200–500 BC), show admixture of Baltic Late Neolithic population with WHG and Baltic hunter-gatherers, clustering closely to Latvian samples from Kivutkalns and to modern Lithuanians and Estonians, slightly to the north of modern eastern Europeans (Mittnik, Wang, et al. 2018). Samples include three of hg. R1a1a1b-Z645, including one subclade of hg. R1a1a1b1a2a-Z92 (YP617+)⁺ (formed ca. 1400 BC, TMRCA ca. 1400 BC). The distribution of R1a1a1b1a2a-Z92 (formed ca. 2600 BC, TMRCA ca. 2500 BC) mainly among modern Fennoscandian peoples and northern Russians, and the ancient cluster formed with other Baltic peoples, points to the relationship of this haplogroup with the eastern Baltic rather than with the Trzciniec culture (Suppl. Graph. 11).

Since both territories of the Trzciniec culture sampled lie each at one edge of its east–west territory, and no sample can be clearly attributed to the culture (one is too early, the other too late), the overall genetic picture of the culture remains unclear. However, the presence of one clear outlier in Baltic Bronze Age samples from Turlojiškė (ca. 1075 BC) supports the close contacts of this area with central Europe, most likely facilitated by the Trzciniec culture, which can then be classified as genetically central European rather than Baltic-like, consistent with its cultural influences. These and later interactions with peoples of the Battle Axe culture reveal the origin of long-term Balto-Slavic–Finno-Permic contacts (Koivulehto 2006; Kallio 2008), including the likely evolution of North-West Indo-European-like Pre-Balto-Slavic phonology derived from Finno-Permic bilingual speakers becoming eventually Balto-Slavic speakers.

It is therefore likely that the central European-like ancestry of Iwno–Trzciniec became even more western European with the expansion of the Lusatian culture, under the influence of the Tumulus and Urnfield cultures. Even though there is no sampling of the Lusatian culture yet, the Urnfield samples from the Lichtenstein Cave in Saxony-Anhalt (ca. 1000– 00 BC) lie close to the culture's border, and they show a mixed society including probably ten individuals of hg. I2a1b2-L621, one R1a1a1b-Z645, and one R1b1a1b1a-L23 (Schilz 2006; Lipson et al. 2017), as is expected from a developing Balto-Slavic community in the east, based on findings among early Slavs (see below).

Chemical traces suggest that warriors from Tollense (see *§VIII.6.3. Tumulus period (MBA)*) close to the Lusatian culture territory, came from far away, with only a few showing values typical of the northern European plain. While the majority of sampled individuals fall within the variation of contemporary northern central European, but slightly shifted to EHG populations, there are some outliers closer to Neolithic LBK and modern Basques (Suppl. Graph. 12), suggesting that central and western European

EBA cultures were still at that time closely interconnected (Sell 2017). The renewed contacts of the Late Bronze age between the British Isles, Iberia, Sardinia, and Scandinavia, apparent in the pan-European warrior symbolism—such as bi-horned warriors and their presence in rock art panels—likely relied on close and direct human interaction (Melheim et al. 2018), continuing thus the connections created during the Bell Beaker expansion a thousand years earlier.

The east-central European origin of Balto-Slavic peoples during the Bronze Age seems thus to be supported by the findings of the Tollense valley, where most sampled warriors cluster closely to modern northern-central Europeans, including East Germans, Austrians, and West Slavic populations (Sell 2017). The prehistorical regions of interaction formed by Únětice–Mierzanowice, Tumulus–Trzciniec, and Urnfield–Lusatian cultures are thus the best candidates for the ancestral Balto-Slavic community, as is the partial continuity in lineages under I2a1b2-L621 and R1a1a1b1a1a-M458 in early Slavs.

The nature of Balto-Slavic peoples as stemming from an east-central European population, initially not related to Corded Ware-related ancestry, is more clearly seen in the genetic shift from the Corded Ware population—originally linked to Uralic-speaking peoples (see *§vii.1. Western and Eastern Uralians*)—towards a central European cluster in the late Trzciniec outlier and early Slavs (see below), continued today in modern West Slavs.

This cluster is also close to the only available samples from ancient east-central Europe: a late Corded Ware/Proto-Únětice sample and the two Iwno/Proto-Trzciniec samples. The multiple documented migrations of steppe-related peoples to the west (see *§viii.19. Iranians*), and the hypothesised alternative origin of the Slavic expansion near the north Pontic area should have shifted early Slavs genetically from a Corded Ware cluster to the east, and not—as these ancient samples and Modern Slavs show—to the west.

This east-central European origin stemming ultimately from the Bell Beaker expansion is also supported by the sizeable presence of varied

R1b1a1b1-L23 subclades (ca. 10-30%) in Slavs of east-central Europe and among Balts (Semino 2000; Luca et al. 2007; Rębała et al. 2012; Kushniarevich et al. 2015), in contrast to the bottlenecks seen in some East Slavic (under typically Finno-Ugric R1a1a1b1a2a-Z92 subclades) and South Slavic groups (under typically Balkan subclades). The simplistic attribution of these varied R1b1a1b1-L23 lineages to recently acculturated "Germanic" or "Celtic" peoples must be, therefore, rejected.

viii.8.1. Balts

There is a great degree of genetic continuity in modern Baltic-speaking peoples with the Bronze Age population of the area (Mittnik, Wang, et al. 2018), which suggests either an infiltration of peoples of Lusatian origin in the Pomeranian and related West-Baltic culture of cairns and admixture with locals, or rather an earlier infiltration through the Trzciniec culture, as evidenced by the Bronze Age outlier. In fact, we could tentatively identify the infiltration of Proto-East Baltic peoples among Baltic populations—hence retaining mainly their 'eastern' male R1a1a1b1a2-Z280 lines—with late Trzciniec, and a slightly later arrival of Proto-West Baltic peoples with the West-Baltic culture of cairns and possibly more R1a1a1b1a1a-M458 lineages, which would fit their ancestral split.

Before the migration period, Baltic peoples probably bordered Finno-Permic tribes around the Upper Daugava and the Upper Dnieper, even though studied hydronyms show that Finno-Permic names reached the Lower Daugava, too (Ojārs 2014). The Late Dyakovo culture (ca. AD 3rd–7th c.) and the Long Barrow culture (ca. AD 5th–10th c.) probably represent the continuation of the previous Dnieper–Dvina culture as West Uralic in nature[29],

[29] According to Kallio (2015): "(...) the substrate toponyms tell us more about the extinct Uralic languages spoken further in the north in the Northern Dvina region where the Slavicization took place so recently during the third quarter of the second millennium AD that its Uralic substrate toponyms are much easier to identify. In addition to later Finnic strata, there also seems to have been an earlier stratum having close ties to Saami, even though it most likely represented another separate branch of Finno-Mordvin (Saarikivi 2004b, 2007a; Helimski 2006)."

the proto-historical Chudes (Figure 69), at the same time as the Scratched Surface Ceramics typical of Baltic countries influenced the western areas, likely representing incoming Eastern Balts. The Long Barrow culture was also influenced in a later period by East Slavs from the south (Rahkonen 2011).

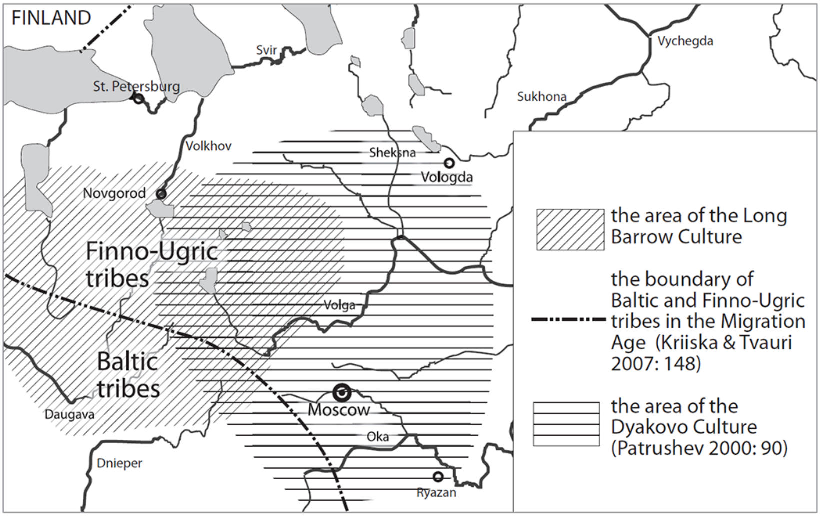

Figure 69. Boundary of Finno-Permic and Baltic tribes in the Age of Migrations according to Kriiska & Tvauri (2007:148). Image modified from Rahkonen (2011).

The Kolochin material culture was a transformation of the old Kyiv culture (Kobyliński 2005), but evidence of Baltic river names in the region has made some propose an original Baltic occupation (Mallory and Adams 1997) before the East Slavic migration. Indeed, Baltic peoples have been found to be genetically the closest to East Slavs (Kushniarevich et al. 2015), which is compatible with Baltic- and Finno-Permic speaking peoples undergoing a cultural assimilation ('Slavicisation') with the East Slavic expansion, evidenced by a stronger influence of Finno-Permic on Slavic than on Proto-East Baltic or Proto-West Baltic. A precise analysis of a temporal transect of Finno-Ugric and Baltic populations would be necessary to discern which R1a1a1b-Z645 (and N1a1a1a1a-L392) subclades may have been associated with which migrations and expansions in north-eastern Europe.

viii.9.2. Slavs

The division of historical Slavic tribes in territories and cultures of the AD 5th–7th centuries remains a hotly debated topic (Curta 2001), and the adoption or introduction of Slavic in east-central and eastern Europe is impossible to pinpoint with precision, despite commonly accepted views such as the link to the Prague-Korchak culture (Suppl. Fig. 16). Nevertheless, this culture is believed by German archaeologists to have come to east-central Europe from the south, not from the east, while archaeological influences seen in the east seem to have come from the Middle Danube to the Middle Dnieper, and not in the opposite direction (Curta 2019).

For the expansion of Slavonic, some have proposed the model of a *koiné*, others that of a *lingua franca*, the latter most likely used within the Avar polity during the last century of its existence. The most acceptable model today is that Proto-Slavic movements may have been initially triggered by Germanic migrations (see *§viii.7. Germanic peoples*), spreading thus from a tiny region close to the West Baltic (based on its connection with Baltic languages). Common Slavic must have spread closer to the Carpathians in the second half of the first millennium, with the first unequivocal historic attestations appearing around the Middle Danube (Curta 2019).

Early Slavic is known to have spread differently in the different regions: the sparsely populated area in the north-west was probably subjected to migration; the east shows mainly assimilation and language shift among Finno-Ugric groups; and the south-east might show a more complex scenario, involving both phenomena, migration and language shift (Lindstedt and Salmela 2019).

Two females of the Avar culture in Szólád (AD 540–640) are genetically similar to modern eastern Europeans: one clusters between modern Russians, Ukrainians and Latvians (consistent with the contacts of Avars in their migrations through eastern Europe), and one closer to Poles (consistent with the admixture of Slavs, of a more western cluster); both suggest thus a rapid population turnover after the Migration Period (Amorim et al. 2018). Two Early West Slavic females from Bohemia (ca. AD 600–900) cluster with modern Czechs, western Poles, and eastern Germans, suggesting a great degree of continuity among West Slavic populations since the Middle Ages (Allentoft et al. 2015).

The complex nature of early Slavonic ethnicity is also reflected in the varied haplogroups among early Slavs: Two West Slavs from Niemcza, Silesia (AD 900–1000) show hg. I2a1b2-L621 and J2a1a-L26; one from Markowice, Greater Poland (AD 1000–1200) shows hg. I1a2a2a5-Y5384 (Stolarek et al. 2018)[30]; two from Usedom, in Mecklenburg-Vorpommern (AD 1200), show hg. R1a1a1b1a1a-M458 and E1b1b-M215 (Freder 2010), and another one from Hrádek nad Nisou, in Northern Bohemia (ca. AD 1330), also shows E1b1b-M215 (Vanek et al. 2015). An early East Slavic individual from Sunghir (ca. AD 1100-1200), probably from the Vladimir-Suzdalian Rus’, shows hg. I2a1a2b1a1-CTS10228+ (formed ca. 3100 BC, TMRCA ca. 1800 BC), while the paternal lineage of Yaroslav Osmomysl, the Prince of Halych, has been reported to be E1b1b1a1b1a-V13.

The high variability in haplogroups, and the common finding of I2a1b2-L621 (likely I2a1a2b1a1-CTS10228) and E1b1b-M215 (likely E1b1b1a1b1a-V13) lineages in independent early Slavic samplings, apart from the prevalence of I2a1a2b1a1-CTS10228 among modern South Slavs, and their sizeable presence among West Slavs, supports that the current distribution of R1a1a1b1a-Z282 lineages in Slavic populations is mainly the product of recent bottlenecks. Individuals of hg. E1b1b1a1b1a-V13 and I2a1b2-L621 among Hungarian Conquerors and Early Hungarians (see below *§viii.17.1. Ugrians*) support that these were originally paternal lines associated with early Slavs from the Carpathian Basin.

[30] Two more samples from Poland are reported as E1b1-M215 and R1a-M420, although the precise subclades and sites are unknown, and they could be related either to East Germanic or to West Slavic peoples.

The shared E1b1b1a1b1a-V13 lineages from the West Baltic to the Balkans during the Iron Age (see below *§viii.11. Thracians and Albanians*) would support an origin of the expansion around the Carpathians. The prevalence of this subclade among Rusyns (ca. 35%)—East Slavs from the Carpathians not associated with the Kievan Rus' expansion—coupled with studies of Slavic toponymy (Figure 70), place the East Slavic homeland white accurately north of the Carpathians (Udolph 1997, 2016).

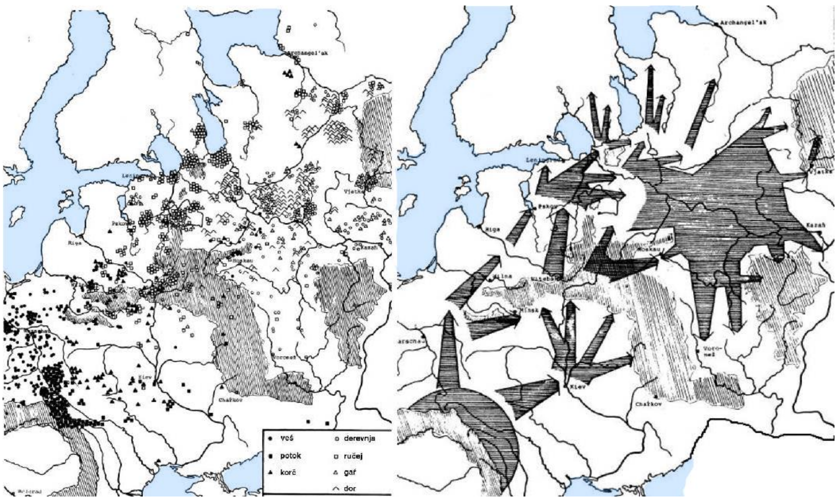

Figure 70. Left: map of older and younger East Slavic names. Right:Conversion of data to expansion of East Slavic settlements. Image from Udolph (2016).

An individual of European admixture of the Golden Horde Mongol State, from Karasuyr, Kazakhstan (AD mid–13th c.)—buried together with a high status individual of East Asian ancestry and hg. C2-M217, both with buddhist customs (de Barros Damgaard, Marchi, et al. 2018)—clusters close to Baltic Bronze Age and Iron Age samples (see below *§viii.16. Saami and Baltic Finns*). His haplogroup, R1a1a1b1a2a1a1a1-YP575 (formed ca. AD 250, TMRCA ca. AD 250), a subclade of hg. R1a1a1b1a2a-Z92, is also related to ancient north-eastern Europeans, and is present in modern populations from Fennoscandia and Eastern Europe.

This individual was probably related to early East Slavs from the region, hence a paternal line corresponding to acculturated Baltic Finns or Volga Finns, since it is generally accepted that Russians assimilated many Finno-Ugric groups of East Europe before the Slavonic migration to the area. Alternatively, he may have been himself the product of the eastern European slave trade that connected eastern Europe with Fennoscandia (Korpela 2019), although the features of the burial do not seem proper of a recent slave. Both interpretations may explain the high Finno-Ugrian admixture found in the modern East Slavic populations, reflected in their *eastern* cluster in the PCA and in their prevalent R1a1a1b1a2a-Z92 subclades, which further supports the origin of early Slavs to the west. This Finno-Ugric origin of East Slavs, especially among the Kievan Rus', is also supported in whole genomic studies of modern Russians (Zhernakova, Evsyukov, et al. 2019; Zhernakova, Brukhin, et al. 2019).

The expansion of the Penkov culture in the Danube has been related to the expansion of South Slavic, although it was a culture most likely related to steppe nomads. Confusing accounts of the Byzantine Empire of the raids and migrations of a federation of tribes (the Antes and the Sklavenes) in their frontiers give a general idea of the complex interaction of different groups in the Balkans (Curta 2001, 2019). The prevalent distribution of hg. I2a1b2-L621 among modern South Slavic populations (Kushniarevich et al. 2015) suggests a relevant role of Slavic migrations to the area, apart from recent bottlenecks.

The western Baltic and eastern European peaks in the modern distribution of R1a1a1b1a1a-M458 lineages (Underhill et al. 2015), especially R1a1a1b1a1a1-Y2604 (formed ca. 2700 BC, TMRCA ca. 2500 BC) with its main subclades R1a1a1b1a1a1c-CTS11962 (TMRCA ca. 1100 BC) and especially R1a1a1b1a1a1a-L260 (TMRCA ca. 500 BC), support west–east migrations of this lineage coinciding with the Late Bronze / Iron Age, potentially associated (at least in part) with Balto-Slavic movements. On the other hand, subclades R1a1a1b1a1a1a1-YP256 (TMRCA ca. 200 BC) and R1a1a1b1a1a1a2-YP1337 (TMRCA ca. AD 450 BC) could be linked to Proto-Slavic migrations under these lineages during the Iron Age / Early Middle Ages (Horváth 2014). This is also suggested by the presence of rare

R1a1a1b1a1a-M458 subclades in modern Poles, and by the lack of this haplogroup to date in sampled north-eastern European (i.e. Finno-Ugric) and steppe (i.e. Indo-Iranian) peoples, contrasting with R1a1a1b1a2-Z280 lineages, which are found widespread in eastern Europe and Asia.

Certain R1a1a1b1a2-Z280 (xR1a1a1b1a2a-Z92) subclades have been proposed to be involved in early Slavic expansions; for example, R1a1a1b1a2b3a-CTS3402 (formed ca. 2200 BC, TMRCA ca. 2200 BC) is prevalent among R1a1a1b1a-Z282 subclades in modern Slovenians (Maisano Delser et al. 2018), and other subclades are also found among modern West, South, and East Slavic populations, as well as some modern central European peoples.

However, the widespread presence of R1a1a1b1a2b-CTS1211 and shared haplotypes in modern Finno-Ugrians on both sides of the Urals—including its presence among Hungarian Conquerors (see below *§viii.17.1. Ugrians*)—suggest that this haplogroup was originally a Finno-Ugric paternal line, and many modern (especially East) Slavic R1a1a1b1a2b-CTS1211 lines are from recently acculturated Finno-Ugric populations in the past 1,000 years. Nevertheless, some early subclades seem to have formed part of ancient east-central European populations, likely including Proto-Baltic and Proto-Slavic peoples close to the Baltic, before their expansions to the east and south, respectively.

VIII.9. Adriatic province

VIII.9.1. Cetina

Proto-Cetina/Cetina, in the southern Balkans, appears as a Bell Beaker periphery connecting the West Adriatic coast with the East Adriatic area ca. 2400–2300 BC, under the influence of Central Mediterranean Bell Beakers, whose heartlands are on one hand northern Italy and Tuscany, and on the other hand Sardinia and western Sicily (Heyd 2007).

Wristguards are present in higher quantity than in northern Italy or the Csepel group, and known from the published sites both in some numbers and as single finds, in settlements as in graves. There are also triangular riveted daggers, apart from gold jewellery in a rich grave inventory in Nin–Privlaka. There are many undecorated bowls, jugs, and cups, proper of the Begleitkeramik of the Middle Bell Beaker period, instead of Bell Beakers, of which only two beaker derivates are found, created in contact with the Adriatic variant of Vučedol (Heyd 2007).

Tumuli of several meters in diameter, primarily of stone, can have a kerb of large stones. They contain usually a rectangular cist grave made of stone slabs, with a stone-covering slab. A single person buried in a contracted position on the left or right side is the standard. Cremation is mixed with inhumation, showing local differences in the burial ritual. Tumuli with no remains are common, probably representing cenotaphs (Teržan and Karavanić 2013).

Cetina is therefore a syncretistic culture developed probably in combination with local cultures by migrating Bell Beakers, likely from a region near the Adriatic island of Palagruža, where Bell Beaker elements are predominant: wristguards, comb–stamp decorated pottery sherds with Bell Beaker decoration, and flint-inventory with characteristic arrowheads typical of Mediterranean Bell Beakers (Heyd 2007). Characteristic settlements, especially in the western Balkan hinterland, suggest that Cetina settlers were nomadic herders.

The twenty-five Cetina sites comprise the whole northern and western Adriatic shore, stretching from Trieste in the north to the ‘heel’ of southern Apulia, with concentrations around the Daunia peninsula and the Apulian plain, with related pottery in the Corazzo–Zungri settlement showing extension towards Calabria and further inland, including also a northern site in the province of Trento. Its influence is thus felt along the Adriatic from Istria and the karst hinterland of Trieste to the Peloponnnese and the southern Apennines, but also to the western Balkan hinterland, where no settlements (other than cave shelters) are known (Heyd 2007).

Chronologically, it seems that first maritime beakers appear ca. 2500 BC or shortly after that in south and south-east Italy, impacting native cultures like the Laterza–Cellino San Marco culture. After that, Italian Cetina appears ca. 2500–2300 BC, under the most recent Bell Beaker influence with the stamp and puncture decorated vessels preceding the classic (East Adriatic) Cetina phase (Figure 71) and its typical framed decoration that appeared later (Heyd 2007).

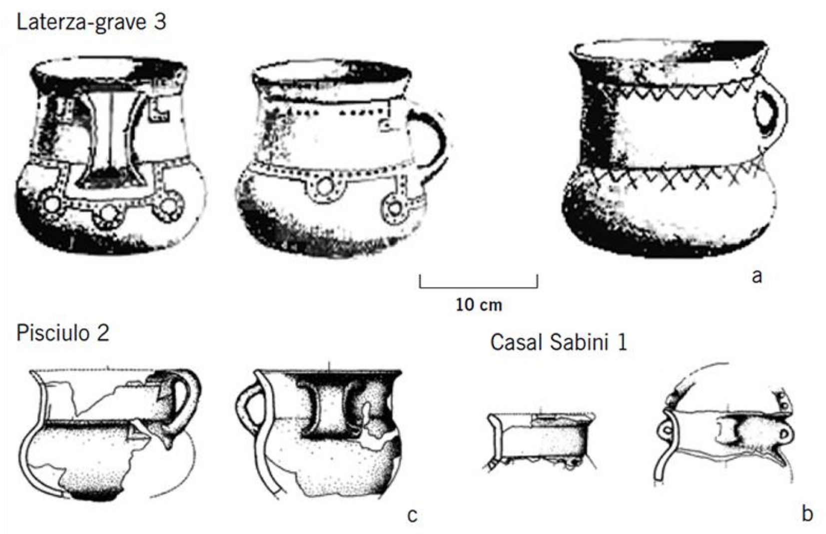

Figure 71. Cetina-type pottery from Apulian sites. Image modified from Pacciarelli, Scarano, and Crispino (2015).

VIII.9.2. Castellieri

The term Cultura dei castellieri or Kašteljerska kultura is used to define the Bronze Age culture with characteristic settlements particularly prevalent in the northern and north-eastern Adriatic region. The culture features *castellieri-gradine*, settlements in strategic positions that could be easily defended—like prominent hills, edges of high plateaus, tongue-shaped promontories on valleys—fortified with dry-stone ramparts adapted to the terrain, either surrounding the settlement or built on the more accessible places (Mihovilić 2013).

It features a well-organised society with knowledge of building methods. Settlements located on tops of hills or other selected sites were levelled, with stone being broken and extracted. Plans show a proto-urban organisation, with the larger settlements featuring a separated fortified citadel or acropolis containing large structures, covered doorways, narrow passageways, etc. Labyrinthine entrances became with time an additional way to secure the settlements, as was the additional earthwork with sharp upright stones found some 10 m in front of the rampart circuit in certain settlements (Mihovilić 2013).

Findings in central areas confirm they were inhabited by a ruling elite, supporting the existence of a stratified society. All areas surrounded by ramparts—which ranged from 2/3 to 10 m in width, and from 3 to 6/10 m in height—were intensively settled. Apparently, houses had rectangular, 1m-high stone foundations often carved into the level bedrock, complemented with a wooden superstructure. Cavities hollowed out from the bedrock may have served to collect rainwater from house roofs, which would have been necessary since the Adriatic has a problem of water supply (Mihovilić 2013).

Castellieri appear to have formed centres of specific surrounding microregions, potentially specialised and forming alliances with others. Near the castellieri, short-lived settlements are known from caves and rock-shelters, and the importance of cattle-breeding supports its potential link to the main settlements. Grinding stones confirm the importance of agriculture, and vine-growing areas are also found. Long-range trade contacts are evidenced by loaf–of–bread idols (particularly important in the Lower Danube, Moravia, and northern Italy), amber beads (typical of southern Únětice and Tumulus), and finds of bronze weapons of south-eastern (Aegean) and north-western (Rhône, Italian) origins (Mihovilić 2013).

Inhumations in stone cists covered with stone tumuli or in small cemeteries beside the main entrance are the standard from the EBA on. The fortified settlement at Monkodonja, characteristic of the culture, shows two peculiar tombs integrated into the monumental labyrinth-like main entrance, containing rectangular stone cist graves. They represented probably special burials of selected members of the local elite, with cult of the forefathers (Teržan and Karavanić 2013). The emergence of cremation marks a crisis during the Urnfield period, with abandonment of some settlements and a new wave of castellieri being established, at the same time as Proto-Villanovan and Late Helladic IIIC findings appear in its material culture.

The Posušje or Dinaric culture of the Dalmatian hinterland lasted from the EBA to the MBA, and features small hill forts of a mean 50–100 m^2, elevated settlements fortified with powerful walls, in some cases including bastions, made in the dry-stone technique. Larger settlements (ca. 150 m^2) have an interior with additional walls, showing a complete fortification with an acropolis. Posušje hill forts shows parallels with the Castellieri culture, and its sedentary farmers (primarily agriculturalists) coexisted with the Cetina culture of nomadic herders in the same geographical area. In the Adriatic and its hinterland, inhumation is the main rite, although in some places cremation was also used (Teržan and Karavanić 2013).

In the Late Bronze Age (ca. 1200–800 BC) human occupation in the valleys (*polja*) of the Dinaric Alps in Croatia, like Gacka to the north and Ličko to the south, show a change from ephemeral sites to increased burial activity, including inhumations under earthen and stone tumuli, and the emergence of hill forts, which proliferate near mountain passes and river access points, suggesting their need for defence and control of resources. The largest hill forts in each valley acted as a centralising force for smaller forts and settlements nearby (Zavodny et al. 2018).

The end of the Bronze Age marks a dramatic change in regional burial practices to large communal necropolises close to hill forts, with the appearance of Baltic amber in graves highlighting changing sociopolitical and economic forces, including the participation in interregional trade networks, marking the start of an integrative regional culture known as the Iapodians, who existed until the Roman conquest (ca. 35 BC). This period marks a trend towards intensified and expanded animal management practices, with cattle and sheep–goat herds becoming larger and more numerous, necessitating non-local pastures, which were found in the hillsides around valleys or into even higher mountain areas, in order to preserve valley bottoms for agriculture (Zavodny et al. 2018).

VIII.9.3. Vatina

The continental areas of the western Balkan Peninsula south of the Pannonian basin and west of the Dinaric mountain range form part of an extensive ore-bearing region, probably exploited throughout the Copper and Bronze Ages. The Somogyvár–Vinkovci culture dominated to the north, as a transitional cultural phenomenon related to traditions of the preceding Vučedol culture. Settlements were usually located on elevated positions near waterways, including artificial heights like tells, usually without fortifications. Houses were rectangular, above-ground, single-roomed constructions built with load-bearing wooden beams. Dug-in structures were also common, potentially as cellars or storage pits. Subsistence economy was based on stockbreeding, mostly cattle, but also pigs and small animals, and a mainly sedentary way of life can be assumed (Teržan and Karavanić 2013).

The Vatina culture (ca. 2100–1600/1500 BC) represents a significant cultural shift in the whole region. It is represented by few large fortified ‘central’ settlements dominating over microregions. This contrasts with previous periods, where large numbers of smaller, mostly unfortified hamlets predominated. Settlements were surrounded by a defensive ditch and earthen bank with palisade, with some kind of ‘suburb’ or outlying settlement outside the defences. The fortified area showed a proto-urban organisation, with standardised rectangular houses arranged along narrow streets, with some broader ones representing the main corridors. The house interior fittings showed a high level of living style. Up to one thousand people could inhabit the whole settlement area (Teržan and Karavanić 2013).

In the mountainous parts, in the middle of ore-bearing areas, contacts and synthesis are seen between the Mediterranean and areas of Carpathian–Danubian cultures, forming the so-called ‘transitional zone’ between Pannonia and the Adriatic. Small, elevated settlements or hill forts with natural defences are prevalent from 2000–1600 BC, with high population density and a clear sociopolitical connection with Vatina, reflected in the proto-urban organisation and layout of settlements. Traces of metallurgical activity are found in these settlements (Teržan and Karavanić 2013).

During the MBA, smaller unfortified settlements replace the previous large Vatina settlements, mainly along the edges of the plateau and on lower-lying terraces, at roughly equal distances from one another, mainly small hamlets with 2–6 buildings up to 50 m from one another, indicating individual farms. This new economic base and spatial utilisation suggests an organised colonisation of the area, possibly with a hiatus from the previous Vatina culture (Teržan and Karavanić 2013).

Cremation burials were prevalent, as in many groups in Pannonia and the western Balkans, but there were also individual inhumations featuring weapons (swords and battle–axes) already during the EBA, without a direct relationship to the Tumulus culture, which suggest some sort of convergence phenomenon. This trend is later kept in the cultures succeeding Vatina, and spreads into more southern groups like Donja Brnjica–Gornja Stražava group (Teržan and Karavanić 2013).

During the classic Urnfield period, new groups featuring large flat urnfields with hundreds of graves settle the central Danube basin up to the south in modern Slovenia, showing strict gender differentiation and social stratification. In central and eastern Serbia, the surviving groups succeeding the Vatina culture during the LBA show tumuli as the standard burial ritual, but cremation is also common. Material culture points to strong contacts with Glasinac, but also with Danubian, other western Balkan, and Aegean cultural spheres (Teržan and Karavanić 2013).

VIII.9.4. Glasinac and Paraćin

The Glasinac culture evolves from Vatina in modern central Bosnia and western Serbia, and continues into the Early Iron Age. This regional variant shows mainly earthen tumuli of ca. 8–12 m diameter found in large groups. Mounds contain usually several graves with pebbles on the base, lined and covered with stones, with the dead in an extended or slightly contracted position, but there are also cases of cremation. The erection of mounds suggest the use for family burials for one or two generations, and together with rich assemblages they evidence social stratification and cult of the warrior (Teržan and Karavanić 2013).

Further to the south, the Paraćin group (along the course of the Morava) and the Donja Brnjica–Gornja Stražava group to the south and west of Paraćin show mainly cremation and urn burials coexisting with inhumation, with a complex burial rite featuring special constructions of stone slabs and circuits of stones, and grave pits lined and covered with stones suggesting graves or clusters of graves under small tumuli.

Weaponry and prestige goods in inhumations suggest that they were representatives of the social elite, possibly of foreign origin. Tumuli are the dominant form of grave monument, with no or scarce grave goods, and warrior cult manifested through weaponry in assemblages. Apart from local differences (such as the body position), the burial rite shows a tradition rooted in the Cetina culture. Nevertheless, some MBA groups in the Adriatic hinterlands show collective or double burials with specific rituals that probably reflect some degree of isolation of different communities (Teržan and Karavanić 2013).

To the west of the Middle Danube, the Virovitica culture replaced the *Litzenkeramik* group of Somogyvár–Vinkovci, and expanded further to the south, with numerous settlements located in plains on low elevations near waterways, sometimes with defensive ditches fortified with a palisade. Houses were single-roomed buildings joined in small, dense groups around a courtyard area that contained several hearths or ovens, probably representing farming settlements (Teržan and Karavanić 2013).

The LBA marks another change in settlement pattern, with a large number of MBA settlements abandoned. The Kalakača–Bosut horizon shows the emergence of settlements arranged in groups of several small rectangular buildings representing individual farming households. Basarabi-type pottery appears from the eastern Balkans, and the synchronic radical reduction of settlements—with the survival or emergence of a few on fortified positions—supports an invasion of nomadic horsemen from the eastern steppes (Teržan and Karavanić 2013).

West of the Danube, an increase in occupation is seen during the Urnfield period in the lowlands along watercourses, coinciding with an increase in metallurgical production and extensive trade, probably led by specialised craftsmen and travelling prospectors. Two main types of settlements can be distinguished: open or scattered settlements without defensive systems, probably individual farmsteads; and fortified, central settlements with proto-urban features, especially after ca. 1000 BC, located primarily on elevated outcrops or high river terraces. These lasted until the Iron Age, when new fortified settlements, hill forts, formed at elevated spots, leading to a new territorial organisation (Teržan and Karavanić 2013).

viii.9. Messapians and Illyrians

It remains unclear if Messapic expanded with Bell Beakers migrating through the Italian Peninsula, or rather southward through the eastern Adriatic coast. Based on the connections of the Cetina culture with Bell Beakers from the Italian Peninsula, and the potential nature of Messapian as a North-West Indo-European dialect, it seems more likely that Proto-Messapic speakers expanded first southward from the Alps into mainland areas east of the Appennines, and were later replaced and displaced to the south-eastern corner with migrations of Italic peoples.

Two individuals from Early/Middle Bronze Age from Veliki Vanik in Split-Dalmatia (ca. 1630–1510 BC) include one of hg. J2b2a-M241 (formed ca. 118000 BC, TMRCA ca 7800 BC), probably corresponding to subclade J2b2a1-L283 (TMRCA ca. 3400 BC), since basal clades are found today in modern populations of southern Italy and Anatolia. These and a later sample of the Late Bronze Age from the Jazinka Cave, near Nečven (ca. 780 BC) show similar ancestry to other available Balkan samples, but with increased Steppe ancestry (ca. 35%), and slightly less WHG (although similar EHG) contribution compared to other Early Bronze Age individuals from the Balkans.

Interestingly, this haplogroup, which probably arrived in the Balkans from a westward expansion through Anatolia during the Chalcolithic or Neolithic, is found later in Armenia MLBA in an individual with Steppe ancestry (see *§viii.14. Caucasians and Armenians*). The finding of haplogroup J-M304 among Mycenaeans (see *§viii.12. Greeks and Philistines*) further suggests a relative infiltration rather than a massive migration of Yamna male lineages in the southern Balkans, probably due in great part to the higher demographic density of south-eastern Europe (Müller and Diachenko 2019).

In the south-east, Messapic-speaking Iapyginians from Botromagno (ca. 7th–4th c. BC) show mainly mtDNA subclades H and U, while the later Romans from nearby Vagnari (ca. AD 1st-4th c.) show more varied mtDNA haplogroups, with closer affinities to eastern Mediterranean populations. This replacement may be associated with the migration of Romans from central and northern Italy, but is likely to represent a direct gene flow from the eastern Mediterranean due to immigration or slave trade (Emery 2018).

VIII.10. Carpathian province

The EBA in the Carpathian area is marked by a great population increase compared to the previous period, suggested by a peaceful lifestyle in tell settlements and the large number of graves in cemeteries. Advanced cultivation skills (grain cultivation supplemented with horticulture) and cattle breeding are probably behind this improvement. Riverine transport and animal transport over land, suggested by spoked wheels and horse cheek-pieces, suggest intense trading networks (Marková and Ilon 2013).

Similar to the findings in the Baltic coast, east Baltic inland and Belarus (see *§VIII.8.2. North-Eastern province – Iwno*), there is a sort of eastern *march* of the Bell Beaker territory that spans from the easternmost Classic Bell Beaker groups (like Moravia or Csepel) to western Ukraine, where the comb–stamp decorated beakers with horizontal band structure are strongly reminiscent of Classical Bell Beakers, even though their shape is clearly original from the Catacomb Grave culture (Heyd 2013).

Bell Beaker findings in this huge eastern area of influence, which covers the Carpathian Basin, include wristguards, *Begleitkeramik*, flint arrowheads, and bone pendants, as well as the preferred comb–stamp decorated vessels and sherds with horizontal zoned decoration. They reflect their late connection with Bell Beaker, as well as cultural adaptations to local or regional cultures. The Csepel group shows often cremation graves instead of inhumation as is common to the west, and features extensive riverbank settlements with boat-shaped buildings and ritual pits. Bell Beaker materials are also encountered in traditional Vučedol territory (Heyd 2013).

Roots of the EBA of the Carpathian region are found in the extensive Makó/Kosihý–Čaka culture, which showed isolated graves featuring cremation in scattered graves and in urns, and sporadic inhumations at the end of the culture. Metallurgy shows a connection with Circum-Pontic cultures, including artefacts and moulds for copper, and shaft–hole axes During the EBA, the Somogyvár–Vinkovci culture dominates over the north and north-western Balkans up to Transdanubia in the west. It shows scattered, short-term open settlements, with post-built or semi-subterranean houses, and varying funeral rites including usually inhumations, and less often urned cremations, with graves in mounds, flat, or with stone packing (Marková and Ilon 2013).

The Nagyrév culture from the Danube–Tisza region to the Carpathians in the north show short-lived, unfortified, sparse settlements, with post-built houses and relief ornamentation in walls and pottery. Burials feature scattered graves and urned cremations, with inhumations proper of its formative phase (Marková and Ilon 2013).

In the north-east Carpathian area, the Nyírség–Zatín culture shows single-phase upland and lowland settlements and tells. Burial rite was cremation in an urn. The Andrid culture represents a transitional group with the Ottomány culture, appearing in settlements before tell sites. It is supposed to have consisted of farmers and stockbreeders. Cremation in pits or urns was the preferred burial rite (Marková and Ilon 2013).

The Kisapostag culture was based on the Makó/Kosihý–Čaka culture, with contributions from the late Somogyvár culture. Cremation is prevalent, with urns and scattered graves. Copper-sheet industry artefacts (like pendants, tubes, diadems) are typical, and imports from this culture are found as far as the Tisza region in the east, and the upper Danube in the west. It was succeeded by the Transdanubian Encrusted Pottery culture (also North Pannonian culture), with a distinction into a northern and a southern group. Settlements are usually short-lived, and cattle breeding is the main subsistence economy. A hierarchy is suggested based on settlement size. Cremation in pits and urns are the norm, they are placed in groups, and elite objects associated with social ranking are deposited in a ritual manner (Marková and Ilon 2013). West of the Danube, the wire-brushed pottery culture (Litzenkeramik) was probably a regional variant of the Kisapostag culture, and the few graves found show bi-ritual funerary practices, i.e. inhumation and cremation.

The Vatya culture forms from the basis of Nagyrév with influences from the Kisapostag culture. Burials show a consistent rite, with cremations laid out in a structured manner, sometimes bounded or covered by stones. Cemeteries comprise several hundred urn burials, and urns were ordered initially in clan groupings. Social differentiation was seen in grave goods in the final phase of the culture. Fortifications appear probably reflecting the formation of social hierarchy, and they show enclosed areas dedicated particular functions, such as metallurgy. Bronze artefacts are abundant. Nagyrév sites are continued in Vatya settlements, which expand to previously unsettled sandy locations (Marková and Ilon 2013).

The Hatvan culture formed from the former Nagyrév culture (with eastern influence evident in its metallurgy), in previous Nagyrév and Nyírség areas. Settlements include tells and tell-like settlements, with small fortified areas surrounded by ditches in settlements which had unfortified annexes or satellite settlements. Small family cemeteries with scattered cremation and urn graves in groups were located around the settlements. Interaction with the Ottomány–Füzesabony complex induced changes in the pottery (Marková and Ilon 2013).

The Early Bronze Age Ottomány I–Füzesabony cultural complex (ca. 2150-1650 BC) spread over a good part of the Pannonian basin, and a quite close interaction with the Hatvan culture. Decorative elements on fine wares mostly geometric, including incised lines and chevrons (Duffy et al. 2019). Regional Füzesabony groups show differences in pottery forms, but they share a common strict burial rite: inhumation burial in crouched position with gender differentiation—males on the right side and females on the left side—and large cemeteries formed by hundreds of graves. Orientation varies depending on phase and region. Grave goods reflect social status, as do the use of a wooden coffin or a grave lining or shroud (Marková and Ilon 2013).

At the end of the culture, urnfields begin (Ottomány–Piliny horizon and Ottomány–Suciu de Sus horizon). Settlement patterns suggest social and economic distinction, and there is evidence of craft production of gold and bronze. In the Middle Bronze Age Gyulavarsánd/Otomani II–III culture (ca. 1750–1450 BC), to the east of the Tisza, Forms become elaborate, flared rims appear on pitchers, cup handles rise high above the rim and smoothed, uniform surfaces become sculpted bas-relief. The culture shows southern influences from the Vatina culture, and ornamental elements similar to the Füzesabony culture, with imports from the eastern Wietenberg culture (in Transilvania). Burial rite shows inhumations in crouched position. Tell settlements appear in new locations, with fortified tells and open settlements with post-built houses (Marková and Ilon 2013).

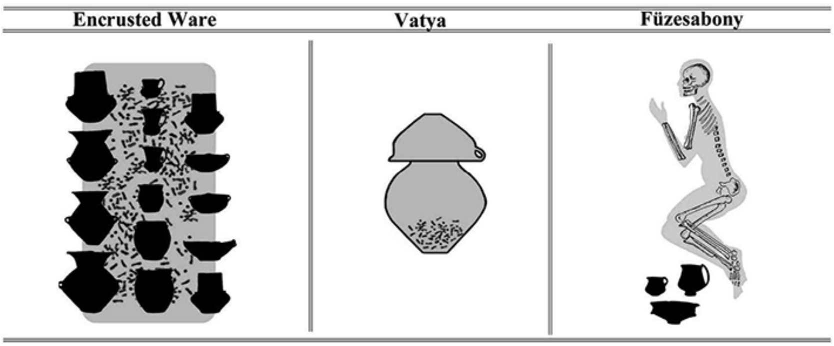

Figure 72. Relationship between pottery and material body in MBA graves. Encrusted Ware: scattered bones, large amount of pottery over the grave, body-sized. Vatya: enclosed bones, pottery as container, urns in pits. Füzesabony: inhumation, sets of pottery annotating parts of the body, body-sized grave pits. Image and text from (Sørensen and Rebay-Salisbury 2008).

It has been argued that important ideological changes in Europe (starting ca. 1600 BC) may have corresponded to the abandonment of tell settlements, but not non-tell sites, in the Great Hungarian Plain, which may also be related to a mass west-to-east migration of the Tumulus group into the area. In the Late Bronze Age, the enormous variety of Ceramic styles across the Carpathian Basin—including forms, techniques, and combinations of elements, such as the vast array of lugs, spirals, chevrons, channels and other motifs and appliqués—fell out of use. The tell system collapses, with densities showing a striking decrease in the early phase (ca. 1450–1200 BC) until a late stage (ca.

1200–900 BC), when the arrival of the Urnfield culture in Central Europe and Transdanubia coincides with large numbers of settlements (Duffy et al. 2019).

viii.10. Carpathian Bell Beakers

After the admixture of Yamna settlers with local populations in Hungary to form the East Bell Beaker group, the genetic picture in the Carpathian Basin in the following centuries (ca. 2500–2200 BC) probably reflects to a great extent the *sink* that the Hungarian Plains represented for Yamna migrants, with high variability in Steppe ancestry and R1b1a1b1-L23 lineages (see *§vii.7. North-West Indo-Europeans*).

During the early phase of the Nagyrév culture in the Csepel island—formed by foreign Bell Beakers gradually merging with local populations and replacing local Bell Beakers—samples from Szigetszentmiklós–Üdülősor (ca. 2500–2200 BC) show a reduction in Steppe ancestry (ca. 19%) compared to the previous Csepel group (which belonged to the Danubian EEBA), and a more mixed haplogroup distribution, among them a child of hg. R1b1a1b1a1a-L151 (xR1b1a1b1a1a1-U106, xR1b1a1b1a1a2-P312), a brother of R1b1a1b1b3-Z2106 lineage, another relative reported as R1b1a1b-M269, and one sample of hg. I2a1a-P37.2, consistent with further admixture with (and resurgence of) locals (Olalde et al. 2018)

Samples of the Vatya culture show a continuation of this trend, with two individuals from Százhalombatta–Földvár (ca. 2200–1600 BC), one of hg. I2a1a-P37.2 and the other of hg. I2a1b1a-CTS616; and four individuals from Erd (ca. 2000–1500 BC), one of hg. I2a1b1a1b1b-S18331 (formed ca. 3400 BC, TMRCA ca. 3200 BC). A similar ancestry is found in samples of the Makó culture from Kompolt–Kigyoser (ca. 2200–2000 BC), of the Hungary MBA from Battonya Vörös (ca. 2000–1800 BC), and in two samples of the Maros group, which belonged to the Danubian Early Bronze Age (Allentoft et al. 2015).

An early sample from Szólád (ca. 1900 BC), of subclade R1a1a1b2a2a1-Z2123 (Amorim et al. 2018) belongs to the westward expansion of Srubna; a sample of the Kyjatice group of the Urnfield culture from Ludas–Varjú dűlő (ca. 1200 BC), of hg. J2a1b-M67, probably reflects a local lineage (Gamba et al. 2014); while a sample of haplogroup N-M231 of the Mezőcsát Culture (ca. 900 BC) belongs to the expanding Cimmerians from the steppes. This and further movements reveal the nature of the Hungarian Plains as the sink of many different migrations since prehistoric times.

VIII.11. Balkan province

VIII.11.1. Balkans EBA

In southern Romania and in Bulgaria, earthen mound-burials of 'ochre' related to the Yamna tradition are still in use during the Early Bronze Age, with stone slab cists—possibly related to the Globular Amphorae tradition—found widespread from east Transylvania to the east and south-east, contrasting with mounds to the west. Up to the Dalmatian hinterland (in Kupreško polje, unrelated to the Cetina culture), tumuli related to steppe cultures can be found. Four-wheeled, rectangular chariots drawn by bovids or horses can be seen from the EBA to the MBA, but disappear in the LBA (Boroffka 2013).

In the eastern Carpathian region, the Baden complex (including the Coţofeni group) give way to the Glina–Schneckenberg culture and early Zimnicea, marked by the disappearance of incised and incrusted (or painted in the Cucuteni–Trypillia) decoration to a dominance of plastic knobs and ribs, as found in Şoimuş, Roşia, the Tumulus grave group of western Transylvania, Glina–Schneckenberg, Folteşti, Delacău–Babino, early Zimnicea, Ezero. Another widespread change is seen in vessel-rims with exterior sleeve-like thickening (Boroffka 2013).

The expansion of the Bell Beaker tradition throughout Europe is seen in its easternmost area with the expansion of small footed bowls, the foot sometimes in the shape of a cross, which can be found in Glina and Ezero contexts to the south and as far east as Romanian Moldova, often together with cord decoration. Metal finds, such as massive golden lock-rings, are found in the Carpathians and the Balkans up to Greece, showing one of the long-distance contacts that appeared during the EBA (Boroffka 2013).

Further to the south-east, marginal remains are also found in the Aegean Early Bronze Age, including Greece and particularly the Peloponnese, with special relations found between Early Helladic III and the Dalmatian Cetina culture: double handled forms sparsely decorated or showing remains of the typical framed decoration in an incised technique. These findings are among the oldest EH III period, but two other notable sherds are found in the previous EH II context, all of them probably under BBC influence after ca. 2500 BC (Heyd 2013).

From EBA in Hungary expanded vessels with brushed or combed lower body, probably with the aim of enlarging the outer surface of cooking vessels for better heat absorption and higher porosity for the cooling of liquid contents by evaporation through the wall. This influence is observed during the EBA in the south in Ezero, Dyadovo, and in the east in Bogdăneşti, Iacobeni, and continues into the MBA with Mureş, Ottomány, and Wietenberg groups (Boroffka 2013).

The other strong influence in the western Balkans during the EBA comes from the Troad in Turkey, which is felt up to south-eastern Bulgaria, although the potter's wheel—well established in Troy itself—was not adopted, the few wheel-thrown fragments being most likely imports. Zooarchaeological material such as the bones of fallow deer, native to Turkey east of the Bosphorus, appears in imports up to the Danube and in the eastern Balkans (Boroffka 2013).

VIII.11.2. Balkans MBA

During the Middle Bronze Age, different groups show the expansion of characteristic EBA pottery shapes, with regional differences in burial rites, settlement structures, economics or ritual elements, with Verbicioara, Tei (later Gîrla Mare/Žuto Brdo), Monteoru, and Costişa groups sharing thus common elements with Ottomány, Wietenberg or Maros groups to the west. In general, the following developments are seen (Boroffka 2013):

1. There is an evolution from spiral to meander motifs.
2. Channelled decoration—usually oblique, but sometimes spiral—appears in the development stages of most MBA cultures.
3. One-handled cups are replaced by other vessels shapes, all presumably for drinking: in eastern Tei and Verbicioara cups are

replaced by kantharoi, in western Wietenberg and Ottomány and Suciu de Sus they are replaced by weakly profiled, shallow open bowls, often with *omphalos* instead of a handle.

Monteoru (which replaced Costişa) in the south-east and Maros in the south-west stand out because of the *kantharoi* that were used along cups (Figure 73), probably because of a southern influence, evidenced by a similar shape and ornament found in southern Romania, Bulgaria, and northern Greece (Boroffka 2013).

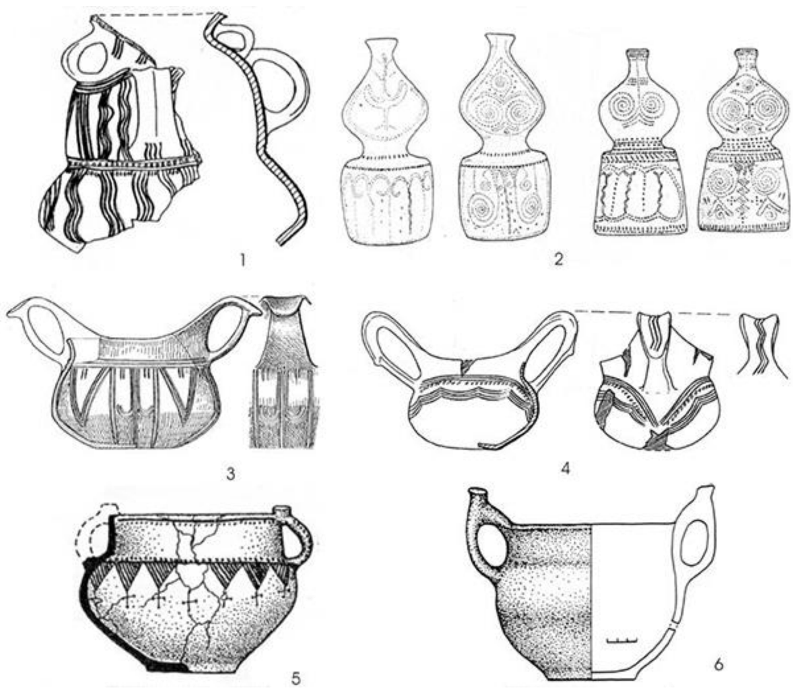

Figure 73. Ceramic from Monteoru culture (1, 3, 4), Komarowo culture (5) and Noua culture (6) with statuette of the Gîrla Mare culture (2). Modified from Dietrich (2011), including images from După Zaharia 1993, Sava 1994, Sava 2002, and Şandor-Chicideanu 2003.

Continued long-distance connections are seen from the west in bar-shaped cheek-pieces, and from the east e.g. in bone psalia (bridle parts), with round plate-shaped variants of the cheek-pieces (as found in Monteoru and Wietenberg), probably originating in the steppes. Especially interesting are bone objects ornamented with spiral-based motifs ('pulley-ornament'), which may be followed as far east as the Ural region, or south to Mycenaean Greece, where they appear much later (Boroffka 2013).

Settlement structures seem to be dependent on the environment rather than on pottery traditions. In Wietenberg, simple cremation appears in burials in urns, rarely with grave goods; in Gîrla Mare/Žuto Brdo, the rule is also cremation and deposition in urns with complex arrangements of vessels and clay figurines; in Monteoru, crouched inhumations with vessels, jewellery and some tools or weapons are the standard, although cremation is also documented, and funerary environment is complex, with simple pits, stone cists, stone rings, and catacomb-like subterranean structures (Boroffka 2013).

Weaponry shows fighting tactics in the Balkan–Carpathian region up to Greece, different from central and western Europe, with disc-butted axes (later also with pointed butt) used as 'battle–axes', in contrast to daggers and swords to the north-west. Swords were probably used mainly as a status object (Boroffka 2013).

The use of wagons pulled by equids in the Carpathian Basin cannot be excluded, with remains of four-wheeled charts (often with a raised front) formally corresponding to the early fighting wagons of the steppes. Light spoked wheels are also present in these cultures, and may be connected to the light chariot, although evidence is scarce. Wagons carry a practical (transport) but also a religious (as transport for the transition to another world) meaning, as well as ideological, marking a special social position (Boroffka 2013).

VIII.11.3. Balkans LBA

During the Late Bronze Age, cultures overlapping with the MBA deepened the east–west divide, with more unified and widely distributed traditions. The western group (Ciumeşti, Lăpuş I, Igriţa, Belegiš–Cruceni, and Bistreţ–Işalniţa groups) shows less variation in vessel shape, and oblique or garland-shaped channelling replaces incised decoration. This process of 'Hallstattisation' caused by influence from Tumulus and Urnfield cultures continues into the Early Iron Age. The dead were cremated and buried in urns (Boroffka 2013).

In the south and south-east, the Čerkovna/Zimnicea– Plovdiv group evolves in central and western Bulgaria from late Tei and Verbicioara, and shows an expansion southward as far as northern Greece. It shows the *kantharoi* as its characteristic shape, a late revival of older pottery shapes, with pottery remains decorated with incised, originally encrusted ornaments, similar to those found in northern Greece. It also features deposition of complete vessels in wells which ceased to function, continuing a Verbicioara tradition. Cremation under mounds seems to be the rule, but crouched inhumation is found in Zimnicea (Boroffka 2013).

Long-distance connections show a clear south-west–north-east axis, illustrated by 'Mycenaean' rapiers found in Bulgaria and Romania during the LBA, and pins with perforated head and knobs on the neck (from the Noua group) found in northern Greece. Stone sceptres of phallic shape and the shape of axe– sceptres with inward curled tip and mushroom-shaped butt have analogies in the south Turkish coast (Boroffka 2013).

The eastern Noua–Sabatinovka–Coslogeni complex shows an eastern intrusion from the steppes, connected to the Srubna culture (see *§VIII.19.2. Srubna and Sabatinovka*), westward into Moldavia and Transylvania, and southward into Dobruja and north-eastern Bulgaria. It features a reduction of the repertoire of vessel forms, with pottery that lacked ornamentation or was sparsely decorated with channelling or incisions. While Balkan axes continue in part previous traditions, the characteristic eastern socketed axes can be traced back to the Eurasian Seima–Turbino phenomenon (Boroffka 2013).

Specific settlement structures—groups of the so-called ash-mound (*zolnik*), round or oval low mounds with whitish-grey soil—and large quantity of animal bones suggesting a pastoralist stockbreeding economy are proof of a highly mobile nomadic society. Nevertheless, the shape and decoration of its pottery partially continues the previous Monteoru culture, and spread into Transylvania. Inhumation in a crouched position with scarce grave goods was the standard burial rite, with cemeteries sometimes including burials in or on older tumuli (Boroffka 2013).

VIII.11.4. Balkans EIA

With the Early Iron Age, the expansion of Hallstatt causes the spread of channelled pottery groups, closely connected to the Urnfield groups further west, and coincident with the demise of steppe influence of Noua–Sabatinovka–Coslogeni in the region. Continuity with the LBA is seen in some ceramic shapes and decorations.

A northern block represented by the Gáva–Holihrady culture spreads from Transylvania to Moldova, while Belegiš II-type pottery spreads through the south into Moldova, including the late eastern variant Chişinău–Corlăteni. In the north, large vessels show exaggerated large hyptertrophic upwards-curving knobs on the body, while Belegiš II urns bear smaller paired knobs pointing upwards and downwards (Boroffka 2013).

In the Dobruja, Bulgaria, and later in Moldova, channelled pottery appears sometimes combined with stamped and incised decoration, representing the origin of the later widespread Basarabi culture, displaying connections with the Gáva–Holihrady culture to the north rather than to the neighbouring Belegiš II type. These elements are found further south in Troy VIIb and in the so-called ‘Barbarian Ware’ of Greece. While Belegiš II and Gáva–Holihrady display mainly cremation, inhumation graves (and tumuli) coexist in southern Romania and Bulgaria, although it is unclear the actual distribution of the burial rite (Boroffka 2013).

viii.11. Thracians and Albanians

viii.11.2. Thracians

There is scarce data on the Eastern Balkans during the Early Bronze Age. Eastern Balkan cultures likely continued the infiltration of Yamna-related peoples south of the Danube. R1b1a1b1b-Z2103 lineages are found widespread along the Lower Danube, from the east in late Yamna and Catacomb samples (ca. 2500–1950 BC), to the west in Vučedol from Beli Manastir (ca. 2775 BC), in early Nagýrev (ca. 2500–2200 BC), and in some East Bell Beaker groups (ca. 2500–2000 BC).

This overwhelming presence of R1b1a1b1b-Z2103 lineages bears witness to the most likely situation to the south of the Danube, too, where these Yamna-related clans probably replaced in part previous ones of I2a1b1a2a2a-L699 lineages (see *§vii.5. Palaeo-Balkan peoples*), given the scarce presence of this haplogroup in more recent times, including modern populations. The cultural connection of Mycenaeans to Early Bronze Age populations of the Balkans and the Carpathian Basin makes a direct connection of Palaeo-Balkan R1b1a1b1b-Z2103 lineages with the Catacomb culture (e.g. driven by the westward expansion of R1a1a1b2-Z93 and R1a1a1b1a2-Z280 subclades with Srubna) unlikely.

Samples of elevated Steppe ancestry and haplogroup R1a1a1b2-Z93 are found in the Middle Bronze Age along the Danube: one from the Kairyaka necropolis in Merichleri (ca. 1690 BC), ca. 1,000 younger than the other one of hg. I2a1b1a2a2-Y5606 (Mathieson et al. 2018); and one to the west in Szólád, Hungary (ca. 1900 BC), of subclade R1a1a1b2a2a1-Z2123, clustering closely with south-east European samples (Amorim et al. 2018). Both intrusive lineages probably represent male-driven incursions of Srubna-related settlers along the Lower Danube reaching the Hungarian steppes, associated with the appearance of round plate-shaped variants of the cheek-pieces in these territories. These and possibly also later contacts with Cimmerians may explain some recent Indo-Iranian influence in Palaeo-Balkan dialects, like Armenian.

Thracians, traditionally distinguished from nomadic pastoralist Scythians by their agricultural economy, are known to have established urban centres on the right bank of the Danube—beyond their stronghold in Thrace—towards the middle of the 1st millennium BC, with Getae tribes expanding (ca. 650–350 BC) also along the Prut and Dniester, at the same time as Scythians were present south of the Danube. Thraco-Scythian contacts, interaction, and osmosis, their openness to acculturation, and the mixed economy found in different ethnolinguistic group, as well as the potential Sea routes between the north Pontic area and the eastern Balkans, and the incursion of Greeks, complicates the genetic picture.

Two Thracian individuals from Bulgaria show different ancestry, with one showing elevated NWAN ancestry, while another—an aristocratic individual buried with a rich assemblage—clustered closer to the Steppe (Sikora et al. 2014). Both clusters may be tentatively identified with the recently described ‘Southern European’ and ‘Central’ clusters among north Pontic Scythians (Krzewińska, Kılınç, et al. 2018), closer to Balkan clusters, and showing increased NWAN contribution: from ca. 5% among Srubna and east Scythians up to 35% (see *§viii.19. Iranians*).

The different haplogroups in these clusters, including two R1b1a1b1b-Z2103 lineages, one of them R1b1a1b1b3-Z2106, one I2a1b1a2a1b-Y7219 (formed ca. 4100 BC, TMRCA ca. 2000 BC) and one E1b1b1a1b1-L618 (formed ca. 10000 BC, TMRCA ca. 6100 BC), also in contrast to eastern Scythians and other previous or later steppe populations, suggest the likely acculturation of the region, and thus the potential spread of Thracian peoples at least partly with R1b1a1b1b-Z2103 lineages.

viii.11.2. Albanians

The lack of close linguistic relationship of Albanian with Illyrian, the lack of Proto-Albanian toponymy in Illyria, and the absence of indigenous sea-faring terminology in the reconstructed language (borrowing corresponding words from Romance or Greek) make it likely that Albanians were unrelated to the ancient Illyrians. It has been proposed that they came from further north, with the settling of Proto-Albanians believed to be in Dacia Ripensis and farther north, in the foothills of the Carpathian Mountains and the Beskidy/Bieszczady (possibly a toponym of Albanian origin), with the migration to Illyria via the eastern slopes of the Balkans taking place before (but not much earlier than) their contact with Romance speakers and the end of the Proto-Albanian period (Orel 1998).

The diversity of haplogroups among modern Albanians reflect their complex ethnogenesis (Peričić et al. 2005; Battaglia et al. 2008): An origin of the Albanoid homeland close to the north-west Pontic region during the Iron Age, before their expansion and subsequent Y-DNA bottlenecks, is supported by the prevalent E1b1b1a1b1-L618 lineages (ca. 24–44%)—mainly V13+ (formed ca. 6100 BC, TMRCA ca. 2800 BC)—a haplogroup found previously in Neolithic Hungary and among Scythians of the north-west Pontic area, with a likely origin in early European farmers; and by hg. R1b1a1b2-M269 (ca. 18–20%), mainly R1b1a1b1b3a1a1c-Y10789 with Z2705+ (formed ca. 700 BC, TMRCA ca. AD 550), a subclade of R1b1a1b1b-Z2103. Their close contact with other Palaeo-Balkan groups, probably through mixture with local peoples of the Balkan and Adriatic regions after their migration from the Carpathians, possibly as early as the 7th century BC (Witczak 2016), is to be inferred from the presence (ca. 15–17%) of J2b2a1-L283 lineages (formed ca. 7700 BC, TMRCA ca. 3400 BC), proper of Balkan populations; but also possibly from hg. R1b1a1b2-PF7562 (ca. 5%)[31], an early offshoot of R1b1a1b2-M269,

[31] Data based on reported subclades from the FTDNA group *Albanian Bloodlines*.

associated directly or indirectly to the Yamna expansion to the west (see *§vi.1. Disintegrating Indo-Europeans*).

VIII.12. The Aegean

VIII.12.1. Middle Helladic and Minoan

The Middle Helladic (MH) period starts around 2100 BC or earlier with a severe crisis, which sees the depopulation and destruction in various sites, changes in material culture, burial rite and settlement pattern, hierarchy, and space. Traditionally, these changes have been explained as the consequence of migrations—or at least infiltrations—of ethnic groups probably from the north. Many sites are destroyed or abandoned between 2350 and 2100 BC, and the number of sites in use decreases dramatically. Trade relations are broken, inferred from the lack of circulation of ceramics and chipped stone (Voutsaki 2010).

Especially rural sites are affected, with a decrease in size of the existing settlements and disappearance of site hierarchy. Some sites retain a considerable size, such as Thebes, Argos, or Mycenae. In this new period, few settlements are fortified. Houses are self-standing and positioned in an irregular fashion, with stone foundations and mud-brick superstructure, with ca. 50–60 m^2. In the following period (ca. 2100–1700 BC) recovery in different regions is seen at different pace, with resettlement of areas and increase in size of the old sites, larger or more complex domestic structures appear, and some accumulation of wealth (Voutsaki 2010).

Slight changes can be seen in burial rite in the early period (ca. 2100–1700 BC), with burials being intramural, and tumuli found with an uneven distribution. There is evidence that tumuli are also places of cult rites. Extramural cemeteries appear later (especially ca. 1900 BC onwards). Grave types include simple pits, cists of various types, and large pithoi, with single, contracted inhumations and rarely offerings. Later, extramural cemeteries become widespread, new tomb types are used (shaft grave, tholos tomb, chamber tomb) and reuse of the grave and secondary treatment of the body become common. This time coincides with the appearance of shrines, at the end of the Middle Helladic period (Voutsaki 2010).

Changes in material culture include the appearance of apsidal buildings, terracotta ‘anchors’, stone shaft–hole hammer–axes, and tumuli, which point to the influence of northern migrants. Arsenic copper is replaced with bronze metallurgy, and the potter’s wheel is adopted. Toward the end of the period (from ca. 1700 BC), the mainland sees an intensification of exchanges within and beyond the Aegean, with diversification of pottery styles and technologies, including Cycladic and Minoan influences, the appearance of a uniform ceramic style, the adoption of figurative elements, and the import of valuable objects (Voutsaki 2010).

New trade contacts appeared soon after ca. 2100 BC between the eastern coast and the Aegean islands, with fluctuating small-scale overlapping networks. Contacts with Epirus and Macedonia included Minyan imports and local imitations, probably related to the newcomers, found also in a few coastal sites. The Adriatic inner and coastal trade was irregular, with some communities or social groups showing more success than others in the different periods. Most of the copper and all of the lead used come from the Aegean, although some may have come from the Aegean Islands, Cyprus, or Rodopi in Thrace (Voutsaki 2010).

The MH society was organised in villages with a subsistence economy based on agriculture and animal husbandry, and limited craft specialisation. This is in contrast to the Aegean Islands, where pottery production was highly organised. The existence of elites is evidenced by the presence of few rich tombs in the early period (ca. 2100–1700 BC), whose rarity may point to different forms of social organisation in the mainland, until the appearance of Shaft Grave elites at the end of the MH period. There is a subtle increase in the complexity of mortuary practices. More radical changes take place after ca. 1700 BC (Voutsaki 2010).

The Middle Minoan period features the appearance of the ‘First’ or ‘Old’ palaces (ca. 1900 BC or earlier) in several sites on Crete, probably as an evolution of similar structures with a central court and storage facilities. They represent both the residence of the elite and probably regional redistributive centres linked to an agricultural hinterland, akin to the redistributive temple economy of the Near East, as evidenced by the administrative nature of Linear B tablets. The emergence of similar buildings through Crete point to a hierarchical society. Minoan palaces were probably also minor production centres (e.g. textiles) and concentrated high-status objects, as well as agricultural commodities. Writing and sealing practices are also traditionally associated with the emergence of the palaces (Schoep 2010).

VIII.12.2. Mycenaean Civilisation

The Mycenaean Civilisation (ca. 1700–1100 BC) begins during the late phase of the Middle Helladic period, as a unifying process of the material culture, boosted by the competitive interaction of mainland elites, based on hunting and military prowess, access to external materials, and control of the trade of the mainland with Minoan Crete and the Cyclades, as these cultures intensified contacts (Shelton 2010).

The Early Mycenaean period (ca. 1600–1400 BC) features the first tombs displaying power, wealth, and warfare (such as the Shaft Graves of Mycenae), with pottery, burial customs, and weapons indicating cultural continuity, and thus emerging elites within the previous community. Cemeteries are well defined, organised and divided, and settlements are small, possibly organised into functional or social divisions. Individual regions develop independently, probably under individual chiefs or alliances of chiefs, although common uniform trends are also seen (Shelton 2010).

The palatial system saw a complete stratification of society, with independent settlements gradually consolidated into competing polities organised around larger sites, represented by strong families or chiefs as evidenced by tholoi. Contacts with Minoan palaces was essential for wealth acquisition by Mycenaeans, marking political and social status. Mycenaean styles, arts and beliefs imitate those from Minoans, and it becomes difficult to distinguish them. During the Early Palatial period on the Greek mainland, destructions occur on Crete, and afterward Mycenaean control clearly expands in the southern Aegean, with a takeover of Minoan trade routes and depots. At the end of this period, mainland influence is seen on Crete (Shelton 2010).

The Palatial period (ca. 1400–1200 BC) is marked by the evolution of many previously competing polities into centrally focused and administered states, with stabilisation of the social organisation and institutionalisation of power structures (Figure 74). This period shows an expansion of Mycenaean culture to the north into Mount Olympus, to the west into Epirus, and to the east into the Dodecanese (Shelton 2010).

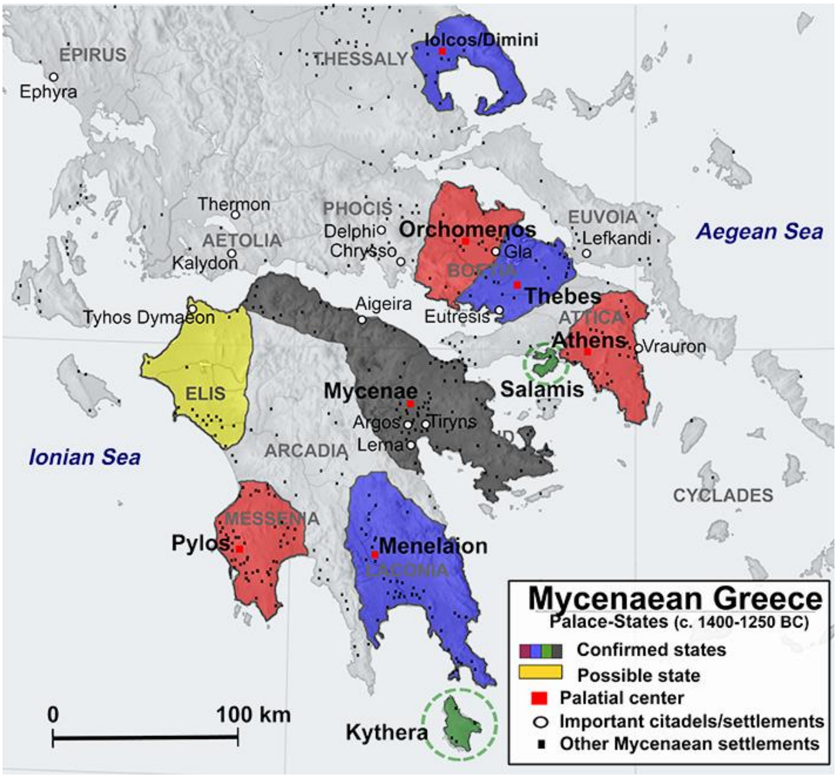

Figure 74. Reconstruction of the political landscape in c. 1400–1250 BC mainland southern Greece, based on Kelder (2010). Image by Alexikoua.

The economic success of Mycenaean palaces reached Asia Minor to the east, Macedonia to the north, Sardinia to the west, and the northern Aegean. Extensive building programs, engineering, and infrastructure support in citadels, palaces, and settlements a large but exclusive elite class and a substantial population at varying distances from the centre, with widespread systematic transportation and communication networks intra- and interregionally (Shelton 2010).

Evidence from the clay tablets written in Linear B script show a power hierarchy with the *wanaks* (king) at the top, as well an administrative system with a power hierarchy, with many administrators being individual landowners, and where material and human resources are mobilised from the centre for the needs of the political economy. Homogeneous Mycenaean pottery ('the Mycenaean koine') appears over much of the Mediterranean, probably necessary for the trade of its content, especially oil and wine (Shelton 2010).

The increasing centralised control was accompanied by localised destructions followed by rebuilding on a large scale. Around 1200 BC, growing isolated instances of destruction and decline and tightening of control gave way to the destruction of all palaces, which are not rebuilt. Many non-palatial sites are abandoned, and the administrative system disappears. Certain sites recover and prosper for a brief time, on a much smaller scale, and regional and local cultural traits develop. The population decreases, and after this small economic recovery, there is a more rapid economic decline in the 11th century BC (Shelton 2010).

viii.12. Greeks and Philistines

The expansion of the first waves of Proto-Greek speakers into the southern tip of the Balkan peninsula must have started at the end of the Early Helladic and beginning of the Middle Helladic period, possibly coinciding with the expanding Minyan pottery style (Beekes 2011), and with the appearance of horse breeding, millet-consuming cultures from the north or north-east, via river valleys leading to the Danube (Valamoti 2016). Mycenaean samples from the Peloponnese show a contribution of Steppe ancestry (ca. 20%), which can only be interpreted as the arrival of peoples from the north, although this ancestry is not found in one Mycenaean individual from Crete (Lazaridis et al. 2017).

These investigated samples from the Peloponnese include: from the eastern site of Galatas Apatheia, one early individual (ca. 2900–1900 BC) in a primary pit–grave buried with two dog carcasses—connected to the social and ideological role of hunting in the Mycenaean society—suggesting that she was a distinguished member of the local community, and a later male (ca. 1700–1200 BC, with estimated range for pottery ca. 1500–1200 BC), of hg. J2a1d-M319, the same found previously among Minoans (see *§vii.4. Aegeans and Anatolians*); to the north of Apatheia, from Agia Kyriaki in Salamina (ca. 1340 BC), a large chamber tomb cemetery belonging to the chief Late Helladic cemetery of the island, corresponding to the Palatial and Post-Palatial periods; and from the western site of Peristeria Tryfilia (ca. 1350 BC), the “Mycenae of the Western Peloponnese”, an early Mycenaean settlement which may have served as a seat of a local ruler dynasty, flourished from the 17th to the end of the 13th century BC.

The Late Minoan III Necropolis of Armenoi in Crete (ca. 1390–1190), with two hundred and thirty-two chamber tombs, and one thousand interred individuals, in a site with a stirrup jar with a Linear B inscription, has yielded one sample without detectable Steppe ancestry (Lazaridis et al. 2017). This individual suggests a variable introduction of Steppe ancestry into the different territories that Mycenaeans eventually controlled, and thus potentially the introduction of the language without much genetic change, similar to how southern Balkan J2a1d-M319 lineages may have been incorporated into the Proto-Greek community (at least partially) through exogamy, due to the high demographic density of the Aegean (Müller and Diachenko 2019).

The only reported Y-chromosome haplogroup from Ancient Greeks comes from the Gulf of Amurakia (ca. 470-30 BC), and is R1b1a1-P297[32], which most likely corresponds to the typical Balkan subclade R1b1a1b1b-Z2103. This sampling is from a population before the Roman foundation of Nikopolis, hence from people likely from Anaktorion in Ancient Acarnania, of Corinthian origin. This strengthens the connection of the modern R1b1a1b1b-Z2103 distribution in Greece to the expansion of Dorians, after the Greek Dark Ages.

The twenty-four individuals from the Greek colony of Emporion in north-east Iberia (ca. 500–100 BC) —founded most likely by Phocaean settlers, from western Anatolia—fall into two main ancestry groups: one similar to Iron Age Iberians, and the other similar to Bronze Age Mycenaeans (Olalde et al. 2019). The striking similarity of this eastern Greek population with ancient Mycenaeans from 1,000 years earlier, as well as the presence of two J-M304 lineages in the same cluster, support the likely presence of north-south and west-east clines of Steppe ancestry and typical Yamna lineages in the Ancient Greek-speaking Aegean.

Analysis of modern Greek and Cretan lineages point to a Neolithic expansion of haplogroup R1b1a1b-M269 in the region, which was found nearer to Italian than to Balkan lineages (King et al. 2008). Analysis of Greek-Cypriot modern populations revealed the presence of R1b1a1b1b-Z2103 lineages in easternmost and westernmost sides of the island, with R1b1a1b1b3a1-Z2110 lineages appearing only in the east (Voskarides et al. 2016). The early attestation of Mycenaean Greek in the island points to an early expansion of R1b1a1b1b3a1-Z2110 lineages.

[32] Report by Nikolaos Psonis, from the IMBB Joint Colloquia (2018).

Most R1b1a1b-M269 lineages in Greece are probably linked to the Bronze Age expansion associated with the Minyan pottery, in turn linked to an earlier Yamna expansion into south-eastern Europe. Most R1a1a1-M417 lineages, whose proportion in Greece and in historically Greek Anatolia increases with latitude and in peripheral areas, are thus to be linked to the recent migration of southern Balkan populations of R1a1a1b1-Z283 lineages (mainly Slavs, but also Aromanians and Albanians), and to the western spread of Iranian peoples of R1a1a1b2-Z93 lineages (Heraclides et al. 2017).

A potentially older invasion of certain R1a1a1b2-Z93 (and possibly R1a1a1b1-Z283) lineages during the Bronze Age could be supported by the finding of this lineage in Srubna-related settlers along the Danube in the first half of the 2nd millennium BC, although it is unlikely that they reached Greece in sizeable numbers (see *§viii.11. Thracians and Albanians*).

On the controversial ethnicity and language of the Sea Peoples (Figure 75) and the closely related Philistine question, archaeological evidence suggests a large scale immigration to southern Canaan from Anatolia and Cyprus in the 13th–11th c. BC, and material culture of Cypriote, Aegean, and especially Mycenaean influence associated with cultural changes during the transition of the Late Bronze to the Iron Age (Woudhuizen 2006; Maeir, Davis, and Hitchcock 2016; Middleton 2015).

In particular, Monochrome and foreign Bichrome styles contemporaneous in Canaan reflect social interactions during ca. 100 years, supporting the notion that foreigners arrived to Canaan in more than a single event, supporting a “deep change” in the local material culture, including cultural mixing or creolisation and hybridisation. This influence started in Philistia to the south in the late 13th c. BC, during the time of Ramesses III, and diffused to the north after the retreat of the 20th Egyptian Dynasty (Asscher and Boaretto 2018). The turnover in the southern Levantine pig population to European lineages around this time also support increased mobility from west to east (Meiri et al. 2019).

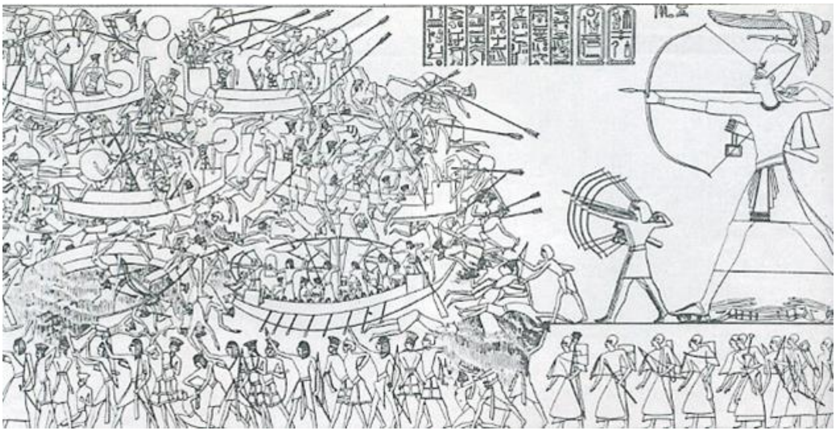

Figure 75. Famous scene from the north wall of Medinet Habu that illustrates the Egyptian campaign against the Sea Peoples in the Battle of the Delta. Egypt's enemies are described simply as being from "northern countries", but early scholars noted the similarities between the hairstyles and accessories worn by the combatants and other reliefs in which such groups are named. Image from Wikipedia.

A Canaanite individual from a clay coffin burial in Tel Shaddud (ca. 1250 BC), reported as of hg. R1b1a1b-M269^{+}, has been interpreted as a Canaanite official residing at this site and emulating selected funerary aspects of Egyptian mortuary culture, apparently connected to the administrative centre at Bet Sheʿan during the 19th and 20th Dynasties (van den Brink et al. 2017). This and another contemporary, non-relative individual from a nearby burial pit, of hg. J, show similar estimated ancestry, clustering closely with modern Levantine populations (see *§vi.5. Semites and Berbers*). While the nature of the Egyptian presence in Canaan during the Late Bronze Age is still discussed, the presence of a typically Indo-European lineage in the Levant during the LBA would further support the potential association of Sea Peoples with the Aegean in general, and with Greek speakers in particular.

Genetic research points to a mixture of Steppe ancestry found in the Lebanese population that occurred ca. 1740–160 BC (Haber et al. 2017). Steppe ancestry is found in Roman Period individuals, but not in Bronze Age individuals, which supports its introduction more than 2,000 years ago (Haber et al. 2018). R1b1a1b1b-Z2103 lineages appearing in the region after the Bronze Age are probably of Balkan origin (Greeks or Armenians), while

R1a1a1b2-Z93 lineages are of Indo-Aryan or Iranian origin, although R1b1a1b1b-Z2103 could have also been associated with Indo-Iranians and early Iranians.

VIII.13. Anatolia

VIII.13.1. The Kārum period

During the first centuries of the 2nd millennium BC, Assyrian merchants originating from Assur (Upper Tigris) organised large-scale commercial exchanges with central Anatolia, settling in several fortified towns on the main roads called *kārums*, and smaller trading posts called *wabartums*. Large settlements show an organisation around a huge palace and several temples built on top of the mound, with a lower terrace, where occupation areas are made up of two-storey houses constructed with wood and mudbricks over stone foundations (Michel 2011).

Sociopolitical and economic changes are seen with the new material culture—open wheel-made vessels with coloured geometric decorations—with figurative art (zoomorphological rhyta, lead and ivory figurines), buried bodies under the floors of the houses together with artefacts, all pointing to Assyrian burial customs. The seal industry is the best example of Old Assyrian influence, with Old Anatolian iconography combining elements and filling empty spaces with animal figures. Treaties are documented (ca. 2000–1800 BC) between Assyrian kings and local Anatolian rulers (Michel 2011).

Old Assyrian was used as diplomatic language (with Hittite loanwords since ca. 19th c. BC), and writing continued the Assyrian cuneiform tradition without changes. In family law, husband and wife enjoyed equal status, and they owned house and goods in common. Both could divorce, and contracts were established under the supervision of the local ruler and his second–in–command. Adoption is also attested, with the possibility of adopted individuals to inherit (Michel 2011).

The first generations of Assyrians who came to Anatolia was made up of men who left their families in Assur, temporarily at the beginning, but eventually contracting a second marriage, often with an Anatolian woman, who stayed in Anatolia as ‘secondary wife’ and brought up their children, taking care of the household, and doing agricultural tasks while their husbands were travelling and trading. When some Assyrians went to retire in Assur, they left their Anatolian wives and drew up a divorce contract, with women keeping usually the house, furniture, and some divorce money, as well as their younger children, with the father paying for their upbringing—although he could also decide to take some of his Anatolian children to Assur (Michel 2011).

VIII.13.2. The Hittite period

Precise archaeological studies do not parallel written accounts, which remain the best source for knowledge of Anatolia during the Bronze and Iron Ages. In the west, the Arzawa territories are assumed to correspond to earlier Luwiya, and refers strictly to the five states or kingdoms constituting the Arzawa Lands: Mira, Šeḫa River Land, Wiluša, and Ḫapalla. It is unclear to what extent these territories formed a social, ethnic, or political unity in the different periods (Bryce 2011).

The eventual presence of Luwian hieroglyphs, the eventual dominance of Mira over western Anatolia, and the succeeding Luwic and Carian groups in the region suggest that at least part of western Anatolia was mainly Luwic-speaking territory in the first half of the 2nd millennium BC. During the mid–2nd millennium, the appearance of Mycenaean settlements—evidenced by fortifications, pottery, domestic architecture, burial practices—suggests that the Hittite form Aḫḫiyawa corresponds to the Greek name *Achaiwia*, Achaean, supporting the close Greek–Anatolian contacts during this period.

The beginning of the Hittite kingdom followed the collapse of the *kārum* period network of Assyrian trade colonies, caused by the struggle of various groups, and eventually the emergence ca. 1650–1600 BC of the Ḫatti kingdom based on Ḫattuša and the area within the Maraššantiya/Kızıl Irmak River. To consolidate their rule, Hittite kings followed an active settlement policy to fund new provincial centres in the semi-arid highlands of Anatolia, bordered by the Pontic Mountains in the north, and the Taurus Mountains to the south, but also including Cilicia in south-eastern Anatolia, and the Upper Euphrates region (Seeher 2011).

Around 1350 BC, during the reign of Tudḫaliya III, enemy attacks from everywhere led to heavy losses of territory and power, and the conflagration of the capital. The recovery of the state was accompanied by the massive development of Hittite rule in the Hittite Empire, evidenced in widespread city growth and monumental architecture, such as the creation of rock reliefs. The collapse of the empire at the end of the Late Bronze Age (ca. 1200/1180 BC) is accompanied by destruction of Empire period sites, with some Early Iron Age sites yielding a pronounced non-Hittite material culture, possibly settlers who took advantage of the deserted landscapes.

viii.13. Assyrians and Hittites

Anatolia EBA individuals from Ovaören (ca. 2300–2000 BC), one of hg. J2a-M410, and later Assyrian and Old Hittite individuals from the MLBA in Kalehöyuk show continuity with Chalcolithic samples, with no statistically significant EHG-related ancestry that could be compatible with a sizeable impact of steppe migrations (de Barros Damgaard, Martiniano, et al. 2018).

Samples from Kalehöyük include individuals from the Assyrian period (ca. 2000–1750 BC), contemporary with the international trade system managed by expatriate Assyrian merchants, one of hg. G2a2b1-M406, mtDNA H6a1b2e, and another of hg. J2a1-L26; and two of the Old Hittite period (ca. 1750–1500 BC), contemporary with the emergence of the Hittite state, one of hg. J2a1-L26. Interestingly, the mtDNA found in one Assyrian sample is of European origin (found also in the steppe), not yet found in any ancient sample of the Near East.

This genetic picture, although as of yet incomplete (lacking a good temporal and regional transect of Anatolia, and Anatolian speakers in particular), is consistent with the description of the Assyrian colony period as one of admixture of Assyrian male settlers with local women, in this case probably Anatolian speakers, who raised their children locally, and the Hittite period representing the emergence of local rulers (of Assyrian patrilineal descent) who spoke the maternal language.

The prevalent presence of non-Indo-European languages of the area, including Hattic, possibly part of the North-West Caucasian group, and Hurrian, part of the Hurro-Urartian family that may have also been related to languages of the Caucasus (see *§vi.4. Northern Caucasians*), is consistent with the appearance of haplogroups G2a-P15 and J2a-M410, both related to migrations through the Fertile Crescent and the Caucasus, and not linked to Indo-Europeans migrating from the steppe.

VIII.14. The Caucasus

The early Trialeti cultural complex (ca. 2000–1700 BC) shows a significant connection of the southern Caucasus with neighbouring lands, in particular Anatolia, and is characterised by their barrow tradition and mobile subsistence economy. The main difference between barrows is the richness displayed. The lavish and grandiose log structures corresponded to the elite social class, who practised cremation with ashes placed in wooden containers, and the only bones appearing in the burial being those of animals, especially cattle. This change in ritual has been associated with a religious change, a transformation of the physical into the metaphysical, which had the effect of entrenching power and authority of the leader and his kin (Sagona 2017).

In the second rank, the dead were interred. Some tombs were also rich, displaying four-wheeled vehicles, and animal remains probably consumed during a ritual feast. The lowest rank is represented by small barrows with poor assemblages. Bronze tools and weapons, which are not found in large numbers in elite burials, are more common in small barrows. Interesting is the deposit of skin of the sacrificed oxen (and later of horses) with its severed forelegs attached, a practice widespread in the Eurasian steppes during the 4th millennium BC, and seen in funerary rites in central and northern Europe up to the medieval period (Sagona 2017).

Wagons and carts, which had been known in the Caucasus since the Kura–Araxes culture, continue to be built and probably represent an important part of the subsistence economy and symbolism in Trialeti, with the practice of burial wagons spreading beyond its borders, and not being gender specific. This tradition was continued in the Late Bronze Age (ca. 1600–1000 BC), with some of the greatest concentrations and highest complexity of carpentry displayed during this time (Sagona 2017). There is no evidence of large-scale regional movements based on isotopic evidence, though, especially to the south into the Ararat Plain, although it is unclear how mobile specific local pastoralist groups may have been (Chazin, Gordon, and Knudson 2019).

Their objects of precious metals and bronze show a fusion of local traits with foreign influences, suggesting its participation in a system of exchange extending to the shores of the eastern Mediterranean during the 2nd millennium BC. The slim sword blade (rapier) found in Trialeti, with its slender, sharply edged and pointed form, 1-meter long and widening at the handle end, is best suited for thrusting attacks. It has been suggested that it represents a local development on the basis of south Caucasian rapiers, that spread to the Aegean via Anatolia (Sagona 2017).

viii.14. Caucasians and Armenians

Individuals of the Late North Caucasus post-Catacomb horizon from Kabardinka (ca. 2200–2000 BC), one of hg. R1b1a1b-Z2103, show typical Steppe ancestry profile, while MBA samples from a site 90 km to the west, Kudachurt (ca. 1950–1775 BC), one of hg. J2b2a1-L283^{+}, retain the typical 'southern' Caucasus profile. This 'southern' genetic profile is also seen in a recent individual of the western LBA Dolmen culture (ca. 1400–1200 BC), of hg. J2a-M410^{+}. Contrasting with these populations, an individual of the Lola culture (ca. 2115–1925 BC), of hg. Q1b2a1a1a-L717^{+}, resembles the ancestry profile of steppe Maikop individuals, of high ANE ancestry—one of which was of hg. Q1b2b1b-L932^{+}—clustering closely to Afontova Gora 3, which suggests the survival of certain isolated pockets in the region since the Epipalaeolithic (Wang et al. 2019).

The language ancestral to Armenian, like Phrygian, is believed to have belonged to the peoples that came from the west and overran the Hittite empire around the 12th century BC (Beekes 2011). The collapse of the Hittite power (ca. 1180 BC) seems to have only impacted regional centres over the next generation (i.e. by mid-12th c. BC), with a radical reorganisation of the economy over a relatively short period (less than 100 years), and a distinctive Early Iron Age material culture suggestinig an increase in population mobility across the region (Kealhofer, Grave, and Voigt 2019). The suggested migration of Balkan peoples through Anatolia, evidenced by the eventual rapid emergence of the Phrygian polity (ca. 9th c. BC) may be related to the intrusion of a population with elevated Steppe ancestry reflected in two sampled individuals of the Hellenistic period from Kalehöyük (ca. 1200–30 BC), although this ancestry is most likely related to later Iron Age Galatians, of Celtic origin (de Barros Damgaard, Martiniano, et al. 2018).

Armenia MLBA samples show an increase in EHG (ca. 10%) and Anatolia Neolithic ancestry (ca. 55%) relative to previous Kura–Araxes and Chalcolithic samples, with an intermediate position between both in the PCA (Allentoft et al. 2015). The diversity of haplogroups and the presence of certain clear outliers of steppe origin suggests close interactions between peoples of the southern and the northern Caucasus.

The sampling of Armenia MLBA includes three individuals of Nerquin Getashen (ca. 1900–1200 BC), one of hg. R1b-M343, two of hg. E1b1-P2; two samples from Kapan (ca. 1200–850 BC), one of hg. R1b-M343; two samples from Norabak (ca. 1200–900 BC), one of hg. J2b2a-M241; and one sample from Noratus (ca. 1050 BC). Interesting is the finding of R1b-M343 subclades in the region—although they may be related to the previously described resurgence of R1b1a-L388—and especially of haplogroup J2b2a-M241, which is also found in the Jazinka Cave in the western Balkans (ca. 780 BC), with elevated Steppe ancestry (ca. 35%), supporting a potential recent Balkan origin of certain typically Neolithic subclades.

An individual of an Iron Age burial at Tepe Hasanlu (ca. 971-832 BC), of haplogroup R1b1a1b1b-Z2103^{+}, and with contributions of Steppe ancestry, clustering close to previous Armenia MLBA samples (Broushaki et al. 2016), is most likely related to the arrival of Armenian speakers to the region. Another sample of Hajji Firuz Tepe, attributed to the Chalcolithic, but with a date incompatible with its reported haplogroup R1b1a1b1b-Z2103, also shows contribution of Steppe ancestry and a position in the PCA compatible with interactions with populations of the Caucasus (Narasimhan et al. 2018), being thus also likely related to incoming Armenians[33].

The origin of Armenian speakers in the region is complicated with the current data because of the poorly documented archaeological context of samples potentially related to Armenians published from Armenia and Northern Iran; the lack of peer-reviewed studies on the origin of the Steppe ancestry in these samples; and the potential origin of R1b1a1b1b-Z2103 in earlier northern Caucasus populations (potentially integrated in Caucasus populations since the Maikop period), in the Balkans (among Palaeo-Balkan-speaking populations), and probably among certain Indo-Aryan and Iranian groups expanding into the Fertile Crescent. Nevertheless, the clear genetic shift from previous Chalcolithic and EBA (i.e. Kura–Araxes) individuals to Armenia MLBA samples and their outliers is coincident with the expected period of their arrival in the region.

In the case of the Armenian highlands, there is ancestry levelling and genetic continuity in the Middle East during the Neolithic and Chalcolithic (Lazaridis et al. 2016), including ancient mtDNA lineages, also partially during the Bronze Age and Iron Age, which suggests a late and heavily male-biased migration of Armenians (Margaryan et al. 2017). This genetic continuity of Armenians has traditionally been explained by a history of genetic isolation from their surroundings (Haber, Mezzavilla, Xue, et al. 2016). The current data of northern Caucasus populations seems to contradict a late expansion of peoples from the steppe through the Caucasus.

Populations of the western part of the Armenian Highland, Van, Turkey, and Lebanon show genetic affinity with European populations, and their absence in previous studies "should be considered a consequence of the absence in their Armenian datasets of populations from the western region of the Armenian highland" (Hovhannisyan et al. 2014). Ascertaining the origin of Armenians is hindered by the loss of data due to the effects of the Armenian Genocide and massive population displacements of the 19th and 20th centuries.

---

[33] New radiocarbon date reported as corresponding to the Bronze Age – probably close to the Iron Age – by Vagheesh Narasimhan (2019).

VIII.15. Eastern European Forest Zone

VIII.15.1. Balanovo

During the Eneolithic, subsistence economy on the Cis-Urals forest zone was based on the effective hunting of big hoofed animals (reindeer, elk, antelope, wild pig, bear, and beaver), gathering, and productive fishing (sturgeon, grayling, pike, chub, idus, tench, etc.). Large wooden rectangular houses were arranged in rows along the riverbank, and connected to each other and with farmyards by roofed passages. Small settlements were concentrated at the confluence of rivers (Koryakova and Epimakhov 2007).

Groups of the Cis-Urals region—descended from sub-Neolithic Volga–Kama and Kama cultures, and probably related to Volosovo—like Novolin, Garino–Bor, and Yurtik cultures showed late and simple metalwork, limited in forms, made from poor copper of the western Urals region. The eastward diffusion of cattle breeders and farmers of Corded Ware cultures brought a change in pottery design, stone tools, subsistence economy, and funerary ritual—including flat and kurgan burials containing crouched skeletons, accompanied mostly by globular short-necked vessels and stone battle–axes—which can only be explained by the sudden irruption of western settlers (Koryakova and Epimakhov 2007).

The north-east province of the Balanovo culture, a variant of Fatyanovo, was the easternmost group of the Corded Ware culture, occupying the Kama–Vyatka–Vetluga interfluve. Hundreds of sites, including villages, cemeteries, and numerous stone axes found by chance, represent the expansion of the culture in the region, with sites usually located on the high hills of riverbanks, and villages consisting of several above-ground houses (ca. 16–28 m^2) built from wooden logs and saddle roofs, joined by passages (Koryakova and Epimakhov 2007).

Cemeteries contain both individual and collective graves, with men buried on the right side, women on the left side, both in contracted position, and dead wrapped in animal skins or birch bark, and placed into wooden constructions.

Grave assemblages depend on sex, age, and social position, with copper axes accompanying elites, stone axe–hammers with men and teenagers, and flint axes with everyone, except chiefs. Balanovo layers are basically connected or overlap the late Volosovo and Garino layers, which indicates that Balanovo settlers occupied previous Eneolithic sites (Koryakova and Epimakhov 2007).

Balanovo brought a more advanced economic and cultural tradition than that of their neighbours. Their subsistence economy was based on animal husbandry, primarily pigs and sheep, but also later including cattle and horses depending on the local ecological conditions. They used draught cattle and wagons, exploited the local copper sandstone deposits—bringing thus metallurgical tradition to the region—and pioneered the swidden method of farming (Koryakova and Epimakhov 2007).

VIII.15.2. Netted Ware, Chirkovo, Kazan

The Netted Ware or Textile Ware culture (Figure 76) appeared ca. 1900 BC in the Upper Volga–Oka region, derived from Fatyanovo–Balanovo settlers that inhabited previous Volosovo area and interacted with the Seima–Turbino network. It spread ca. 1900–1800 BC to the north into inner Finland, at the same time as the Pozdnyakovo branch of early Srubna exerted its influence on it.

Netted Ware expanded into regions previously occupied by cultures producing asbestos- and organic-tempered wares, reaching the Narva River on the eastern border of Estonia to the west, the Oulu River to the north, and Karelia but did not settle in the coastal zones (Figure 77). The early period of Netted Ware in Finland and Karelia is represented by the Sarsa–Tomitsa ceramics, starting ca. 1700 BC, with a later subgroup of Kalmistonmáki ceramics (Parpola 2018).

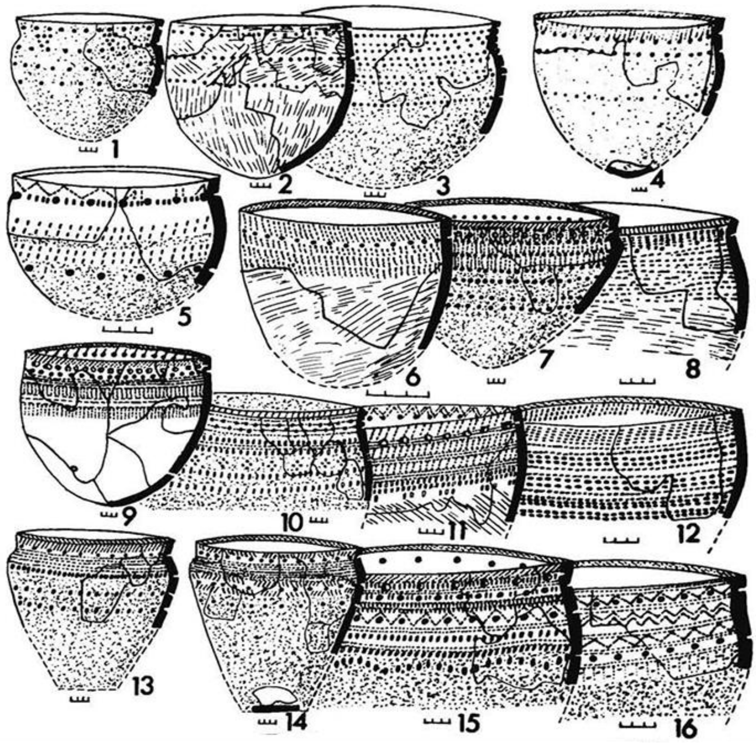

Figure 76. Vessels of the Netted Ware culture from Karelia. Modified from Kosmenko (1996).

It is not clear yet what the relationships between this immigrant tradition and the local populations of inner Finland were, but it is evident that changes took place in all fields of life: settlements, material culture, means of subsistence, and thus *Weltanschauung*. This does not imply a synchronous or abrupt change, or a complete population turnover, because traditional forms of subsistence held their ground alongside slash–and–burn agriculture for centuries and even millennia (Nordqvist 2018).

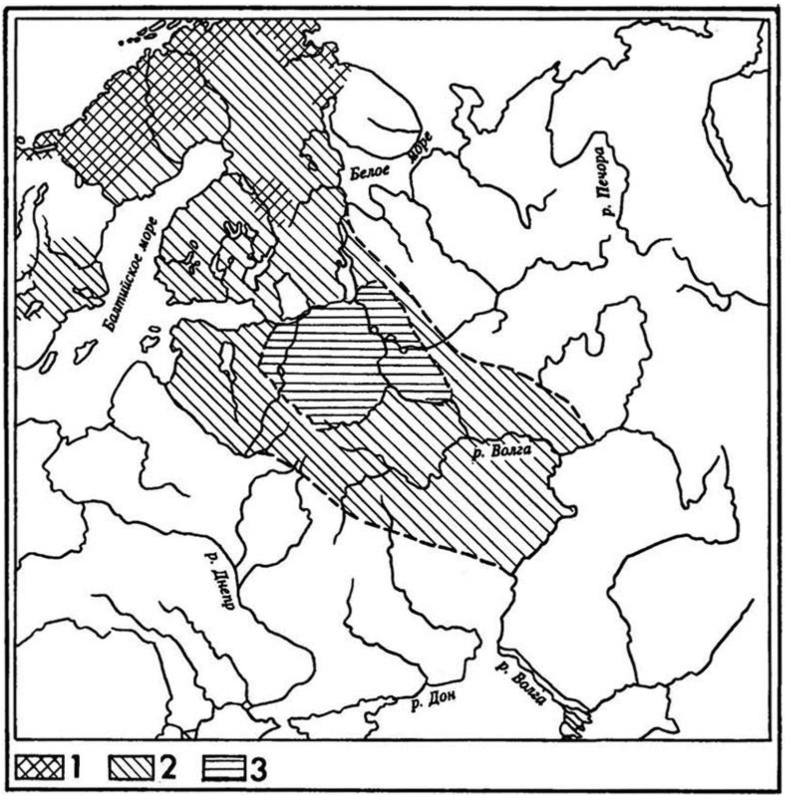

Figure 77. Distribution of eastern Textile Ceramics in northern Europe. 1 'Wafer' ceramics; 2 Area of eastern Textile Ceramics; 3 Area in the early stage. Modified from Kosmenko (1996).

To the east of the textile ceramics area, in the Mid–Volga region, Abashevo settlers fought for the possession of the area between the mouths of the Kama and Vyatka, rich in copper deposits. The Chirkovo culture (ca. 1800–700 BC) formed eventually by the fusion of Abashevo and Balanovo elites over previous Volosovo territory, with Balanovo remains found well into the second half of the 2nd millennium BC. In its early phase, it included the Seima site—one of the type sites for the Seima–Turbino phenomenon, with evidence of materials from as far away as the Krotovo culture—and participated in the Seima–Turbino network, from the forest-steppe of the middle Irtysh to the Baraba steppe on the upper Ob (Parpola 2018).

The Kazan culture (ca. 1900–800 BC) developed in the Vetluga–Volga–Vyatka interfluve based on Balanovo settlers over previous Garino–Bor territory, from which it retained local traditions. Bronzes of the first phase are of the Seima–Turbino type, and it eventually comprised the Kama and Belaya basins, as well as areas of the Middle Volga almost up to Samara to the south, interacting with early Srubna. Its final Maklasheevka phase (ca. 1000–800 BC) immediately preceded its replacement by the Ananyino culture (Parpola 2018).

Similarly, Late Bronze Age groups of the Cis-Urals Prikamsky subarea (Prikazanska, Erzovska, Lugovska, Kurmantau, Buiska), which continued Eneolithic traditions in pottery and house designs, had adopted animal husbandry based on cattle, horse, and to a lesser extent pigs, and sheep, with evidence of cultivation and continuing influence from Andronovo–Cherkaskul, which points to the settlement of Corded Ware-related peoples and partial acculturation of the region (Koryakova and Epimakhov 2007).

VIII.15.3. Ananyino and Akozino

At the turn of the 2nd–1st millennium BC, the Early Iron Age begins in the steppes with the expansion of ‘Pre-Scythian’ horse-riding nomads. In the Middle Volga area, the Ananyino culture appears in the Kama River and its tributaries Vyatka, Chusovaya, and Belaya, famed for its metallurgy, with revived features of the Seima–Turbino and Eurasian types. It represented the main Cis-Urals metallurgical centre, and features tin, tin–antimony–arsenic, and pure copper alloys, widespread in the Bronze Age. It produced a large number of socketed axes, spearheads, arrowheads, battle hammers, knives-daggers, and plenty of ornaments (Parpola 2013).

It expanded to the north and north-east into the basins of the Pechora, Vychegda, and Mesen’ rivers in the first half of the 1st millennium BC. To the south, a buffer zone existed between Ananyino territory and the area of the South Uralian and Volga Sauromatian nomads, although they were in close contact with the north Pontic area, the Caucasus, and Kazakhstan, by this time developing Pre-Sauromatian traditions. Their metallurgical techniques were based in part on technology from the Caucasus, and from the Pontic–Caspian steppes were imported Cimmerian bronzes, such as daggers with cross-linked handles, Koban bronze axes, or two-ring horse bits. Only later (ca. 4th c. BC on) would the local production change its orientation to that of Sauromatian needs (Vasilyev 2002).

Up to eleven territorial variants of the culture can be distinguished, although ceramics are quite homogeneous. Two main interrelated groups can be distinguished: the Post-Maklasheyevo group, at the core of Ananyino expansion to the east; and the Textile group (see below Akozino), both occupying the broad-leafed forests of the Volga–Kama area and being more advanced economically, possessing a quite developed bronze metallurgy. Northern cultural groups occupying the forests of the Kama, Vyatka, and Vetluga rivers under the influence of Ananyino were orientated mainly to hunting and fishing, with an archaic stone industry rooted in the preceding time (Koryakova and Epimakhov 2007).

There are open and fortified settlements, the latter appearing first in the south as a reaction to the nomadic threat and spreading "the Age of Fortresses" in the forest zone, characteristic of the Iron Age throughout eastern Europe and western Siberia. The expansion of a chiefdom-based system is marked thus by the appearance of fortified settlements in the core area of the culture. The Ananyino society shows the greatest degree of militarisation compared to other societies of the Eurasian temperate forest zones, including a great quantity of advanced forms of weaponry. Settlements were divided according to function into a clear hierarchy, with large fortified settlements as administrative centres, smaller sites as watch posts, and open villages of various sizes. Male chiefs probably related by kinship are distinguished by rich and distinguished goods, including imported objects (Koryakova and Epimakhov 2007).

Fortresses are therefore proper of middle and late stages, with earlier settlements being smaller and simpler, in close proximity to water. Fortified settlements were usually located on narrow promontories of high river banks, separated some 20–40 km from each other. They were variable in size, from large administrative and ceremonial centres (up to 30,000 m^2) to small fortified subordinated settlements (up to ca. 4,000 m^2), and both had usually two sides defended by steep slopes, and a third size limited by a big earthen moat and ditch. There were also seasonal, temporary hunting camps (Koryakova and Epimakhov 2007).

Settlements had numerous rectangular houses with a trend to develop large, above-ground pillar or log wooden constructions, from the early small semisubterranean dwellings. Hearths were located in the central part of a house floor, with one or two entrances to the houses, which were aligned in rows. There could have been a division according to function, with some central structures serving for ritual ceremonies, including sacrifices (e.g. horses, cows), and some exterior zones used for economic activities (Koryakova and Epimakhov 2007).

Ananyino graveyards were located near rivers, on high banks and terraces connected to certain villages. Graves with likely burnt wooden logs above them (in a sort of “mortuary house” above the burial) appear in the dozens or hundreds, organised in rows parallel to the river. The dead were placed in shallow oval or rectangular pits in an extended position, with their legs orientated to the river. Apparently, the Volga and Kama rivers were of great importance for the local population, which could have considered these running waters to be pathways for the dead (Koryakova and Epimakhov 2007).

The Ananyino cosmological model is connected in its upper level with the sun, an image that is repeated on various objects: round discs with the depiction of the face, round plaques with a concentric design, concentrically decorated spindle-whorls, etc. The middle level is associated with animals like elk, bear, wolf, and horse, while the underwater and underground creatures represent the lower level. Communal and tribal ritual centres show remains of fire surrounded by posts with various offerings, great accumulation of ash, charcoal, crushed bones, votive objects, thousands of arrowheads, hundreds of anthropomorphic and zoomorphic figurines, dogs, and bees (Koryakova and Epimakhov 2007).

Individual primary burials were the norm, but there were some collective and double burials, and some secondary burials with cleaned bones or separate skulls only. All graves contained pottery, and there were some practices involving fire cult, based on the charcoal in the grave infilling, possibly from pyres or sacrificial places with cremation. Male graves contained horse bones, weapons (spearheads, arrowheads, battle hammer-axes, socketed axes), tools (knives), decorations (belts with pendants, torques, bracelets). Female burials contained cattle bones, decorations, needles, and spindle whorls. Tombs of chiefs were more complex, with a circle of stone and a wooden roof cover, as well as rich assemblages (Koryakova and Epimakhov 2007).

Pottery is round bottomed, with profiled neck and smooth, sometimes polished surface. Corded and comb decoration combined with holes covers the upper part. Subsistence economy is based on stalled animal husbandry, which make up the majority of animal bones recovered, and—depending on the local environment—included cattle (30–40%), horses (ca. 30%), big pigs (ca. 20–40%) and sheep (ca. 10%), also used a source of wool. Dogs were commonly used, and hunting was common for fur and as an essential dietary complement, together with fishing and gathering. The advanced bronze metallurgy was also complemented by bone- and woodworking and iron production, which eventually replaced bronze production. Its main demographic growth due to the use of natural resources must have happened around the 5th–4th c. BC (Koryakova and Epimakhov 2007).

At the same time as the Ananyino culture begins to expand ca. 1000 BC, the Netted Ware tradition from the middle Oka expanded eastwards into the Oka–Vyatka interfluve of the Middle Volga region, until then occupied by the Chirkovo culture. Eventually, the Akozino and Akhmylovo groups (ca. 800–300 BC) emerged from the area, showing a strong cultural influence from the Ananyino culture (and often considered the *Textile* variant of the culture), by that time already expanding into the north-east forest of the Cis-Urals region (Parpola 2013).

The Akozino culture remained nevertheless linked to the western Forest Zone traditions, showing (Kuzminykh and Chizhevskij 2009):

- Netted Ware ceramics;
- socketed axes of “Akozino–Mälar” type, produced in a special metallurgical furnace distinct from that of the Ananyino culture, related to influences from the Lusatian culture from Poland (Parpola 2013); and
- funeral customs involving the inclusion of the Akozino–Mälar axes and other specific weapons among the grave goods.

An extensive interregional trade system developed during this time in the eastern Baltic area. Celts of Ananyino type and shape are found widespread from ca. 10th to the 5th centuries BC in the eastern Baltic, including Sweden, Finland, and Karelia. Findings with Ananyino origins also include bimetallic, single-edged daggers with iron blade and bronze hilts, characteristic of the second stage of Ananyino development, ca. 8th – 7th centuries BC. On the other hand, Mälar-type celts—so called because of the original belief (as with axes) that they were produced in Mälaren, Sweden—appear with an even wider geographical distribution, including Norway, southern Scandinavia, the Northern European Plains (Paavel et al. 2019), showing in the east a higher concentration on the western area of the Volga–Kama region, which connects it to the Akozino culture (Yushkova 2010).

The Gorodets culture (ca. 800 BC – AD 800) from the forest-steppe zone north and west of the Volga, shows fortified settlements during the Iron Age. Incursions of Gorodets iron makers into the Samara valley are seen by deposits of their typical pottery and a bloom or iron in the region (Kuznetsov and Mochalov 2016). This attests to continued contact between forest and steppe areas in the Cis-Ural region.

In the western region of the Forest Steppe, the Dnieper–Dvina and the Hatched Ware cultures develop with slight differences. Both of them feature jar-shaped and slightly-profiled forms, but while the Dnieper–Dvina culture shows smooth vessels, Early Hatched Ware culture shows mainly hatched vessels. Haching is also seen in Dnieper–Dvina, whose slightly-profiled pots show inverted or vertical rims, in contrast to the elongated and inverted rims of the Hatched Ware. In later stages, during the first centuries AD, carinated pottery features in the Late Hatched Ware, while profiled vessels with elongated rims prevail in the Dnieper–Dvina culture.

The Ananyino culture evolution in the Iron Age can be followed through its zoomorphic styles into Iron Age Pyanobor and Glyadenovo cultures, which partially reject the previous style and 'barbarise' (simplify) the ornamentations, under the influence from Scythian and related styles. The Glyadenov style of flat anthropomorphic and zoomorphic figurines can be followed in morphology and styles to the analogous Ural-Siberian Middle Age cultures—Itkuska, Ust'-Poluiska, Kulaiska cultures—which can in turn be considered as prototypes of Permian styles (Vasilyev 2002).

viii.15. Mordvins and Mari-Permians

The Cis-Uralian forest-steppe zone north of the Pontic–Caspian steppes represents a key prehistorical linguistic and cultural frontier, a north–south ecotone between the pastoral steppes to the south and the forest zone to the north. Pastoral steppe subsistence is associated with dynamic organisations represented by Turkic, before that Iranian, and before that eastern Proto-Indo-European. The Forest Zone is clearly represented pre- and proto-historically by Uralic languages, before they were displaced by Russian (Anthony 2016).

The synchronous appearance of closely related cultures in the forest-steppe and steppe regions, coupled with the emergence of fortified settlements (and thus a chiefdom-based system) in the whole Middle Volga area, should be identified as one of the few cases known where this stable prehistoric linguistic and cultural frontier has been crossed, allowing for the infiltration of Abashevo peoples from the forest into the steppe, probably boosted by the expansion of late Corded Ware groups in the region. This and subsequent interactions between northern and southern Abashevo settlers for centuries left a strong genetic and linguistic impact in both forest and steppe cultures, although each territory eventually retained their own ancestral culture and subsistence economies, which in turn determined their ethnolinguistic identification.

Uralic is widely supported to be spread through the east European forest zone already during the Fatyanovo-Balanovo and Abashevo expansion (Koivulehto 2001, 2003; Kallio 2002, 2017; Parpola 2013). The presence of Proto-Indo-Iranian and Proto-Iranian loanwords in Finno-Ugric (Kallio 2002; Koivulehto 2003; Koivulehto 1991), as well as the Uralic influence in Proto-Indo-Iranian (Kallio 2001), prove that these communities bordered each other in long-lasting contacts. Non-Uralic toponyms in the Volga–Oka and Volga–Kama areas support the admixture of incoming Uralic speakers with non-Uralic-speaking local hunter-gatherers of the Pit–Comb Ware culture (Kallio 2015; Zhivlov 2015), some of which may have survived in northern Russia up to the Common Era, based on topo-hydronyms of the area (Helimski 2001).

The synchronous appearance of Sintashta–Potapovka–Filatovka complex in the steppes, derived in great part from the migration of Abashevo settlers and transformation of southern Abashevo territory (see *§VIII.18.1. Sintashta–Potapovka–Filatovka*), should be identified in part with this interaction area in the forest-steppe and steppe areas. Southern Abashevo and later Pozdnyakovo (from Srubna), as well as the steppes, would then correspond to the Pre- and Proto-Indo-Iranian period, while northern Abashevo and related Fatyanovo and Battle Axe cultures to the north would correspond to the evolving Finno-Ugric community.

While Abashevo has not been sampled yet, the Poltavka outlier from the Sok River in Samara (ca. 2900–2500 BC), of hg. R1a1a1b2a-Z94, clustering closely with Corded Ware, probably represents an Abashevo-related immigrant. Similarly, early Sintashta and Srubna samples, of intrusive

R1a1a1b2-Z93 lineages (and some of hg. R1a1a1b1a2-Z280 in Srubna) suggest the mixture of both haplogroups in Abashevo, probably with a gradient of increasing R1a1a1b1a-Z282 to the north in Fatyanovo–Balanovo.

The expansion of Balanovo- and Abashevo-related groups to the north-east, and the eventual formation of the Ananyino culture, are probably to be associated with the evolution of Proto-Permic. “It is commonly accepted by archaeology, ethnography, and linguistics that the ancestors of the Permian peoples (the Udmurts, Komi-Permians, and Komi-Zyryans) left the sites of Ananyino cultural intercommunity. In the west, in the Middle Volga basin, the Ananyino groups were neighbors of the groups that produced textile ceramics, these were ancestors of the Volga Finns (Goldina 1999; Napolskikh 1997)” (Koryakova and Epimakhov 2007).

The sudden emergence of the Ananyino and Akhmylovo cultures ca. 1000–800 BC is linked to the expansion of Iranian-speaking cultures of the southern steppe, creating a ‘push’ event that caused the emergence of a chiefdom-based social system in eastern Europe. Ananyino later split into two cultures, the Pyanobor culture (ca. 300 BC – AD 200) on the Vyatka, middle and lower Kama, and lower Balaya river, associated with Proto-Udmurt; and the Glyadenovo culture (ca. 200 BC – AD 500) on the upper Kama, connected with Proto-Komi (Parpola 2013).

The expansion of Ananyino culture into the north-east Cis-Urals region, with the formation of the Northern cultural groups of the Kama, Vyatka, and Vetluga rivers, is probably to be associated with the integration of some N1a1a1a1a-L392 lineages (formed ca. 4400 BC, TMRCA ca. 2900 BC)—by this time probably widely distributed in the Circum-Arctic region and in central and western Siberia (see *§§viii.16. Saami and Baltic Finns*, *§viii.21.1. Yukaghirs*, and *§viii.21.2. Turkic peoples and Mongols*)—into the Permic genetic stock. The best fit for northern Komi including AP ancestry (Sikora et al. 2018), instead of Baikal-related ancestry (as is common for some eastern

Uralic groups), further supports the integration of distinct Circum-Arctic and Palaeosiberian groups among different expanding Uralic-speaking populations.

The expansion of Netted Ware from Abashevo near the Middle Volga, and its expansion into inner southern Finland, including the Sarsa and Tomitsa groups, possibly represented an expansion of West Uralic peoples, although Textile ceramics in the north are most likely also associated with West Uralic Balto-Finnic and Samic dialects. The emergence of Akozino in Netted Ware territory probably represents the spread of Proto-Mordvinic and closely related Volga-Finnic dialects, while the Gorodets culture can be more specifically correlated with the development of Mordvinians (Parpola 2013).

The expansion of Akozino warrior-traders under influence of Ananyino is probably to be related to a Y-chromosome bottleneck involving N1a1a1a1a1a-VL29 lineages (formed ca. 2100 BC, TMRCA ca. 1600 BC), accompanying migrants to the west into cultures around the Baltic area, likely through alliances and exogamy practices, in an integration facilitated by the emergence of chiefdoms in eastern Europe and the cultural influence and demographic growth of Ananyino and Akozino (see *§viii.16.2. Baltic Finns*). The more intense contacts with forest populations, and later expansion westwards by Akozino may justify a common, recent origin of certain non-Uralic loanwords shared by Balto-Finnic and Mordvinic (Häkkinen 2009).

An origin of haplogroup N1a1a1a1a1a-VL29 in western Siberia, between the Urals and Lake Baikal, can be proposed based on modern (Ilumäe et al. 2016) and ancient DNA (Cui et al. 2013; de Barros Damgaard, Martiniano, et al. 2018). The connection of its upper clade N1a1a1a1a1-Y6058/CTS10760 (formed ca. 2900 BC) with populations of Northern and Eastern Eurasia, and in particular the expansion of sister clade N1a1a1a1a3a-F4205 with Avars (see *§viii.21.2. Turkic peoples and Mongols*), and N1a1a1a1a-L392 with Northern Asian populations (see *§viii.17.1. Ugrians*), further supports its ancestral connection with Palaeosiberian populations (see *§v.8. Palaeosiberians*) and its lack of relationship with Uralic peoples, until their gradual incorporation during the expansion of Uralic dialects to the east and north (Figure 78).

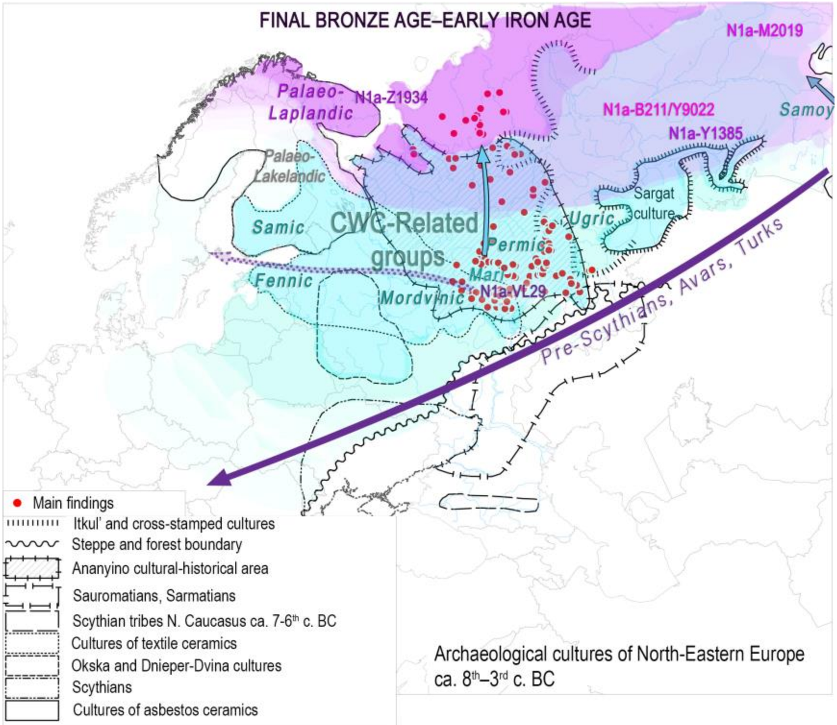

Figure 78. Map of archaeological cultures in north-eastern Europe ca. 8th–3rd centuries BC. Modified from (Vasilyev 2002). Shaded area represents the Ananyino cultural-historical society. In pink and purple, Circum-Arctic and Siberian populations. Solid arrows depict the expansion of Uralic languages to the north, and steppe populations to the west, while dotted arrows represent the direction of "Siberian" ancestry and haplogroups from Akozino into the Baltic. Labelled are regions where N1a1-Tat is probably going to be found, with pink color representing non-N1a1a1a1a-L392 lineages. N1a1a1a1a2-Z1936 shows an ancestral connection between Palaeo-Laplandic and forest peoples from the Trans-Urals, while N1a1a1a1a1a-CTS10760 connects the Volga region with Altaic peoples. Image modified from Vasilyev (2002).

In fact, some available ancient DNA samples attributed to steppe nomads since the LBA–Iron Age transition show likely N1a1-Tat subclades—such as an LBA individual from Afontova Gora (ca. 1000–850 BC), a Cimmerian from Hungary (ca. 980–930BC), and Scytho-Siberians (see below *§viii.19. Iranians*)—which suggests a potential expansion of lineages ancestral to N1a1a1a1a1a-

VL29 with Pre-Scythian and Scythian populations through a southern route across the Urals, and their integration into the Middle Volga area because of the intense contacts of Ananyino and Akozino–Akhmylovo with steppe peoples.

Mordovians seem to be less affected by the admixture with Palaeosiberian populations from the Circum-Arctic region, showing an ancestry closer to Corded Ware populations of the forest zone, formed by CWC (ca. 79%), WHG (ca. 9%) and Nganasan-like (ca. 12%), compatible with a lesser admixture with Palaeo-Arctic-like populations (Jeong et al. 2019). Mordovians also show more hg. R1a1a-M198 (ca. 27%), with less I-M170 (ca. 20%), N1a1-Tat (ca. 16%), R1b-M343 (ca. 13%), and J-M304 (ca. 12%).

Maris show a north-south cline of N1a2b-P43 (ca. 42% in Bashkirian Maris) against N1a1-Tat (ca. 13% among Bashkirian Maris, with up to 46% in northern Maris), with R1a1a-M198 lineages represented in both populations (ca. 28% in the south, 22% in the north), with approximately half R1a1a1b1a2-Z280 (16%), and half R1a1a1b2-Z93 (16%). None of the N1a1-Tat subclades among Bashkirian Maris investigated belonged to common subclades N1a1a1a1a1a-VL29 or N1a1a1a1a2-Z1936 (Dudás et al. 2019).

Among Permic peoples, Udmurts and Besermyans show a similar ancestry, formed by CWC (ca. 71–74%) and Nganasan-like (ca. 25–29%), which support closer contacts with Palaeo-Arctic and Trans-Uralian populations (Jeong et al. 2019). Southern Udmurts show more hg. N1a1-Tat (ca. 54%) than R1a1a-M198 (ca. 19%) or N-M231(xN1a1-Tat) (ca. 17%); while northern Komis show less differences between N1a1-Tat (ca. 37%), R1a1a-M198 (ca. 27%) or N-M231(xN1a1-Tat) (ca. 19%).

The cluster formed by modern Mordovians, Estonians, as well as some Finns, Karelians, and Mansis probably represents the original Uralic cluster near Abashevo (Tambets et al. 2018). The presence of N-M231(xN1a1-Tat) lineages suggests contacts with Palaeosiberian peoples to the north, possibly involving migrations from the east (see *§viii.17. Ugrians and* Samoyeds).

VIII.16. Fennoscandia

VIII.16.1. Kiukainen

Late Comb Ware pottery is found especially in coastal areas well into the Corded Ware period (after ca. 2500 BC), probably withstanding cooking and thus used for processing of marine products. Comb Ware settlements, faunal assemblages and the size and fragility of Comb Ware vessels suggest that these populations were sedentary, with a specialised economy based upon coastal resources (Oinonen et al. 2014).

The decrease and even lack of archaeological material from the later 3rd millennium BC onwards has been explained by decreasing population numbers, which would have been caused by the deteriorating climate, characterised by cooler seasons at the end of the 3rd millennium BC. However, the abundant number of burial cairns and pollen analyses showing anthropogenic activities indicate that no complete depopulation took place, so the change was mainly in ways of leaving and material cultures, which left materials difficult to identify archaeologically (Nordqvist 2018).

These changes seem to be connected to external influences. The Corded Ware culture disappears (ca. 2300/2000 BC), and on the coast, the Kiukainen culture appears ca. 2300 BC, coinciding with cultural impulses from the Estonian Western Textile Ceramic tradition – different from the eastern Textile Ceramic or Netted Ware (appearing in eastern Estonia ca. 1700 BC). After ca. 2000 BC, two Corded Ware-related cultures remain in the region: in the coast, the Final Neolithic Kiukais or Kiukainen culture, derived from the original Circum-Baltic Corded Ware settlers, reverts to a subsistence economy which includes hunting and fishing, modest swidden cultivation, and bronze metallurgy, keeping mainly settlements from the best territories along the coast, including the Gulf of Finland (Nordqvist 2018). In inner Finland, another Textile ceramic tradition appears ca. 1900–1800 BC, connected to the northward expansion of Netted Ware from the Mid-Volga area (see *§VIII.15.2. Netted Ware, Chirkovo, Kazan*).

The ceramic inventory of the Kiukainen culture shows similarities with late Corded Ware, but also to local hunter-fisher-forager ware (Pyheensilt and late Comb Ware), and is believed to be a cultural amalgamation and reversion to aquatic foods emerging locally. Pottery residues show a mix of ruminant and non-ruminant/marine products, which suggests that (compared to Corded Ware) this culture used a less-specialised economy, probably reintroducing aquatic resources to complement diminishing terrestrial sources, as is historically common among Scandinavian cultures (Cramp et al. 2014).

Later, the Kiukainen culture probably spread with the custom of burying chiefs in stone cairns to Estonia. The Kiukainen culture evolved into the Paimio ceramics in south-western Finland, and the corresponding Asva Ware of Estonia, whose influence over the area spans ca. 1600–700 BC. This continuity supports the maintenance of close cultural connections through the Gulf of Finland after the demise of the Corded Ware cultural complex (Parpola 2018).

VIII.16.2. Asbestos Ware cultures

Like the isolated Bell Beaker findings of the eastern Baltic, Finland, and Belarus, isolated Bell Beaker findings in the northernmost territories of Norway have to be interpreted in the context of the initial expansive phase of the Bell Beaker peoples, before their integration into distinct regional cultures.

The dichotomy marked by environmental constraints in Scandinavia appears throughout the whole Nordic Bronze Age period, evidenced by the lack of relevance of centres of dominant chiefdoms in northern and mountainous regions, where metal is scarcely known at all. This difference is as relevant between these regions as between the Nordic Bronze Age and Norrland and Finland: for all these groups of foragers and tundra hunters, metal objects and technology must have seemed as fabulous as when bronze was introduced in the south (Thrane 2013). The relationship between southern and northern Scandinavian groups has been described as indirect, based on reciprocal exchange and ideological dominance (Kristiansen 1987).

North Scandinavia shows continuous eastern connections and a Mesolithic way of life, using quartz for flat-based points and scrapers between 1500–500 BC. Small coastal huts were common. Seal oil found in the Nordic EBA was produced in the Åland islands in the Baltic. Asbestos-tempered pots reaching up to central Sweden at the end of the 3rd millennium BC show a decoration and technique evidencing connections across the Baltic to Finland via Åland. Containers used in iron smelting are a northern specialty. Burials show southern acculturation, with man-size stone cists and later smaller cists in the cairns along the coast (Thrane 2013).

The border with the southern regions ran through Ångermanland in northern Sweden, coinciding with the modern border between sub-Arctic nomads and the Swedish-speaking population. Here farming and agriculture began during the Late Bronze Age, which is difficult to distinguish from the Early Iron Age (Thrane 2013).

In northern Fennoscandia, pottery is found only sporadically since 4500–4200 BC until the end of the 3rd millennium BC, and populations are mainly hunter-gatherer communities characterised by seasonal mobility, apparently with specific resource areas. Asbestos temper ceased in eastern Finland at the same time as it appeared in northern parts of Finland and into Norwegian Finnmark and the Kola peninsula, in the Lovozero Ware, ca. 1900–700 BC (Damm 2012).

VIII.16.3. Textile ceramics

During the 2nd millennium BC, textile impressions appear in pottery as a feature across a wide region, from the Urals through the Volga to the Baltic Sea and beyond, in communities that evolved from late Corded Ware groups without much external influence. It has been traditionally suggested that this stylistic phenomenon was part of a Textile ceramic culture that expanded from the east to the north-west. Nevertheless, the decoration proper of textile ware can be easily copied and spread without much long-term interaction or population movement. In fact, it is possible to see influences proper of horizontal transmission from several directions. In the western area, textile impressions were known since the Corded Ware pottery in Estonia and Finland, and is very common in Kiukainen pottery, immediately preceding Textile wares of Finland. Therefore, groups like Paimio/Asva and western Sarsa show most likely cultural continuity (Lavento 2001).

Figure 79. Stone Cist Graves from the Bronze Age in Northern Estonia. Photo of cultural heritage monument of Estonia number 17543.

Finnish subgroups often related to the Netted Ware, like Sarsa, Tomitsa, or Kainuu developed quite differently, some from local knowledge and traditions (Figure 79) without any necessary new craftsmen, others probably due to some incoming groups or individuals (Lavento 2001). In fact, Late Textile ceramics from the Gulf of Finland show more similarities with Netted Ware, which supports the presence of changing trends. A general preference for textile impression is obviously seen across all these groups, with different stylistic trends—first western, then south-eastern—suggesting a close association between them, but not necessarily much mobility (Damm 2012).

Early Metal Age pottery (ca. 1200–500 BC) shows a strong reliance on dairy products. Increasing population size despite continuing climatic deterioration of the Late Holocene is believed to have arisen from the intensification of agriculture and cattle breeding by the Late Metal Ages, which overcame environmental constraints upon population size (Cramp et al. 2014). While the first cereal grains in mainland Finland occur during the LN or Bronze Age (ca. 1900–1250 BC), the earliest bones of sheep–goat are earlier (ca. 2200–1950 BC). However, finds of Scandinavian bronze artifacts show a likely cultural influx from east-central Sweden, which has been proposed (Vanhanen et al. 2019) as the source of development of agriculture in the East Baltic in the Late Bronze Age (ca. 1400-1150 BC).

On the other hand, the appearance of Textile ware tempered with a variety of materials, but rarely with asbestos, marked a crucial difference with other groups. While Textile ware was widespread into northern Fennoscandia, there are essential regional differences. This phenomenon of abandonment of the traditional asbestos temper probably represents a cultural break, a change in the whole distribution of asbestos through marriage and exchange networks, and thus a reorientation of alliances (Damm 2012).

To the west, in Norway and Sweden, these vessels were predominantly tempered with asbestos, which points to a different transmission of knowledge (learning networks) where the use of asbestos continued, although the copying of textile decorations indicate a positive association with eastern communities. To the north, in northern Finland, the expansion of Textile ware represented an expansion of the technology, contrasting with local traditions of sub-Neolithic Lovozero and Pasvik asbestos-tempered pottery (Damm 2012).

VIII.16.4. Morby/Ilmandu

The influence of Akozino culture reached Finland late, at the end of the Late Bronze Age and beginning of the Early Iron Age, when the influence of the Nordic Bronze Age culture on the Gulf of Finland was already declining. At this time, the Paimio ceramics of the coast evolved into the Morby ceramics in Finland (ca. 700 BC - AD 200 BC), and the corresponding Asva Ware of Estonia evolved into the Ilmandu style ceramics (Figure 80), also including Latvia, and the Mälaren area in Sweden (Parpola 2013).

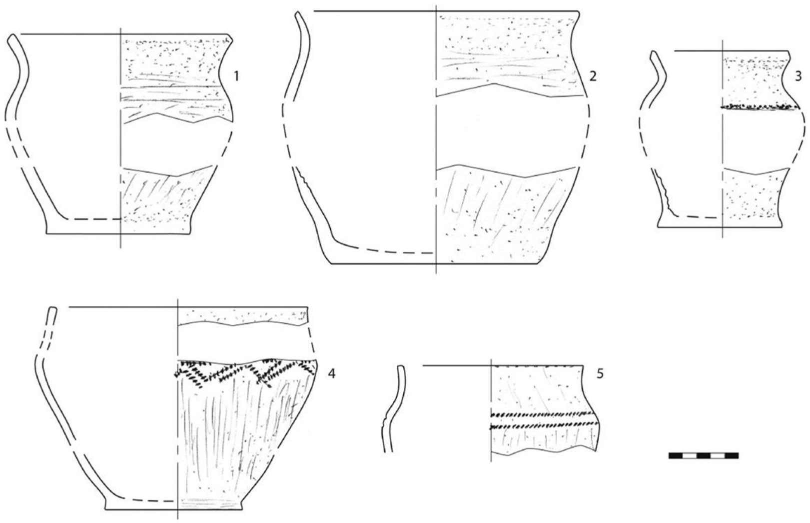

Figure 80. Reconstruction of some clay vessels from a cist grave in Sondlamägi, Muuksi (ca. 1100–800 BC). 1–4 Ilmandu-style pottery; 5 Cord-Impressed Pottery. Modified from Laneman and Lang (2013).

The old Paimio/Asva Ware traditions continued side by side with the new ones, with a clear technical continuity between them, but with ornamentation compared to the EIA cultures of the Upper Volga area. Other pottery types common from Finland and the eastern European forest belt—like the Lüganuse style—also appear in Estonia. Akozino–Mälar axes were introduced into the Baltic area ca. 800–500 BC in such great numbers—especially in south-western Finland, the Åland islands, and the Mälaren area of eastern Sweden—that it is deemed to have involved a movement of people, too (Figure 81). This movement was probably caused by warrior-traders of the Akozino–Akhmylovo culture, following the same waterways that Vikings used more than a thousand years later (Parpola 2013).

At the same time as the new ornamentation appears, early *tarand* graves appear (ca. 800–400 BC) in the coastal areas of northern and western Estonia and on the islands, roughly contemporary with the emergence of similar graves in Ingria, south-western Finland, eastern central Sweden, northern Latvia and Courland. *Tarands* are described as “mortuary houses”, corner-joined horizontal log cabins, in which ancestral bones were stored, and it is quite common to find them forming long rows of rectangular ‘yards’ or ‘enclosures’. Such ‘houses of the dead’ have their origin of similar burial rites in the Akozino–Akhmylovo culture, and grave goods contain ornaments from the Upper and Middle Volga region, while cultural continuity is evidenced by Ilmandu-type pottery (Parpola 2013).

Akozino–Mälar axes are copied in iron in Fennoscandia, with iron being highly valued and rare, and its production technology being a well-guarded secret. Access to this knowledge and to prestige goods was proper of the elites in chiefdom-level societies. Textile ceramic cultures of the Early Iron Age in north-eastern Europe were well armed and possessed hill forts, with those in Finland starting ca. 1000–400 BC, after the Netted Ware expansion. This evolution to a chiefdom-based society—where thousands or tens of thousands formed part of each chiefdom—began slightly earlier than the appearance of Akozino influence and *tarands* (Parpola 2013).

Fortified settlements in the region may have represented visiting warrior-traders settled through matrimonial relationships with local chiefs, eager to get access to coveted goods and become members of a distribution network that could guarantee them even military assistance. Such a system is also seen synchronously in other cultures of the region, e.g. in Vistad in Östergötland, where a fortified settlement within Nordic Bronze Age territory shows Lusatian type pottery and artefacts, suggesting the presence of foreign Lusatian chiefs accommodating long-distance traders in Nordic territory (Parpola 2013).

In the later part of the Early Metal Period and initial Early Iron Age, the use of asbestos temper increased, sign of newly made networks with connections to asbestos sources. Asbestos was used infrequently in Finnish Textile ware during the 2nd millennium BC, but was used in Norwegian Finnmark and the Kola peninsula in the Lovozero ware and in the so-called

Pasvik ware. Asbestos continued to be favoured in Norway and Sweden during the whole period, and was reintroduced in mainland Finnish wares: in the north with the Kjelmøy Ware (ca. 700 BC – AD 300), which replaced the Lovozero Ware; and in the east in inner Finland and Karelia with the Luukonsaari and Sirnihta wares (ca. 700/500 BC – AD 200), where they replaced the previous Sarsa–Tomitsa ceramics (Damm 2012).

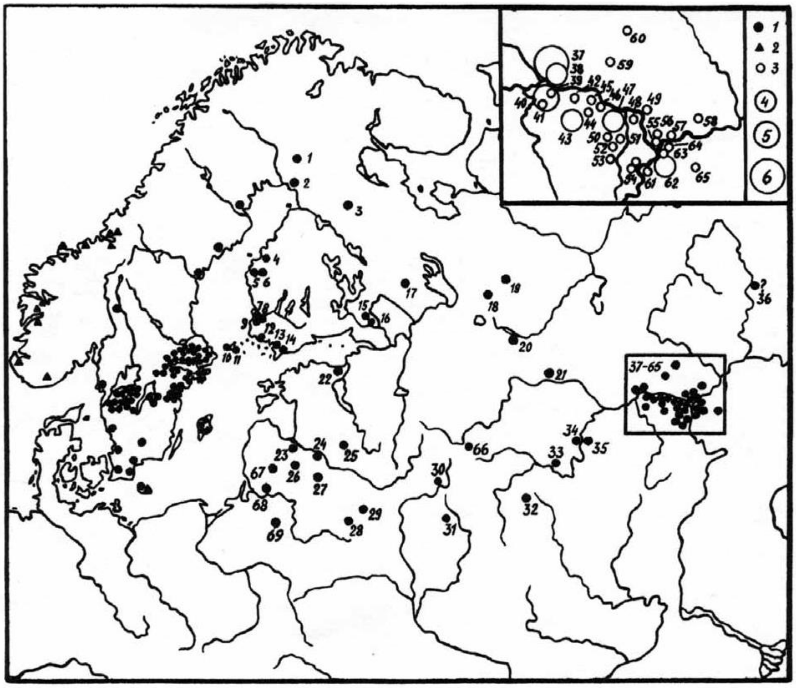

Figure 81. Distribution of the Akozino–Mälar axes in north-eastern Europe according to Sergey V. Kuz'minykh (1996: 8, Fig. 2).

viii.16. Saami and Baltic Finns

R1a1a1b1a-Z282 seems to be the only haplogroup found to the north, in Battle Axe and derived cultures (see *§vii.1. Western and Eastern Uralians*). A late sample also attributed to the Battle Axe culture from Spiginas, Lithuania (ca. 2130–1750 BC) shows subclade R1a1a1b1a2b-CTS1211. Individuals from the Eastern Baltic Bronze Age from Lithuania, Latvia and Estonia (ca. 1230–230 BC) form a common cluster with extra Baltic hunter-gatherer ancestry compared to Late Neolithic samples, a 'northern' shift in the PCA toward WHG, and Baltic haplogroups, none of them stemming necessarily from Comb Ware culture-related samples, which suggests that this population did not play a large role in the ancestry of Bronze Age individuals (Mittnik, Wang, et al. 2018).

In fact, Bronze Age samples need a further source of admixture beyond a Baltic Late Neolihtic population and foragers, including an increase in NWAN-related ancestry, compatible with the arrival of another wave of Battle Axe settlers from east-central European Corded Ware groups, that possibly replaced R1a1a1b1a3-Z284 lineages in the area, or contributed to a Y-chromosome bottleneck different from the one seen in Scandinavia. Another explanation for the presence of R1a1a1b1a3-Z284 in the eastern Baltic area may be continuous contacts with Palaeo-Germanic populations: e.g. through the site of Kivutkalns, a major bronze-working centre located on a trade route that opened to the Baltic Sea on the west and led inland following the Daugava river, and through which surrounding populations might have been in contact (Mittnik, Wang, et al. 2018).

Reported haplogroups include three out of seven samples from the West Baltic site of Turlojiškė, Lithuania (ca. 2000–600 BC), at the border with late Trzciniec (see *§viii.8. Balto-Slavs*), all three of hg. R1a1a1b-Z645, one of them a subclade of R1a1a1b1a2a-Z92, R1a1a1b1a2a1a-YP617 (formed ca. 1400 BC, TMRCA ca. 1400 BC); ten samples from Kivutkalns, Latvia (ca. 810–230 BC) also include only R1a1-M459 lineages, probably all seven of hg. R1a1a1b-

Z645: five of them show hg. R1a1a1b1a2b-CTS1211, including four with mutation Y13467 (formed ca. 2000 BC, TMRCA ca. 2000 BC). One outlier from Turlojiškė (ca. 1075 BC) shows influence from the west (Mittnik, Wang, et al. 2018), probably related to incoming Balto-Slavic populations in the West Baltic through Trzciniec.

In the East Baltic, the sampled population of the Late Bronze Age shows largely continuity with Corded Ware populations, with an ancestry related mainly to Corded Ware samples from the Baltic (ca. 48–65%) and a WHG-like population (ca. 38–52%). They form a common cluster with West Baltic populations, between Corded Ware samples from the Baltic and previous Mesolithic and Neolithic populations from Eastern Europe. Out of nineteen Bronze Age individuals sampled from stone-cist graves in Estonia all sixteen reported haplogroups are R1a-M420, all likely within R1a1a1b-Z645, at least two of hg. R1a1a1b1a2a-Z92 (Saag et al. 2019).

These findings suggest an admixture of incoming Corded Ware migrants of Battle Axe material culture admixing with sub-Neolithic populations of Narva and related eastern Baltic cultures rather than Comb Ceramic groups from the forest zone. Both the origin of males from Corded Ware and their prevalent admixture with western populations in the eastern Baltic area are frontally opposed to the traditional view of Uralic speakers stemming from Volosovo and related hunter-gatherer peoples, and supports the origin of Uralic speakers in Corded Ware migrants instead.

Many R1a1a1b1a2-Z280 lineages (TMRCA ca. 2600 BC) are prevalent in north-eastern European populations around the Baltic: e.g. R1a1a1b1a2a-Z92 (TMRCA ca. 2500 BC), found in ancient samples from Lithuania and in modern north-eastern European populations; R1a1a1b1a2b-CTS1211 (TMRCA ca. 2200), with one ancient sample already found in the Battle Axe culture from Lithuania, and later in Latvia, is found widely distributed in modern populations around the Baltic Sea with basal, early and late subclades. Nevertheless, some late subclades were apparently incorporated into the Slavic expansion, possibly via Trzciniec-mediated interactions, such as R1a1a1b1a2b3-CTS3402 (TMRCA ca. 2200 BC).

Finno-Samic is thought to have developed under strong Nordic Bronze Age influences upon the Baltic coast of Finland and Estonia. The Finno-Samic community, under strong, long-lasting Palaeo-Germanic influence—evidenced by Germanic loanwords representing different dialectal layers—would be thus represented by the transformation of Kiukainen into the Textile ceramic cultures, with Samic probably developing to the north of the Gulf of Finland while Balto-Finnic developed to the south, roughly corresponding to Paimio ceramics and Asva Ware respectively (Kallio 2014).

The conservatism of Finno-Samic phonology relative to Proto-Uralic as late as the Bronze Age further confirms the lack of strong direct external influences, which finds its explanation in the lack of admixture of Corded Ware settlers in the area, and the succeeding contacts mainly with Corded Ware-derived groups, such as Netted Ware and Akozino–Akhmylovo to the east and south-east, Scandinavian peoples (those bilingual communities shifting to a Pre-Germanic language) to the west, and other Finno-Permic populations to the south-west, before their acculturation under expanding Proto-Baltic or Proto-Slavic populations. During the Early Iron Age, the physical separation of Balto-Finnic and Samic communities was probably complete, as reflected by the differing layers of Germanic loanwords in each branch (Kallio 2009, 2012, 2015).

viii.16.1. Saami and Laplandic peoples

To the north of the Gulf of Finland, six individuals of the Lovozero culture from Bolshoy Oleni Ostrov (ca. 1610–1436 BC), two of hg. N1a1a1a1a-L392, show elevated Siberian ancestry—clustering along a Palaeosiberian cline connecting northern Eurasian peoples—and represent most likely a recent expansion of Paleo-Laplandic-speaking hunter-gatherers from west Circum-Arctic Eurasia into the Kola Peninsula, evidenced by the introduction of asbestos-mixed ceramics ca. 2000 BC, and the spread of even-based arrowheads in Lapland from ca. 1900 BC (Lamnidis et al. 2018).

The nearest counterparts of Vardøy ceramics (ca. 1600–1300 BC) can be found on the Taymyr peninsula, much further to the east, compatible with the foreign ancestry found in Lovozero individuals likely related to Neolithic samples from the Cis-Baikal area, as found in modern populations (Jeong et al. 2019). Finally, the Imiyakhtakhskaya culture from Yakutia spread to the Kola Peninsula during the same period, also representing the expansion of Paleosiberian peoples of mainly N1a-L279 lineages across north Eurasia (Lamnidis et al. 2018). The Bolshoy Oleni Ostrov samples cluster in this ancient Palaeosiberian cline near modern Khants, which supports a close original source for both in Circum-Arctic Cis-Urals population.

This movement probably displaced earlier Mesolithic pioneers of the Komsa and Suomusjärvi cultures—probably mainly of Baltic / Scandinavian hunter-gatherer ancestry and of I-M170, R1b1a1-P297(xM269), and R1a1-M459 (xZ645) lineages—from eastern and northern Fennoscandia into central Finland, where they evolved probably with the Kainuu culture. This population probably represents the Palaeo-Lakelandic speakers[34] encountered by Proto-

[34] According to Kallio (2015): “No doubt the most convincing substrate theory has recently been put forward by the Saami Uralicist Ante Aikio (2004), who has not only rehabilitated but also improved the old idea of a non-Uralic substrate in Saami. His study shows that there were still non-Uralic languages spoken in Northern Fennoscandia as recently as the first millennium AD. Most of all, they were not only genetically non-Uralic but also typologically non-Uralic-looking, bearing a closer

Samic peoples during their expansion to the north and east, reflected in Samic substrate words (Aikio 2012; Carpelan and Parpola 2017).

The paternal lineages expanded with Palaeo-Laplandic peoples is probably N1a1a1a1a2a-Z1934 (formed ca. 2800 BC, TMRCA ca. 2400 BC), based on its distribution among present-day populations around the Barents Sea, including Finns (ca. 44%), Vepsas (ca. 32%), Karelians, Saamis, North Russians (ca. 20%), and in eastern Russians and Volga-Ural populations such as Komis, Mordvins, and Chuvashes (up to 9%). This haplogroup is in turn connected to parent N1a1a1a1a2-Z1936, also found in Ugric and Altaic populations (see *§viii.17.1. Ugrians*), hence probably related to Paleosiberian and Palaeo-Arctic hunter-gatherers that expanded to the west into the Kola Peninsula, introducing asbestos-mixed ceramics, even-based arrowheads (Lamnidis et al. 2018), and speaking Palaeo-Laplandic, a substrate language of late Samic (Aikio 2012).

An early Samic individual from Levänluhta in western Finland (ca. AD 388-547), with strontium isotope analysis showing mainly marine dietary resources, compatible with coastal resources 25–30 km to the north-west in the Bothnian Sea, shows an admixture similar to previous Battle Axe and Baltic Bronze Age samples, clustering closely to Battle Axe individuals from Scandinavia, and at the one extremity of the ancient Finno-Samic cluster (opposite to the Baltic Iron Age individual, see below), which supports the physical separation of the Saami population from innovations and population contacts that happened to the south, in the eastern Baltic region and the Gulf of Finland. Slightly later samples from the same site (ca. AD 405–555 and ca. AD 662-774) show signs of progressive admixture with Lovozero-like populations, evidenced by their increased Siberian ancestry and their position closer in the PCA (Suppl. Graph. 14) intermediate between Baltic BA and Iron Age samples and Lovozero (Lamnidis et al. 2018).

---

resemblance to the so-called Palaeo-European substrates (for which see e.g. Schrijver 2001; Vennemann 2003).”

This is compatible with the spread of Samic speakers of the Sarsa culture at the same time as it developed into the Luukonsari culture: to the north admixing with Lovozero-derived Kjelmøy Ware peoples, of mainly hg. N1a1a1a1a-L392 (mainly of N1a1a1a1a2-Z1936 lineages); and to the east, admixing with Sirnihta and Anttila culture peoples from inner Finland and Karelia, likely speakers of Samic- or Volga-Finnic-related languages and Palaeo-Lakelandic peoples derived from Tomitsa and Kainuu ceramics, possibly already admixed with Palaeo-Laplandic peoples of Kola during this period.

Two sampled historical Saami from Chalmny Varre (AD 18th – 19th c.), one of hg. I2a1a-P37.2, show similar intermediate ancestry to the mixed Levänluhta samples, between Baltic BA and Lovozero, but on the EHG and Baltic BA side of the previous cluster, with a corresponding increase in Steppe-related ancestry. One modern Saami, of hg. I1a1b3a1-, clusters close to these historical Saami (Lamnidis et al. 2018).

viii.16.2. Baltic Finns

The emergence of a chiefdom-based system, the spread of Celts of Ananyino type and Akozino–Mälar axes, and the expansion of *tarand* graves ca. 1000–400 BC, all can be potentially associated with the intrusion of Akozino warrior-traders of hg. N1a1a1a1a-L392 across chiefdoms all over the Baltic Sea, probably through regional alliances and exogamy practices:

Among seven sampled Iron Age individuals from tarand graves in Estonia, there is largely continuity of Estonian LBA ancestry, with a slight increase of CWC Baltic ancestry (ca. 57–77%) compared to LBA samples, and decreased WHG-like ancestry (ca. 23–43%). This transition also marks the emergence of a variable "Nganasan-like" ancestral component, found in four samples (ca. 1–4%) out of eleven investigated, together with the first samples of hg. N1a1a1a1a1a-VL29 (Saag et al. 2019).

At least two of the three N1a1a1a1a1a-VL29 samples (and three more samples of the Middle Ages) show hg. N1a1a1a1a1a1a-L550 (formed ca. 1100 BC, TMRCA ca. 900 BC), which is today associated with Germanic, Balto-Slavic, and Balto-Finnic populations around the Baltic Sea. This distribution supports the expansion of Akozino warrior-traders through intermarriages and alliances all over the Baltic, without bringing ethnolinguistic change to the region.

Furthermore, Estonian Iron Age samples still show a majority of hg. R1a1a1b-Z645 (five out of eight reported samples), and they form a cluster closer to Corded Ware samples than Baltic Bronze Age individuals, which suggests an origin of migrations close to the steppe, coincident with the influence of Akozino in the region. Samples of haplogroup N1a1a1a1a1a1a-L550 are not particularly linked to that "Nganasan-like ancestry", and the sample with the highest such proportion (ca. 4%) comes from an early R1a1a1b-Z645 sample in Kund. Another early sample from Kunda, of hg. N1a1a1a1a1a-VL29, clusters closer to the Urals in the PCA, both Kunda samples (dated ca. 600 BC) are described as not locally born, with south-western Finland and Sweden excluded.

This arrival and admixture of Akozino warrior-traders could be linked to a number of innovations shared between Proto-Mordvinic and Proto-Balto-Finnic (on the southern Gulf of Finland), but not on Samic (Parpola 2013, 2018), due to the likely elite domination of some among them along the Baltic coast, although cultural contacts between Finland and the Gorodets culture lasted until the AD 7th–8th centuries, evidenced by imports from the Lomovatovo culture (Koryakova and Epimakhov 2007).

A sample of the Baltic Iron Age from northern Lithuania (ca. AD 1–600) shows hg. N1a1a1a1a1a1a1-L1025+ (formed ca. 900 BC, TMRCA ca. 600 BC) a subclade of hg. N1a1a1a1a1a-VL29, clustering also closely to Corded Ware and Baltic BA samples. This individual corresponds to a period and region of inhumations, among divergent burial traditions that could change abruptly (de Barros Damgaard, Marchi, et al. 2018). The presence of Proto-Baltic loanwords may be dated to the Early Iron Age, which places Balto-Finnic languages in the Gulf of Finland, in close contact with both Germanic and Baltic peoples, once the greater influence of Germanic over Finnic and Samic faded (Kallio 2008).

A late Viking from the town of Sigtuna, in eastern central Sweden (AD 10th–12th century), shows hg. N1a1a1a1a1a1a7-Y4341 (formed ca. 900 BC, TMRCA ca. 600 BC), also subclade of hg. N1a1a1a1a1a-VL29. This individual is of local origin, based on strontium isotope analysis and on his admixture among Nordic peoples (Krzewińska, Kjellström, et al. 2018), hence most likely part of lineages integrated with Proto-Germanic speakers since the expansion of Akozino warrior-traders, rather than a recent intrusion. This lineage supports a Scandinavian origin of Rurik (AD 9th c.), a Varangian prince whose descendants ruled the state of Kievan Rus’, and who shows a subclade of N1a1a1a1a1a1a7a-Y4339 (formed ca. 2600 BC, TMRCA ca. AD 250), a haplogroup found primarily in Sweden (ca. 52%), apart from Finland, Russia, Britain, or Norway, in great part related to the Viking expansions (Volkov and Seslavin 2019).

During AD 5th–10th century, people of present-day north-eastern Belarus, north-western Russia, south-eastern Estonia, and eastern Latvia buried part of their dead in sand barrows, mostly erected in groups on the banks of river valleys, usually in sandy pine forests. These are termed long barrows, and represents a local tradition before the Slavicisation of Russia (Tvauri 2007). A sample from Pskov (AD 8th–10th century), tentatively attributed to the incoming Krivichi Slavic tribe, shows hg. N1a-L279 (Chekunova et al. 2014).

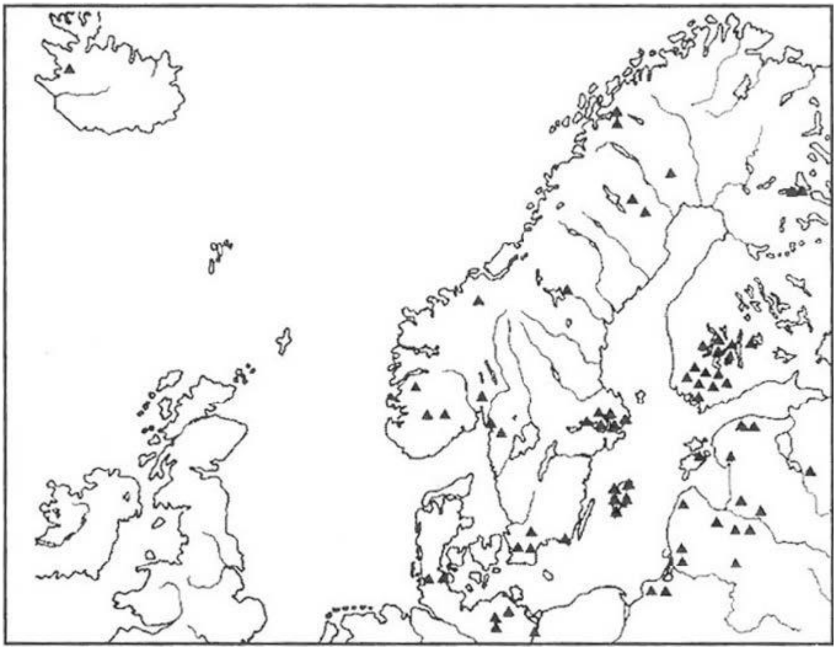

Figure 82. Distribution of finds of similar types of spherical weights, assumed to have been used for trade and transactions during the late Iron Age. Modified from Hedman (2003).

Furthermore, the modern distribution of N1a1a1a1a1a-VL29 reveals a pattern consistent with an Iron Age expansion around the Baltic Sea, with the TMRCA of the most common lineages compatible with Iron Age expansions, found without particular territorial distinction from Kazakhstan and Russia in the east, through Finns, Estonians, Latvians, and Lithuanians, to Swedes, Norwegians, and Poles in the west. The genetic continuity in Estonia since the Bronze Age supports the late infiltration and expansion of foreign lineages from the east (mainly N1a1a1a1a1a-VL29) without cultural change, similar to the various Bronze Age and Iron Age haplogroup expansions in North-West Indo-European-speaking Europe different from the R1b1a1b1a1a-L151 lineages originally expanded with Bell Beakers.

However, there is no evidence for a non-Uralic substrate in Finnic, and—unlike the substrate words of Saami—no structural non-Uralisms are found in Finnic, which suggests that if Finnic borrowed words it would have been from some genetically related (or at least typologically similar) languages, which agrees with archaeological evidence that the Uralisation of the East Baltic region under Balto-Finnic or a closely related dialect must have occurred no later than the Bronze Age, being a Uralic-speaking region from at least ca. 1900 BC (Kallio 2015). Early Palaeo-Germanic loanwords in Saami and Balto-Finnic, and Balto-Slavic loanwords in Balto-Finnic place all these dialects in close contact with each other, likely around the Baltic Sea, since the Early Bronze Age.

Population genomics show thus largely continuity in the East Baltic, coupled with an incursion of few elite individuals of Corded Ware-derived ancestry from ca. 600 BC on, hence likely Akozino warrior-traders. Supporting late intense cultural contacts in the Baltic during the Iron Age is the distribution of different types of weights used to determine the value of products in a certain amount of silver, suggesting that this was an accepted trading system to exchange goods (Figure 82). The expansion of chiefdom-based systems all over the Baltic in the transition to the Iron Age must have eventually caused the division into ethnolinguistic regions (Figure 83) according to personal and political alliances, mostly disconnected from their genetic make-up (safe for the continuity of previous regional differences).

The assumed separation of Southern Estonian first from the common Balto-Finnic trunk supports the origin of Proto-Balto-Finnic in Estonia, which—

based on the similarities of Finnish and Estonian—is estimated to have spread ca. 2,000 years ago (Kallio 2014). This corresponds to the Early Roman Iron Age, in the first centuries AD, with the appearance of *tarand*- or yard-type cemeteries, as well as new types of iron weapons and ornaments originally from coastal Estonia to the south into inland Estonia and northern Latvia. This expansion must have led to the earliest dialectal splits within Finnic into Inland Finnic (> Chud > South Estonian), including the Long Barrow culture (ca. AD 5^{th}–10^{th} c.); Gulf of Riga Finnic (> Livonian); as well as Gulf of Finland Finnic (> North Estonian, Vote, Veps, Karelian, and Finnish), which clearly represent recent newcomers to the area due to several shared post-Proto-Finnic isoglosses (Kallio 2015).

The expansion of Gulf of Finland Finnic to the east replaced an East Finnic (or Para-Finnic) substrate in the region, which further confirms the presence of Balto-Finnic-related dialects all over the Textile Ware areas around the Gulf of Finland up to Lake Ladoga and Lake Onega. Its expansion to the north was slower, because it was climatically less hopitable. Almost all of eastern Fennoscandia was Saami-speaking before the Finnic northward expansion, and only coastal areas must have had Finnic-speaking colonies before ca. AD 300. They replaced Samic languages of central Finland, and probably displaced part of their population, who in turn must have replaced the remnants of Palaeosiberian and Palaeo-European peoples in northern Fennoscandia up to the Germanic-speaking regions (Kallio 2015).

Estonians can be modelled as CWC Baltic (ca. 60%), WHG (ca. 35%) and Nganasan-like ancestry (ca. 5%); Modern Finns and Karelians show more CWC (ca. 81%), less WHG (ca. 10%) and similar Nganasan-like (ca. 9%), with this higher Steppe-related ancestry also visible in their clusters (Suppl. Graph. 15); while Veps are intermediate, with CWC (ca. 77%), WHG (ca. 10%), and slightly more Nganasan-like ancestry (ca. 13%). Saami are closest to the ancient population from the Kola Peninsula, showing less CWC (ca. 60%), similar WHG (ca. 11%) and more Nganasan-like ancestry (ca. 28%). This is compatible with the ancient expansion of Baltic Finns from a southern homeland to the north and east, respectively, replacing the language and admixing with a more CWC-like Proto-Samic population, less admixed with local WHG-like peoples, in line with the expansion of EBA CWC-like settlers to less populated areas (Jeong et al. 2019).

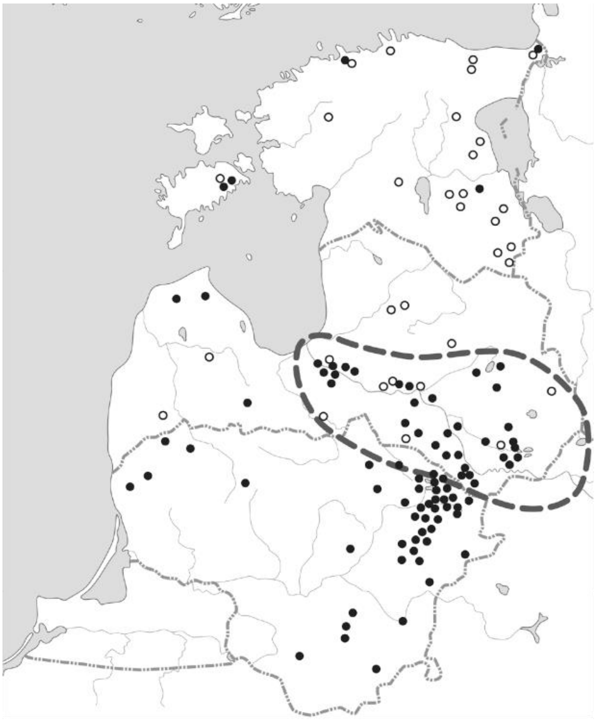

Figure 83. Distribution of fortified settlements (filled circles) and other hilltop sites (empty circles) of the Late Bronze Age and Pre-Roman Iron Ages in the East Baltic region. Tentative area of most intensive contacts between Baltic and Balto-Finnic communities marked with a dashed line. Image modified from (Lang 2016).

While N1a1a1a1a1a-VL29 lineages, already integrated into Balto-Finnic-speaking populations, may have undergone a further Y-chromosome bottleneck during the Finnic expansion, the presence of N1a1a1a1a2-Z1936 lineages (proper of Palaeo-Laplandic peoples) among central Finns suggests either an important role of cultural diffusion into the area, or a less important integration and later bottlenecks due to founder effects. Both options may be supported with the current genetic data, including a bottleneck estimated ca.

AD 500–700 in modern mtDNA among Finns (Översti et al. 2017), and the known several-fold more identity-by-descent segments found in north-east Finns compared to south-west ones, due to the described recent expansion from the Gulf of Finland (Martin et al. 2018).

This bottleneck may be seen in the Iron Age cemetery of Luistari (ca. AD 500–1200), forming a cluster similar to south-western Finns, but where at least four of ten males show haplogroup N-M231, three of them showing mutations linked to Dupuytren’s disease.

Sampled medieval Estonians buried in rural cemeteries, representing the local class, cluster with modern Estonians, which in turn continue Iron Age ancestry in the region (between Bronze Age and Corded Ware populations), while certain urban elite individuals associated with the arrival of western Europeans bringing economic, cultural and political networks cluster genetically with modern Germans. Among modern Balto-Finnic populations, Estonians seem to be less affected by Siberian ancestry, showing more hg. R1a1a-M198 (ca. 35%), with less N1a1-Tat (ca. 32%) and I-M170 (ca. 18%).

Karelians also show more R1a1a-M198 (ca. 41%) than N1a1-Tat (ca. 36%) and I-M170 (ca. 10%). Vepsians, clustering closer to eastern groups, show slightly more N1a1-Tat (ca. 38%) than R1a1a-M198 (ca. 36%). Saami show more N1a1-Tat (ca. 40%), with Saami from the Kola Peninsula showing more R1a1a-M198 (ca. 22%), than I-M170 (ca. 17%), and Saami from Sweden more I-M170 (ca. 33%) than R1a1a-M198 (ca. 18%).

The genetic picture among modern Finns, with more N1a1-Tat (ca. 58%) and I-M170 (ca. 29%) than R1a1a-M198 (ca. 7%), is closer thus to modern (and thus probably ancient) Saami, and possibly also influenced by incoming Nordic peoples from Sweden, but there is little difference in the PCA with Vepsians or Karelians (Tambets et al. 2018), evidencing the described recent founder effect.

A medieval warrior from Janakkala in southern Finland (ca. AD 1250), buried with at least two swords, a spear, an axe, and other materials, shows mainly local admixture and hg. R1b1a1b1a1a2c1-L21[35], probably further subclade R1b1a1b1a1a2c1a2a2a1-S5982 (formed ca. 1200 BC, TMRCA ca. 1000 BC), which is almost exclusively found in the British Isles. This may support the initial assessment of the individual as an early crusader, although his admixture suggests the infiltration of this lineage among locals likely during the Crusade Period (Laakso 2017). A contemporary Golden Horde individual of a R1a1a1b1a2a-Z92 subclade, autosomally close to Baltic Bronze and Iron Age samples, is potentially related to the eastern European slave trade or to acculturated Baltic Finns or Volga Finns (see above *§viii.8. Balto-Slavs*). Both mediaeval samples further suggest that the diversity of haplogroups present after the Iron Age in Europe, and especially the bottlenecks under N1a1a1a1a2-Z1936 in Fennoscandia, are a recent phenomenon not associated with the spread of Uralic languages.

[35] Preliminary results from the National Board of Antiquities and an archaeological team from the York University shared online, and information appeared on online news.

VIII.17. Eurasian forest-steppes

VIII.17.1. Abashevo

In the forest-steppe zone of the Middle Volga and Upper Don, at the easternmost aspect of the Russian forest zone, the last culture descended from Corded Ware ceramic tradition, the Abashevo group, emerged ca. 2500 BC or later (Anthony 2007), spreading through the forest regions westward to the Upper Don, and eastward substituting the late Volosovo groups that still remained in the region, reaching the Upper Ural basin (Suppl. Fig. 12). Settlements to the south appear up to the Samara valley, in immediate neighbourhood of Poltavka settlements, around 2500–2100 BC, with Abashevo and *Abashevoid* ceramic assemblages appearing in the forest-steppe zone (Kuznetsov and Mochalov 2016).

Abashevo was contemporaneous with Sintashta and Multi-Corded Ware cultures to the south, in Pontic–Caspian forest-steppe and steppe regions, and shares with them similar bronze, flint, stone, and bone objects. Mostly regional ceramics help distinguish the culture, with variants of pots with deep belly and prominent funnel-shaped neck appearing only in Abashevo. Abashevo shows—like Sintashta and Multi-Corded Ware cultures—fortified settlements, enclosed by a ditch (Parzinger 2013), usually located on the promontories of the first river terraces in the high valleys.

The occupied area of the biggest settlements does not exceed several thousand m^2, with a number of dwellings using supporting and framing posts dug into a slightly deepened foundation pit. Some storage pits and fireplaces are recognised on the floors, and size and interior design seem to be dependent on functional factors, such as small rooms for metalworking activity (Koryakova and Epimakhov 2007).

Animal husbandry is the main subsistence economy, with cattle predominating (ca. 68-78%) over sheep–goats, as was common in Corded Ware groups, and there is no evidence of agriculture. Pigs, usually associated with agriculture (because they can be fed agricultural products) appear only in the Cis-Urals area, where oak forests, and thus acorns, are available. There is a limited presence of horse bones in settlements, with some horse harness details, but only in settlements, not in funeral sites (Koryakova and Epimakhov 2007).

Copper mining and bronze casting appear at a significant scale. Bronze work included large cast bronze shaft–hole axes and small distinctive copper or bronze ornaments worn around the head and face by women. As a cattle-herding pastoralist economy, it probably competed with Poltavka during its expansion to the south into steppe grasslands (Kuznetsov and Mochalov 2016).

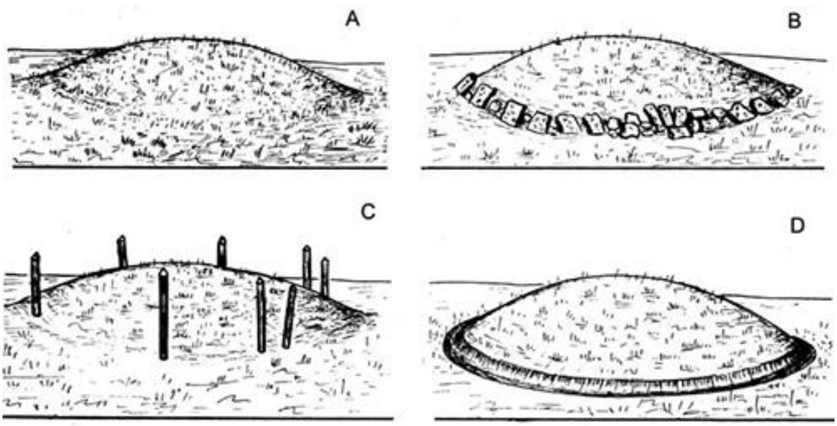

Figure 84. Abashevo kurgan types after Gobunov 1986, image modified from Koryakova and Epimakhov (2007).

Year-round unfortified settlements and seasonal camps are also located near rivers and consist of several houses. Kurgan cemeteries usually occupy river terraces and have several small mounds (80% not higher than 0.5 m, the remaining no more than 1 m) that contain mainly individual inhumations. More than half of the mounds are made of earth, but other elements can be found, such as circular ditches, stone, and wooden fences (Figure 84). Funerary chambers are rectangular and with a dimension connected to the age and number of individuals buried, with average depth less than 1 m. Apart from simple pits without any addition, there are a number of wood and stone inner constructions, such as walling and roofing. The presence of stone is an ethnographic feature of the Cis-Uralian Abashevo sites (Koryakova and Epimakhov 2007).

Grave goods include only limited animal sacrifices in the pit filling, with the majority including pots, some bone and metal objects, including chisels, knives–daggers, sickle-like tools, awls, and hooks, as well as stone and bone arrowheads proper of hunting, and bone “spades”. The most characteristic part of the Abashevo assemblage are the numerous ornaments: bracelets, rings, hollow ribbed tubes, rosette-like, and semi-circular plaques (Koryakova and Epimakhov 2007).

Collective burials are rare in both the Cis-Urals and the Middle Volga area. One of this early mass graves is witness to this period of intense conflict and large-scale battles in the region, with 28 violently killed men at Pepkino in the Middle Volga forest-steppe zone, a battle between forces armed with bronze axes and daggers, dated ca. 2130–1950 BC (Figure 85). Analogies of projectile points from the Turbino cemetery allow it to be dated no earlier than ca. 2100–2000 BC (Chechushkov and Epimakhov 2018).

Traces of injuries—broken bones and skulls pierced with metal axes and stone arrowheads of the Balanovo type—detected on the bones of large number of these skeletons suggest that this represents a serious conflict between the Abashevo and forest Balanovo groups. Some of them had been dismembered, and among them there was a bonzesmith, distinguished by his powerful build (Koryakova and Epimakhov 2007).

The Sosnitsa culture succeeded the Middle Dnieper culture in the middle and upper Dnieper regions, although precise radiocarbon dates are lacking. Kurgan and flat graves with inhumation and cremation are found, and vessel forms and their ornamentation (horizontal beaded decoration on the neck and shoulders) show links to Abashevo, Multi-Cordon Ware, and to the succeeding Srubna culture in the region. East European Bronze Age features are seen in bronze findings—spiral bracelets, spiral pendants, socketed axes—in common with East Trzciniec and especially Komarov cultures, with links to eastern

Carpathian cultures (Ottomány, Madarov'ce) whose influence is felt in the north Pontic region ca. 1750–1500 BC (Parzinger 2013).

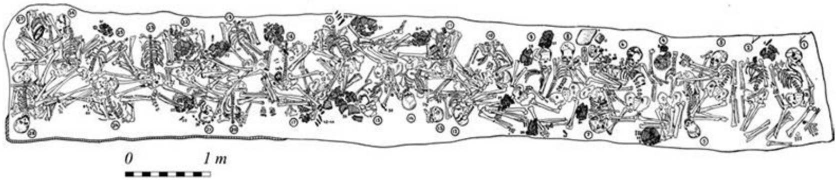

Figure 85. Pepkino collective burial after Khalikov, Lebedinskaya and Gerasimova 1966, image modified from Koryakova and Epimakhov (2007).

VIII.17.2. The Seima–Turbino phenomenon

The Seima–Turbino inter-cultural network (main finds ca. 1900–1600 BC) is associated with materials present in the Abashevo, Sintashta–Petrovka, Taskovo–Loginovo (on the Middle and Lower Tobol and Middle Irtysh), Samus (on the Upper Ob), Krotovo (forest-steppe of the Middle Irtysh to the Baraba steppe on the Upper Ob), Elunino, and Okunevo cultures. This expansion through Eurasian forest and forest-steppe societies roughly corresponds to the expansions of the Srubna–Andronovo horizon through the Eurasian steppes (Carpelan and Parpola 2001).

While the Okunevo culture belongs to the Early Bronze Age (ca. 2250–1900 BC), most other cultures date to a later period, during the Pre-Andronovo horizon (ca. 2100–1800 BC). The better quality of tin–bronze proper of Seima–Turbino objects makes the source of both copper and tin probably central Asian ores (e.g. Upper Irtysh–Bukhtarta area of tin, copper, and gold ores), which is—apart from the knives with depicted mountain sheep and horses typical of the east—why it has been traditionally considered an east–west movement of objects, and potentially of people (Carpelan and Parpola 2001).

Seima–Turbino metalsmiths were the first to regularly use a tin–bronze alloy, and were masters of lost-wax casting (for decorative figures on dagger handles) and thin-walled hollow-mould casting (for socketed spears and hollow axes). Nevertheless, local Okunevo and Afanasevo metallurgy of the Sayan–Altai area is primitive, and it is unlikely that they developed the advanced technology of casting socketed spearheads as one piece around a blank. On the other hand, spearheads of this type appear first in the Caucasus ca. 2000 BC, diffusing early to the Middle Volga–Kama–southern Urals area, where "it was the experienced Abashevo craftsmen who were able to take up the new techniques and develop and distribute new types of spearheads." The presence of specific animals seems to be a local development, since Seima materials on the Oka river depict European elk types (Carpelan and Parpola 2001).

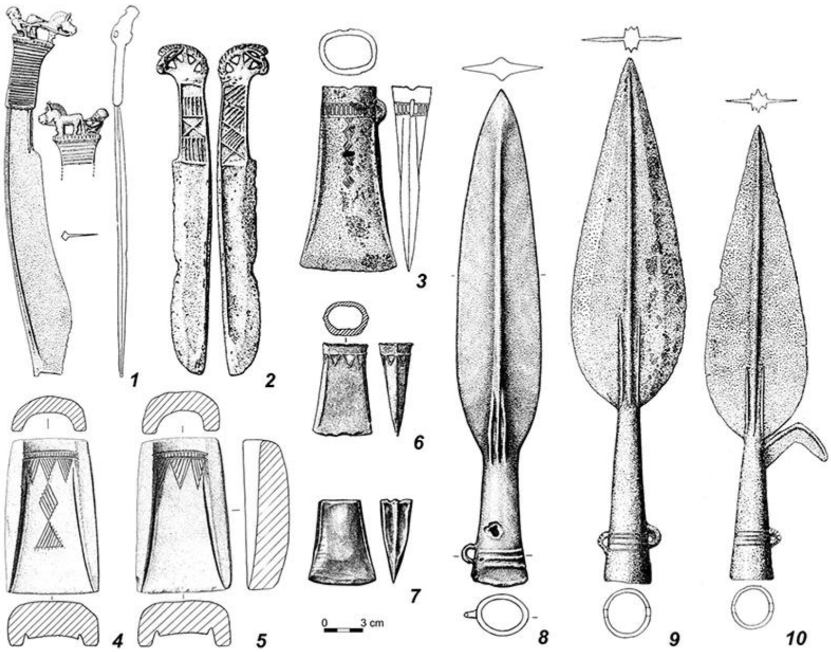

Figure 86. Seima–Turbino objects (4, 5 – stone, the rest are bronze objects) from the burial grounds of southwestern Siberia. Image modified from Marchenko et al. (2017): 3, 9, 10 – Rostovka (Matyushchenko and Sinitsyna 1988); 2 – Elunino 1 (Kiryushin 1987); 4–6 – Sopka 2/4C (Molodin 1983); 7 – Tartas 1 (Molodin et al. 2011), 8 – Preobrazhenka 6 (Molodin et al. 2007).

Sintashta socketed spearheads were made by bending a bronze sheet around a socket form and then forging the seam, while Seima–Turbino types were made by pouring molten metal into a mould that created a seamless cast socket around a suspended core, making a hollow interior, which necessitated tin–bronze rather than arsenical bronze (Anthony 2007). This use of tin–

bronzes, of hollow-mould casting method, and of the lost-wax casting technique were probably learned from BMAC, which is probably explained by the exploratory movements of Abashevo, Sintashta, Srubna, and Andronovo settlers into the tin mining sites of the Zeravshan Valley.

The proportion of tin–bronze, arsenical bronze, and pure copper in Seima–Turbino materials from Europe also speaks in favour of a western origin of the material culture and regional adaptations to ore sources. The presence of pure copper in the Altai supports the presence of Abashevo migrants from the Urals, not yet mining arsenical copper. The main ores for Abashevo metal production were on the Volga–Kama–Belaya area sandstone ores of pure copper, and more easterly Urals deposits of arsenical copper. The Abashevo people, expanding from the Don and Middle Volga to the Urals, developed their metallurgy in the Volga–Kama basin (pure copper) and then moved to the east, where they produced harder weapons and tools of arsenical copper. Further to the south, they contributed to the Sintashta society in a territory richest in copper in the whole Urals region (Parpola 2013).

Arsenical copper was probably connected to the Tash–Kazgan deposits situated on the upper reaches of the Ui River in the southern Trans-Urals, which were transported westward over the low-lying Ural range, for about 250–300 km through the mountains. The rather high variation of arsenic concentration suggests that the Tash–Kazgan ore could be smelted on-site or on the Cis-Urals settlements and then transported to Abashevo and Sintashta areas (Koryakova and Epimakhov 2007).

The finding of Abashevo-like pottery in tin miners’ camp at Karnab on the lower Zeravshan, together with contemporary Sintashta-like pottery at Gonur, points to competing exploratory movements including contact and trade from forest-steppe and steppe cultures in Central Asia in look for tin ores near BMAC sites ca. 2100–2000 BC (Anthony 2007).

The Seima–Turbino phenomenon probably shows, therefore, the connection of areas to the west and east of the Urals in a network created by

Abashevo settlers expanding into West Siberia through the forest-steppe and forest regions (Figure 87). Supporting this common expansion is the appearance of similar flint projectile points in Seima–Turbino and Sintashta graves, as well as objects of Petrovka origin, and the contemporary Andronovo expansion through the steppes (Anthony 2007).

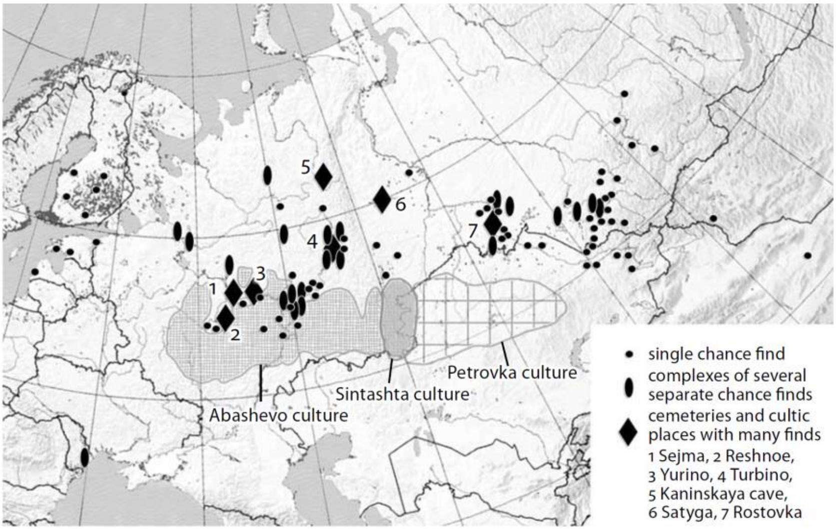

Figure 87. Formative phase of the "Eurasian Metallurgical Province", with the distribution of the Abashevo, Sintashta and Petrovka cultures (the map does not show Petrovka's wider extension to southern Central Asia, Turkmenistan, Tajikistan, Uzbekistan), and the finds of the Seima-Turbino trade network. (After Parpola 2015: 57 Fig. 7.3, based on Chernykh 2007: 77). Image from Parpola (2018).

VIII.17.3. Andronovo-like cultural horizon

Alakul and Fëdorovo material culture appear in the forest-steppe and forest zones of western Siberia, toward the northern taiga, evidenced by numerous settlement sites and decorated ware. They appear as stockbreeders, metallurgists, hunters and fishers, representing a cultural transformation of the vast area east of the Urals. These syncretic cultures are known as "Andronoid" or "Andronovo-like", with apparently stronger connections to Fëdorovo. The horizon is composed of several cultures, including Cherkaskul (middle and southern Trans-Urals), Pakhomovo (Middle Irtysh and Tobol), Suzgun (taiga area of the Middle Irtysh), and Elovka (forest area of the Ob’-Irtysh river basin) (Koryakova and Epimakhov 2007).

All these cultures and smaller groups show similar flat-bottomed pottery with high or middle shoulders, short necks, and compact decoration consisting of alternating geometric motives with recognisable forest “images” and “Andronovo spirit”. They share similarities with Cis-, Trans-Urals, and eastern regions of western Siberia. The appearance of Andronovo-type geometric design into the local pottery reduced the area of the local hole and combed ornamental scheme, which still covered the major part of the taiga and Circum-Arctic area. Metallurgy is present, but there is a decrease in the number of metal objects, probably due to the absence of ores. Population density probably remained low, limited by the capacity of the forest ecological niches, with communities concentrated in clusters along rivers (Koryakova and Epimakhov 2007).

The Cherkaskul tradition (ca. 1850–1500 BC) has probably a direct origin in the expansion of Abashevo with the Seima–Turbino phenomenon over the area of the previous Late Garino–Bor and Sayat culture (ca. 2500–1900 BC) of hunter-gatherers, in the middle and south Trans-Urals, with Kazan as its western neighbour. The spread of Cherkaskul materials is thus closely associated with the Seima–Turbino phenomenon, and with the spread of the Fëdorovo tradition of the Andronovo horizon (see above Figure 90), probably as a northern variant directly linked to Abashevo, and not to the Sintashta culture from the steppes (Parpola 2018).

Cherkaskul sites are mainly found concentrated in the southern forest and northern forest-steppe of the Ural Mountains, with some findings as far south as the steppe zone. Cherkaskul materials are also found in thick concentrations on the southern forest and northern forest-steppe of central Asia, including the Upper Irtysh, Upper Ob’, and Upper Yenissei rivers, close to the Altai and Sayan mountains. Cherkaskul pottery appears frequently along with Fëdorovo types, and many sites produced pottery mixing both types. About half of the bone finds in Cherkaskul sites come from hunted animals, attesting to a predominantly hunter-gatherer population (Parpola 2018).

Its pottery includes the frequent use of carpet design in ornamentation, in common with Fëdorovo types, but is denser and more sophisticated than the Fëdorovo tradition, with flat-bottomed pots having a smooth and pleasing profile. In the forest, houses show shallow basements with rectangular pits as grounds for small frame-pillar wooden constructions (ca. 22–50 m^2), showing internal hearths. Houses had corridor-like entrances. In the forest-steppe and steppe, houses were larger (ca. 100–200 m^2) with deeper basements (Koryakova and Epimakhov 2007).

Settlements show evidence of a stable and settled life, with tolls for hunting, fishing, and bones of domestic animals, including bone dice, and remains of a developed metallurgy. Funerary tradition includes small kurgans with stone fences and mounds, covering individual burials with traces of cremation in the southern area; and inhumation in shallow pits in contracted left-sided position and modest assemblages in the northern and western regions. From the mid–2nd millennium on, different cultures without precise radiocarbon dates evolve from the previous expansion of Cherkaskul (Koryakova and Epimakhov 2007).

The Pakhomovo groups constitute the southern part of the Andronovo-like complex, and are located in the northern forest-steppe and forests of the Tobol-Irtysh basin, with pottery similar to Fëdorovo in morphology, decoration, and manner of surface treatment. Pots covered by monotonous ornaments of the forest style with various holes and figured stamps are common. Settlements are not large (ca. 4,500 m^2 in average), with varied large rectangular houses (ca. 100 m^2), wooden built with vertical pillars supporting a pyramidal roof, which include fixed hearths and wooden constructions for economic use. Tools related to hunting, fishing, metallurgy, and metal objects evidence their mainly fishing and hunting activity complemented by cattle and horse breeding (Koryakova and Epimakhov 2007).

The Suzgun groups occupy the area to the north of Pakhonovo, partially overlapping it in the northern Isim and Irtysh forest-steppe. Settlements are located on high promontories of the Irtysh River valley and on low fluvial terraces, with the environment conditioning the economy. A wooden walled enclosure with rectangular houses formed with vertical pillars in perpendicular rows and corridor-like entrances is possibly the model settlement. Mass ritual actions connected to sacrifices and common eating of oblational food are found in common sanctuaries (Koryakova and Epimakhov 2007).

Several individual inhumations and collective burials are found in cemeteries, where dead were buried in the extended supine position, with some apparently Pre-Andronovo and some Andronovo-like customs found in the funerary ritual. Bronze metalworking seems to be a part of ritual actions, and the most common artefact found is pottery, with flat and round bottomed pots with well pronounced profiles decorated with geometric motifs. The subsistence economy was diverse, with hunting and fishing being an essential part, but cattle being also dominant, and horse occupying the second position (Koryakova and Epimakhov 2007).

VIII.17.4. Mezhovska–Irmen cultural horizon

The Mezhovska–Irmen cultural horizon (ca. 1500–800 BC) involves a group of cultures with common stylistic similarities and local differences, in the forest-steppe area on both sides of the Ural Mountains, from the middle Kama and Belaya rivers to the Tobol river in western Siberia, with sites reaching up to the Altai (Suppl. Fig. 13). They emerged from the previous Andronovo-like cultural complex of the forest-steppe and southern forest of western Siberia, with influence coming from cross-stamped cultures of the north, and include Mezhovska and Irmen cultures around the Urals, the Sargary–Alekseevka culture to the south, and the Karasuk culture to the east (Koryakova and Epimakhov 2007).

Mezhovska sites were present in the forest and forest-steppe zones on both sides of the Urals, including the forest-steppe region from the Belaya bend to the Middle Kama up to the Chusovaya river (in the Cis-Urals), the Trans-Urals, the Ishim–Irtysh area. The Irmen cultures were distributed in the Ob-Irtysh forest-steppe, with its influence found in Sargary–Alekseevka culture in northern Kazakhstan (Koryakova and Epimakhov 2007).

All settlements are small or middle-sized open settlements (200–300 individuals), mainly seasonal camps, but also stable long-term habitation settlements. They are situated on river terraces or lake or river promontories, possibly with defensive constructions. The largest pillar-frame structures are found to the south, related to the Sargary culture, while smaller houses (ca. 100 m^2) are proper of the forest zone. There were vertical pillar-frame constructions, and constructions with deep basement and horizontal frame in its low part. Fireplaces and storage pits are found inside houses, and a corridor-like entrance usually faces the water (Koryakova and Epimakhov 2007).

Subsistence economy in both the Cis-Urals and Trans-Urals depends on the specific ecological niche. It usually includes wild species (up to 15%), with a smaller percentage for 'fur' animals; horse and cattle (ca. 30%), and a small percentage of sheep (ca. 13%), as well as fish. Food producing branches were more prevalent in the south, and the high proportion of horses compared to previous periods is probably related to their ability to forge in the winter. Metallurgy was probably not using local ores (as in the succeeding Itkul' culture), and it was most likely based on domestic needs (Koryakova and Epimakhov 2007).

Characteristic is the decoration of the pottery, usually covering the neck and shoulder, with carved (fretted) elements becoming popular, contrasting with the previous comb–stamped techniques of the region. Ornament patterns are simple, and pottery shapes include pots of globular bodies with short straight or turned up necks, and cans and korchags (large earthenware pots). Bronze objects are represented by massive tools, like celts–axes of the Cimmerian type, gouges of Derbeden type, sickles of Derbeden and Kataisk types, daggers of Kardashinsky and Cimmerian types, as well as double-edged knives with smooth passage to tengue, awls, and needles. Bone and stone arrowheads are also numerous (Koryakova and Epimakhov 2007).

There seems to be a kurgan burial tradition, using stone in the erection of mounds, with one to three inhumations for kurgan, and the dead in extended supine or side position. Secondary burials appear on the ancient surface. Graves are shallow with modest wooden arrangement. Animal bones, mainly cattle, represent remains of the funeral feast, and assemblages include pottery, metal daggers, spearheads, knives, and ornaments (Koryakova and Epimakhov 2007).

The eastern part of the Mezhovska–Irmen horizon is formed by the Irmen culture, with material culture intermediate between Mezhovska and Karasuk. Settlements include traditional large house buildings in variable open villages, small camps and, in a later phase, fortified sites. Houses have several hearths and traces of domestic activities, including animal stabling during the winter, and there are separate houses with structures of economic function. Subsistence economy is also based on livestock breeding, with their bones prevalent over wild animals, and only traces of cultivation. Metallurgy developed depending on the sites and raw material resources (Koryakova and Epimakhov 2007).

Pottery includes large flat-bottomed massive pots, and (proper of burials) smaller pots and jars with flat or round bottoms. Ornamentation includes incised techniques, sometimes accompanied by combed stamps and 'pearls', and Andronovo-like motifs appear in funerary pottery. Cemeteries include kurgans with multiple individual burials, with inhumations in crouched right-sided position with southern direction and orientation. Graves are shallow, and wooden frames furnish them. Assemblages consist of metal goods (nail-like pendants, earrings, sewn plaques) and pottery. Collective burials are rare (Koryakova and Epimakhov 2007).

The Sargary culture emerged from Fëdorovo and Cherkaskul traditions in the forest-steppe between Tobol and Irtysh, in northern and central Kazakhstan.

It formed part of the “horizon of cultures of the Valikova pottery tradition” (Chernykh 1992), which comprised cultures from the Don–Volga–Ural steppes (late Srubna), southern Urals and Trans-Urals, and Kazakhstan (Sargary, Trushnikovo, Dandybai–Begazy, Amirabad), characterised by poorly ornamented flat-bottomed pottery with clay rollers stuck around the shoulder or neck. Other similarities involved metal artefacts, economic structure, and funerary ritual.

In the Dandybai–Begazy culture, mausoleums were constructed especially for people of high social status. The characteristic pottery of globular form and very small bottoms and cylindrical necks, often with polished surfaces and black, yellow, or red colour, and both Sargary and this culture probably formed a unity with a core area in central Kazakhstan, where the centres of metallurgy lied. In the Trans-Urals region, Sargary material culture is found with Mezhovska, and some Meshovksa finds contain Sargary material, probably from the 13th century BC on (Koryakova and Epimakhov 2007).

Sargary settlements include large territories (ca. 20,000 m^2) with semisubterranean buildings with deep basements and up to several dozen large houses, and smaller settlements (1,000–2,500 m^2) with up to fifteen houses, yielding a similar number of finds, suggesting that they were inhabited seasonally. Houses are rectangular, frame-pillar constructions with a floor deepened into the ground, and are placed freely along the river bank. Metal tools are numerous (Koryakova and Epimakhov 2007).

Subsistence economy reveals a pattern connected to the steppe area of eastern Europe, with domestic animals predominating, first cattle, then horse and sheep, with likely yearly cycle herding practices. The first trace of agriculture in the region is associated with this culture. Small cemeteries comprising up to three mounds and solitary kurgans of earth and stone are placed on high ground of the initial riverbank and far from river streams, unlike in the preceding period. The dead are placed in contracted position on their side, and assemblages are modest. Funerary rituals are complex and varied, and kurgan ritual and inhumation were reserved for some people, with society tending to atomisation in the forest-steppe, and to concentration in larger settlements in the south (Koryakova and Epimakhov 2007).

The Karasuk culture (ca. 1400–900 BC), genetically at least partly derived from Fëdorovo, flourished around the upper Yenissei, Mongolia and the Ordos region of China. It probably came into being as a result of a migration of different people from the southeast, from the periphery of Shang period China. The beginning of the Karasuk period also marked the return of some Okunevo traditions that did not manifest themselves during the Fëdorovo period (Parpola 2018).

It preceded the transition of the LBA to the EIA Proto-Scythian period, when the use of saddled horse, composite bow, and the 'animal style' art became integral parts of the steppe life. Around 1000 BC, the Eurasiatic steppes became uniform culturally from Mongolia to Hungary (see *§VIII.19.4. Scythians and Sarmatians*), and for a thousand years East Iranian languages were spoken in the region (Parpola 2013). Among the pictorial tradition of petroglyphs in Andronovo-related groups, those of burials of the Karasuk culture in southern Siberia and Kazakhstan represent the latest tradition (Novozhenov 2012).

VIII.17.5. Itkul'–Gamayun and Sargat

The Gamayun and Itkul' cultures evolved (ca. 800–200 BC) from the Mezhovska cultural region in a narrow band (ca. 150 km wide) on the eastern slope of the Urals. Itkul' constituted the main metallurgical centre of the Trans-Urals region during the Iron Age. They were in contact with the Ananyino and Akhmylovo cultures, which were the metallurgical centres of the western Urals, and neighboured the Gorokhovo culture (Parpola 2018).

The Gamayun culture is rather archaic in appearance, featuring open or fortified settlements and early fortified house-refuges (of ca. 600 m^2), having solid wooden walls with a ditch and strengthened by an earthen bank, and a variable living space (ca. 40–400 m^2). Open settlements include small stable villages consisting of several houses, and seasonal short-time hunting-fishing camps. Fortified villages, chiefly concentrated on the periphery of the occupied territory, were variable in size, and occupied the low hills and promontories along riverbanks, with smaller ones representing frontier-guard stations. Houses vary from small hovels and chums to stable pillar-framed wooden houses with one or two sections, and were also used for economic activities (Koryakova and Epimakhov 2007).

Characteristic of the Gamayun culture is the crosslike stamp ornamentation, which was found widespread among the massive of cultures with stamped crosslike ornaments in the southernmost taiga zone and northern forest-steppe, from the Trans-Urals to the Middle Ob'. These cultures emerged from the Late Bronze Age of the Lower Ob' River forest area, represented by the Lozva–Atlym phase of the Late Bronze Age, when some population groups moved southward in search for game due to the humid conditions at the turn of the $2^{nd}/1^{st}$ millennium BC. Most migrating communities of the LBA and Gamayun sites show a rather small size (ca. 20–30 people), perhaps extended families or clans (Koryakova and Epimakhov 2007).

The Itkul' culture represents thus the strict cultural continuation of Mezhovska in the region, and the initial relations with the Gamayun culture seems to be one of conflicts, based on the fortification of houses and on traces of destruction of Gamayun villages. Eventually, both communities formed a symbiotic system based on division of labour and specialisation. Local Itkul' communities, having harnessed local mineral resources for metal production in a previous period, specialised in metallurgy, while Gamayun groups were hunters, fishers, and most likely miners (Koryakova and Epimakhov 2007).

Itkul' sites were fortified villages or fortified metallurgical workshops, with the vast majority occupying high ground of rivers or lake terraces. Fortifications were simple, with a wall, moat, ditch, or grove, and bigger settlements took up very high topographic positions usually with an open-order defensive line. Buildings included houses, workshops, and structures connected with special productive functions. Houses were rectangular semisubterranean and surface-based buildings of a pillar-framed construction, and they were rather small, with a simple interior, including one or two hearths. Small working areas served for copper smelting, iron working, and most often metal processing, while mass production of metal was done on larger dwellings or outdoor (Koryakova and Epimakhov 2007).

Artefacts and structures evidence the intensive dedication of the sites to metallurgical activity, with specialisation mainly in bronze production with local mineral deposits. There is operational division involving metal smelting and casting in mountain clusters (and further divisions into full or limited cycle of production), and metalworking in the periphery. Their distinctive pottery includes round-bottomed pots, of chiefly horizontal proportions, and decorated with rather standard comb–stamped patterns, covering the pot’s upper third (Koryakova and Epimakhov 2007).

Itkul’ metallurgists had close relations with the Ananyino populations, which used in part Trans-Uralian ores for manufacturing various objects that diffused westwards. Closer connections existed with neighbouring cultures, with Itkul’ supplying regularly metal products to Gorokhovo and to the southern Siberian Sargat groups. More or less regular contacts existed also with The Upper Ob’ Bolsherechye culture, and with the southern Kazakhstan Saka culture (Koryakova and Epimakhov 2007).

To the east of the Itkul’ culture, up to the Ob river, the Nosilovo, Baitovo, Late Irmen, and Krasnoozero cultures (ca. 900–500 BC) developed, some of them in contact with the Akhmylovo culture of the Middle Volga. All these cultures of the forest steppe were later absorbed into the Sargat culture (Parzinger 2006),

The spread of the Suzgun culture with the Baraba trend—marked by the Baraba–Suzgun pottery, featuring slightly and well-profiled pots with a short throat—probably represents a wide-ranging population expansion in pre-taiga and taiga zones in the Irtysh basin. Later, the Berlik tradition expanded with migrants from the south, interacting in certain sites—as in the local Late Irmen cultural tradition—with Late Irmen people inhabiting the citadel of the settlement, and Berlik immigrants inhabiting the surrounding territory (Molodin, Mylnikova, and Kobeleva 2008).

The Sargat culture emerged from the Late Irmen tradition, succeeding the Sargary culture in its territory, comprising all cultural groups between the Tobol–Irtysh forest-steppe interfluve. Apart from the core settlers of the Mezhovska–Irmen horizon of the Final Bronze Age, intercommunity formation was completed by taiga settlers of the Lozva–Atlym LBA from the north, and southern influence from the Valikova pottery horizon and Arzhan phase of the Scythian and Saka confederation. These groups superimposed each other chronologically and territorially, as evidenced in the Chicha settlement. Open and fortified settlements are characteristic (Molodin, Mylnikova, and Kobeleva 2008).

The Gorokhovo cultural group of the Iset–Tobol area also resulted from a population of Sargary–Mezhovska roots, under the influence of climatic, economic, and social factors. With a clear cultural root in the Trans-Uralian forest-steppe, evidenced by its architecture, fortification system, and pottery, they probably adopted pastoral herding under the cultural and possibly political influence of the Saka confederation, evidenced by the funerary ritual. They formed part of a "forest-steppe–steppe system" that involved the Iktul' metallurgical centre, South Urals nomads, and the Sargat culture (Parzinger 2006).

Both Gorokhovo and Sargat eventually developed (ca. 5th c. BC on) the "Golden Age" of the western Siberian forest-steppe, under Sargat dominance coming from the east, and increased influence from steppe nomads from the south. Fortified settlements demonstrate a more complex level of architecture, with large elite barrows including very big kurgans, analogous to those found in the steppes, and mainly individual inhumations. Seminomadic stockbreeding became the main subsistence economy. The expansion of Sargat may have caused an initial expansion of Gorokhovo settlers to the west, until their eventual integration under Sargat (Koryakova and Epimakhov 2007).

viii.17. Ugrians and Samoyeds

Seima–Turbino-related migrations through the Eurasian forest and forest-steppe zones in western Siberia reflect population movements from west to east, coinciding with the arrival of pastoralists in central Asia (Kılınç et al. 2018), which supports the traditional interpretation of Uralic expanding from west to east, originally with Abashevo-related groups, most likely associated with individuals of Steppe MLBA ancestry associated with the Andronovo-like cultural horizon (see *§viii.18.1. Late Indo-Iranians*).

While Mezhovska is the best candidate for the original Proto-Ugric-speaking population, Karasuk has been traditionally proposed as the Pre-Samoyedic-speaking community (Parpola 2013). Both Mezhovska and Tagar samples can be modelled as almost completely of Corded Ware-derived ancestry, in contrast to neighbouring groups like Pazyryk or Zevakino-Chilikta—traditionally considered East Iranian cultures—which show likely contributions from neighbouring Altaic populations.

viii.17.1. Ugrians

Individuals of the Mezhovska culture from the Kapova cave (one dated ca. 1500 BC) are part of the Western Steppe MLBA cluster. It shows mainly Steppe MLBA (ca. 75–84%) and Baikal EBA/Nganasan-like ancestry (ca. 17–20%), with contributions of an ANE-related population (Jeong et al. 2019). One sample is of hg. R1a1a1b1a2-Z280^{+}, and another of hg. R1b1a1b-M269 (Allentoft et al. 2015). Interesting is the presence of one outlier, with ancestry close to the later South-Eastern Iranian cluster, with increased Near Eastern ancestry, which suggests the potential emergence of this cluster in the Andronovo–Srubna complex, i.e. much earlier than suggested by the available samples. The position of Mezhovska samples is close to later Scythians from

Samara, and also close to modern Finns, northern Russians, Early Sarmatians, Estonians, Mordovians, Lithuanians or Belarusians (Unterländer et al. 2017).

The Sargat culture is probably to be identified (at least partly) with the expansion of Proto-Hungarians, who around the 5th century BC "were caught up in a wave of migrations that swept the steppe… Migrating westwards, they settled between the Urals and the Middle Volga region", staying in Bashkiria until ca. 600 BC, in the so-called *Hungaria Magna* of medieval sources (Suppl. Fig. 18). That Ugric peoples were horsemen is supported by the number of equestrian terms in Ugric languages, including the word for horse (Parpola 2018), and by the presence of horse riding equipment and horse bones in graves of Early Hungarian frequent riders, evidenced by their skeletal hip changes (Berthon et al. 2018).

Seven individuals of the Sargat culture from the Baraba forest (ca. 500 BC – AD 500) show five hg. N-M231, two hg. R1a-M420 (Bennett and Kaestle 2010), which is expected to be found in a late Ugric community integrating with Palaeosiberian peoples from the LBA cultures of the Lower Ob' River forest area, likely expanding with hg. N-M231, and becoming integrated both in the Itkul' culture through its association with Gamayun, and in Sargat through the gradual integration of migrants from the taiga region.

Given the sample of hg. N-M231 from the Mezőcsát Culture (ca. 900 BC) in Hungary (Gamba et al. 2014), belonging to expanding Cimmerians, and the Siberian ancestry expanding with Scythian groups (see *§viii.19. Iranians*) and later with Altaic peoples (see *§viii.21.2. Turkic peoples and Mongols*) it is conceivable that at least part of the N-M231 lineages—and N1a1-Tat in particular, including N1a1a1a1a-L392—integrated among Ugric and part of the Samoyedic peoples accompanied westward steppe migrations (see Suppl. Graph. 15 and Suppl. Graph. 17), which is in line with some known shared traits of Uralic and Altaic (Kortlandt 2010).

Modern Ugric populations include Mansis, in the immediate Trans-Urals region, which have more Steppe MLBA (ca. 38–42%) and less Baikal

EBA/Nganasan-like ancestry (ca. 54–61%) than other Ugric and Samoyedic populations, and show variable contributions of an ANE-like population (ca. 0–8%). They show more N-M231(xN1a1-Tat) (ca. 33–60%) than N1a1-Tat (ca. 16–28%), R1a-Z280 (ca. 19%), other R1a1a-M198 (ca. 6%), I-M170 (ca. 6–8%), R1b-M343 (ca. 4%), or J-M304 (ca. 4%). Eastern Khants, on the other hand, show more N1a1-Tat (ca. 49%) than N-M231(xN1a1-Tat) (ca. 31%) or N1a1-Tat (ca. 16%), but they also show R1b-M343 (ca. 11%), R1a1a-M198 (ca. 6%), I-M170 (ca. 8%), or J-M304 (ca. 4%) (Tambets et al. 2018).

Khants and Nenets share similar ancestry, showing a close affinity with Selkups (in turn intermingled with Yeniseian-speaking Kets), too, which suggests the origin of the admixture among Uralic-speaking peoples in the expansion of Corded Ware-related populations to the east, including language shift of neighbouring Palaeosiberian peoples (Karafet et al. 2018; Dudás et al. 2019; Jeong et al. 2019).

Hungarians, on the other hand, show an ancestry indistinguishable from neighbouring European populations around the Carpathian Basin, and similar contributions of hg. R1a-M420 (ca. 21-60%), R1b-L23 (ca. 15–20%) and I-M170 (ca. 11-26%), with intermediate frequency of J-M304, E1b-P177 and G2a-P15 (ca. 5–15%), and much lesser N-M231(xN1a1-Tat) and N1a1-Tat (ca. 1-6%) (Semino 2000; Csányi et al. 2008; Pamjav et al. 2011; Pamjav et al. 2017).

The closest link between Finno-Ugric populations from around the Urals—including Maris, Mansis, and Hungarians—is found in four different haplotypes of hg. R1a1a1b1a2-Z280 (Csáky et al. 2019), derived from the expansion of Corded Ware groups (see above *§vii.1. Western and Eastern Uralians*), most likely within subclade R1a1a1b1a2b-CTS1211, which appears in modern populations in both West and East Uralic speakers, and is also found in ancient Battle Axe populations.

On the other hand, all Bashkirian Mari R1a1a1b2-Z93 samples (seven haplotypes) formed a very isolated branch, different from a Hungarian sample by seven mutational steps, which support their relative isolation since the initial expansion. Other haplotypes found in Khants or Hungarians are scattered and not particularly related to those of Altaians, Khakassians, or Uzbeks (Csáky et al. 2019).

Another shared Finno-Ugric lineage is hg. N1a1a1a1a2-Z1936 (formed ca. 2900 BC, TMRCA ca. 2300 BC), with the most common Ugric subclade being N1a1a1a1a2a1c-Y13850 (formed ca. 2300 BC, TMRCA ca. 2200 BC): a Y24361 branch (TMRCA ca. 350 BC) is found among Tatars and Bashkirs, and also among Hungarians, while a L1034 branch (TMRCA ca. 2200 BC) is found among Bashkirs and Ugric peoples (Post et al. 2019).

These lineages were likely incorporated into the Ugric stock during their expansion through the forest-steppes and the taiga, and did probably expand further among them during the Turkic migrations through the forest-steppes up to the Middle Volga. In particular, population genetic analyses indicate that Hungarian Conquerors had the closest connection to Volga Tatars (Neparáczki et al. 2019), suggesting that the Y24361 branch belongs to recently assimilated Turkic paternal lines.

An origin of the expansion of N1a1a1a1a2-Z1936 in the central Siberian forests is supported by the likely finding of sister clade N1a1a1a1a2a-Z1934 in Palaeo-Laplandic speakers from Lovozero Ware (ca. 1500 BC), likely stemming from the Taymir Peninsula, and originally from the Imiyakhtakhskaya expansion in Yakutia (see *§viii.16.1. Saami and Laplandic peoples*); the presence of N1a1-Tat subclades in Northern Eurasia likely connected to Neolithic populations to the north of Lake Baikal; their recent TMRCA in the west and the lack of findings in ancient samples, compared to their early split and presence in the east; as well as the presence of both lineages in modern populations of the Siberian Taiga and around the Arctic, up to Lake Baikal in the south.

viii.17.1.1. Hungarians

The distribution of haplogroups among early Hungarian conquerors from Karos (ca. AD 895–950)—without taking into account local paternal lineages—is similar to the expected proportion of N1a1-Tat vs. R1a-M420 lineages, based on the available ancient samples from the Trans-Urals forest-steppes and on modern Ob-Ugric peoples: there are four R1a1a1b1a2-Z280, at least three of them R1a1a1b1a2b-CTS1211, one of them an elite individual from Karos II; two R1a1a1b2a2-Z2124, one of them an elite individual; and one N1a1a1a1a2-Z1936(xL1034)[36], one of them an elite individual.

Likely 'eastern' samples include two N1a1a1a1a4-B2118 (formed ca. 4300 BC, TMRCA ca. 1700 BC), prevalent among Turkic-speaking Yakuts and Dolgans, and linguistically distant Evenks and Evens living in Yakutia, but also appearing around the Urals and particularly scattered among modern Turkic peoples. This patrilineage is a prime example of a male population of broad central Siberian ancestry that is not intrinsic to any linguistically defined group of people, with the deepest branches being represented by a Lebanese and a Chinese sample, and a separate sub-lineage found in Bhutan. This supports a recent strong founder effect primarily in central Siberia (Ilumäe et al. 2016).

A military leader from of Karos II and another elite individual show hg. I2a1a2b-L621(xI2a1a2b1a1a1-S17250). Lineages of likely 'western' origin at Karos1 and Karos2 include two E1b1b-M215, at least one E1b1b1a1b1a-V13, one J1-M267, one G2a2b-L30, and one I1-M253(xI1a1b1-L22).

Samples from a small Karos III cemetery stand out from the rest, with three R1b1a1b1a1a1-U106 lineages, likely stemming from an East Germanic population, and its leader being of hg. I2a1a2b-L621 and brother of the leader

[36] Five N1a1a1a1a2-Z1936 samples have been indirectly reported from the study of Fóthi et al. (2019), without reference to its proportion relative to non-N-M231 haplogroups: Three samples in the Upper-Tisza area (Karos II, Bodrogszerdahely/Streda nad Bodrogom) and two in the Middle-Tisza basin cemeteries (Nagykörű and Tiszakécske).

from Karos2, with whom he shares mitogenome and Y-STR haplotypes. The nearby Kenézlő cemetery shows one 'eastern' hg. Q1a-F1096(xQ1a2-M25), one R1b1a1b-L23 (likely R1b1a1b1b-Z2103), and two N1a1a1a1a2-Z1936(xL1034) lineages.

Samples from the small eastern cemetery of Magyarhomorog (ca. AD 10th)—with typical partial horse burials of the early Hungarians containing horse cranium with leg bones and harness objects—show three I2a1a2-M423, at least two of them I2a1a2b-L621(xI2a1a2b1a1a1-S17250). The widespread presence of hg. I2a1a2b-L621 among the elites, as well as the finding of hg. E1b1b1a1b1a-V13 among early conquerors, both lineages found among early Slavs (see *§viii.9.2. Slavs*), suggests that the local population of the Carpathian Basin—home to Slavonic-speaking peoples since the late Avar period, from the 8th century on—became integrated into the new Hungarian-speaking community.

Later samples from Sárrétudvari, representing commoners from the second half of the 10th century, show hg. R1b1a1b1a1a2b-U152 and J2a1a-L26. Unpublished conquerors. Among twelve males from Karos-Eperjesszög (AD 900–1000), at least two are of hg. R1b1a1b-M269, two I2a-L460 (Neparáczki et al. 2017). Another two N1a1-Tat samples have been published (Csányi et al. 2008), one from Szabadkigyos-Palliget (ca. AD 950) and another one from Örménykút[37] (ca. AD 975–1000).

Among early Hungarians interred in Saint Stephen Basilica, Székesfehérvár (AD 12th c.), there are three of hg. R1a-M420, including King Béla III of the Árpád dynasty, of hg. R1a1a1b2a2a1d7-YP451(xYP499)+, common in modern populations of the northern Caucasus, among Karachays and Balkars; two of hg. R1b-M343, one J1-L255, and one E1b1-P2 (Olasz et al. 2018).

[37] This and another conqueror from Tuzsér have been informally reported as of hg. N1a1a1a1a4-M2118, from the unpublished study by Fóthi et al. (2019).

The early mixture found among early Hungarian elites and among modern populations points to the likely domination of a minority of Magyar clans—probably already admixed with Turkic peoples—over a majority of the population of the Carpathian Basin, composed of local lineages, most from Germanic and Slavic populations. The finding of haplogroup R1a1a1b1a2-Z280 (ca. 14-15%) and lesser R1a1a1b2-Z93 (ca. 1%) among modern Hungarians[38] suggests the arrival of some R1a1a1b1a2-Z280 lineages with Magyar tribes, in contrast to the typical Slavic subclades of the area, mainly R1a1a1b1a1a-M458 (ca. 7-20%), I2a1a2b1a1-CTS10228 (ca. 16%), apart from lineages also found among early conquerors.

Further support of the spread of Hungarian conquerors from the Urals region is found in the shared mitogenomes with the ancient populations (AD 6th – 10th c.) of the Volga–Ural region (Szeifert et al. 2018).

viii.17.2. Samoyeds

Seven individuals of the Karasuk culture from Arban, Sabinka and Bystrovka (ca. 1530–1260 BC) form a wide cluster reaching from Western to Eastern Steppe MLBA, and can be modelled as Steppe MLBA (ca. 50–57%) and Baikal EBA/Nganasan-like ancestry (ca. 37–43%), with contributions of an ANE-related population (Jeong et al. 2019), which is compatible with their admixture with populations of the Trans-Uralian and Cis-Baikalic regions, with one particular outlier clustering closely with Khövsgöls in northern Mongolia (see *§viii.21.2. Turkic peoples and Mongols*). Reported haplogroups include two R1a1a1b2a2-Z2124, and one Q1a2a-L712+ (Allentoft et al. 2015).

The Tagar culture (ca. 1000–200 BC) largely continues the traditions of the Karasuk culture in the Minusinsk basin of the Upper Yenissei. This area is considered the homeland to Proto-Samoyedic, based on the Bulghar Turkic loanwords, and thus the Tagar culture probably represents the expansion of the language (Parpola 2018). Sampled Tagar individuals (probably ca. 9th c. BC)

[38] Additional data on subclades taken from the Hungarian-Magyar Y-DNA project of FTDNA.

display increased EHG ancestry compared to other Inner Asian Scythian groups, with unequal ancestry contributions of Steppe MLBA (ca. 83.5%), WSHG (ca. 7.5%), with additional ANE ancestry (ca. 9%), and clear differences of hunter-gatherer ancestry sources with other sampled Sakas, which likely formed a confederation of different peoples (de Barros Damgaard, Marchi, et al. 2018). This is compatible with their origin in the eastern European forest zone, and reported haplogroups include two hg. R1-M173, and one R1a1a1b2a2-Z2124^{+}.

Modern Samoyedic peoples show a higher admixture of Siberian populations relative to Corded Ware ancestry (Jeong et al. 2019). The southern Selkups show Steppe MLBA (ca. 24%), Baikal EBA (ca. 73%), and ANE ancestry (ca. 3%). with a majority of ‘eastern’ haplogroups (ca. 58-66%) like P-P295, Q-M242, R-M207 (xR1a1a-M198, xR1b-M343), or R2-M479, but also more R1a1a-M198 (ca. 14-19%), than other Samoyedic peoples, with lesser R1b-M343 (ca. 6-7%), I-M170 (ca. 0–7%), N-M231(xN1a1-Tat) (ca. 7%), N1a1-Tat (ca. 0–2%), or C2-M217 (ca. 2-5%).

Among northern groups, Enets in central regions have similar proportions of Steppe MLBA ancestry (ca. 21–23%), with more Baikal EBA/Nganasan-like (ca. 79–88%) and less ANE-related ancestry (ca. 0–4%), and show hg. N-M231(xN1a1-Tat) (ca. 78%), R1b-M343 (ca. 11%), and N1a1-Tat (ca. 11%). Nenets to the west show N-M231(xN1a1-Tat) (ca. 57%), N1a1-Tat (ca. 41%), while Nganasans to the east, the most recent Palaeosiberian group to adopt Samoyedic languages (Dolgikh 1960, 1962), show N-M231(xN1a1-Tat) (ca. 92%) and N1a1-Tat (ca. 3%), and an elevated “Siberian component” which has the highest frequency in three Karasuk samples (Karafet et al. 2018).

Eastern and western Circum-Arctic nomads show a prevalence of N1a1-Tat lineages, which appear in the western area as N1a1a1a2-B211 lineages (formed ca. 5400 BC, TMRCA 1900 BC) among Khanty and Mansi peoples, and in the east among some Nganasans in contact with Yukaghirs (see *§viii.21.1. Yukaghirs*). Most Nganasans show a deeper N1b-F2905 subclade (formed ca. 16000 BC, TMRCA ca. 13700 BC), though, also found in lesser proportions among Dolgans, Evenks, Evens, as well as in south Siberian Tofalars, Khakassians, Tuvinians, and Shors (Fedorova et al. 2013).

Central Siberian peoples show a majority of N1a2b-P43 lineages (formed ca. 6800 BC, TMRCA ca. 2700 BC), which may suggest an expansion of N1a-F1206 lineages precisely from this central Siberian area. Its western branch N1a2b2-Y3195 (TMRCA ca. 2200 BC) is found in the Cis-Urals region, with Permic peoples and Volga Finns, while its eastern branch N1a2b1-B478/VL64 (formed ca. 2700 BC, TMRCA ca. 1300 BC) is found in central Siberia and East Asia, and N1a2b1b1-B170 in particular coincident with the interaction east of the Urals (Ilumae et al. 2016; Karafet et al. 2018).

VIII.18. Eurasian steppes

VIII.18.1. Sintashta–Potapovka–Filatovka

A markedly cooler, more arid climate began in the Eurasian steppes from western Russia into the Altai ca. 2500 BC, reaching its coolest and driest peak ca. 2250–2000 BC, creating a paleoecological crisis had a significant effect on the economy of Pontic–Caspian tribes, favouring higher mobility and an almost complete transition to nomadic pastoralism (Demkina et al. 2017).

In the Volga–Ural region, forests, lakes, and marshes declined in area and steppes expanded. In northern steppe pastoralism, the most critical resource was winter fodder/grazing and protection from winter ice and snow. This may have led to increased competition for winter access to declining marshes, with mobile herding groups struggling to permanently settle near the most vital resource, in a sort of child's game of musical chairs (Anthony 2016).

In the period around 2400–2300 BC, there is a clear interaction between mobile steppe herders of the Poltavka culture and forest-steppe groups of the Abashevo culture. This interaction is evidenced in the subsequent period by the emergence ca. 2100 BC of Sintashta in the Ural–Tobol steppes, Potapovka in previous Poltavka territory, and Filatovka in the upper Don (Suppl. Fig. 12). Sintashta east of the Urals and the Multi-Corded Ware culture west of the Volga were the first to settle in permanent locations near marshes (Anthony 2016).

These traditions continue in an early phase the previous Abashevo pottery, but also retained and gradually expanded many cultural traits of Poltavka pottery, followed the same burial rites, and settled on top of or incorporated older Poltavka settlements. "It is difficult to imagine that this was accidental. A symbolic connection with old Poltavka clans must have guided these choices" (Anthony 2007).

This transformation was accompanied by an "unprecedented level of population mixing and interregional north–south movement across the steppe/forest-steppe border in the Middle Volga steppes", which is evident in shared material culture—projectile point styles, pottery, bronze weapons—closely associated with technical innovations in warfare, sign of increasing interregional stress (Anthony 2016).

The Sintashta–Potapovka warrior societies were born from a time of escalating conflict and competition between rival tribal groups in the northern steppes, where raiding must have been endemic, and intensified fighting led to the invention of the light chariot (Anthony 2007). The state of intense warfare was caused by a constant flow of wealth, originating from long-distance metal trade, with formation and destruction of alliances and gathering of large groups of warriors, which created a vicious circle of escalation of conflict, and created new customs, new tactics, and new weapons (Pinheiro 2011).

These harsher conditions and warrying period may also be reflected in demographic trends, with Sintashta–Potapovka cemeteries dominated by children (51%), and the population possibly affected by outbreaks of infectious diseases from domestic animals. However, this trend could simply reflect a cultural change whereby children were included in the burial rite (Khokhlov 2016). The low proportion of deaths caused by violent injuries, and the high subadult mortality—population below 18 years representing up to 75% of buried individuals—further support the scarcity of resources as the most prevalent cause of death, at least in populations around settlements (Judd et al. 2018).

Most Sintashta–Potapovka kurgan burials present large central burial pits, accompanied by abundant sacrificial remains in the form of skulls and limbs of horses, large and small cattle, rich funeral complements including bronze tools and weapons, artefacts of metal production, and objects related to chariots (Kitov, Khokhlov, and Medvedeva 2018).

One of the defining innovations of this period was probably the use of chariots driven into battle, as evidenced by an experimental study on use-wear of Sintashta–Petrovka shield-like cheekpieces, designed to be used with the teamed chariot horses for two-wheeled vehicles driven on the steppe

(Chechushkov, Epimakhov, and Bersenev 2018). This improvement in warfare may have helped the expansion of these and succeeding Eurasian steppe cultures, and the rise of elites among them.

Warring groups were strong enough to take and destroy an entire settlement, signalling an age of fully-fledged conflict, with a succession of changes in the defence systems and planning schemes of the settlements, which caused the concentration of the previously dispersed Poltavka mobile herder population around such fortified settlements to the east of the Urals (Anthony 2016).

The Sintashta culture is characterised by carefully laid-out circular shaped settlements (Figure 88) paired with recognisable kurgan cemeteries, and prominent warrior graves furnished with weapons and chariot grave goods. All Sintashta settlements were built near low spots on banks of small steppe streams, usually on the first terrace of a marshy, meandering stream close to winter grazing, in spite of the obvious concerns for security. In the Middle Volga steppes, similar settlements—with a preference for low terraces beside the wet floodplain, preferably behind a large marsh—begin later, ca. 1900 BC (Anthony 2016).

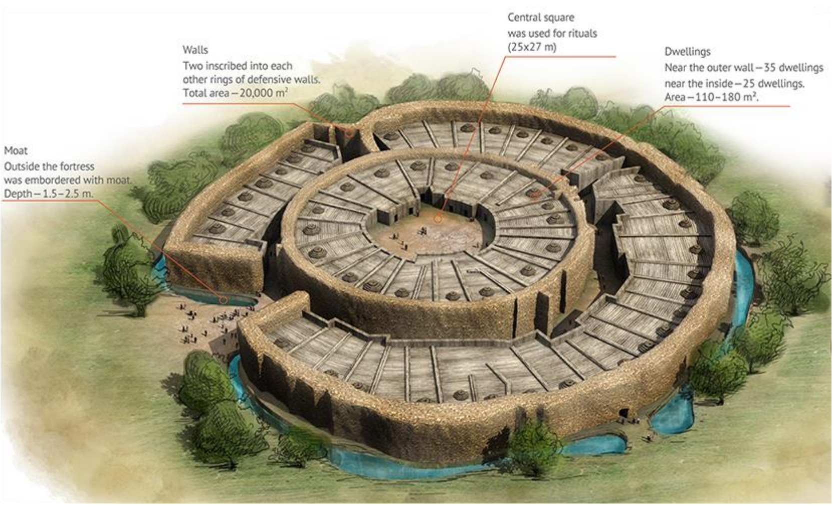

Figure 88. Description of archaeological site of Arkaim, Russia (Wikipedia).

The chronology of Sintashta–Petrovka is short, about 300 years, and can be divided into an earlier Sintashta phase (ca. 2050–1850 BC), and a later Petrovka phase (ca. 1850–1750 BC). Sintashta–Petrovka local communities of nucleated settlements include fortifications with ditches and earth walls, strengthened by wooden and stone constructions. Within settlements, houses are closely packed together in rows or circles in such a way that they share walls. Domestic artefact assemblages do not allow the separation of elites and commoners, even though stratification is visible in burial contexts (Chechushkov and Epimakhov 2018).

Potapovka (ca. 1950–1750 BC) appears in the Volga–Ural steppes as a variant of the Sintashta–Potapovka–Filatovka culture, also under strong Abashevo influence. Its main difference with the groups east of the Urals is the lack of fortified settlements, and thus the mobile nature of its economy, probably based on wagon camps. Nevertheless, domesticated animals are the basic diet of all groups, and there is no evidence for the production of domesticated cereals (Hanks et al. 2018).

Poltavka and Sintashta–Potapovka share nevertheless almost identical metals, ceramics (both similar to Abashevo), and mortuary rituals featuring horse cheek-pieces, paired horse sacrifices including whole horses, and some new ornaments, as well as very similar metal weapons (such as socketed spearpoints and waisted-blade daggers), which support their close relatedness. Distinct from the previous Poltavka period are the lavish graves, with far richer assemblages, featuring more weapons (Anthony 2016; Khokhlov 2016).

Social complexity arose in Sintashta–Petrovka based on herding economy. People who were skilful at managing walled villages, as well as those skilful warriors able to protect from military threats, probably formed the core of the chiefdoms that were created. The majority of the permanent population was involved in craft activities, though, including extraction of copper ores, metallurgy, bone, leather, and woodwork. The most labour-intensive part of the economy was haymaking. Control of craft by clans of miners, metallurgists, blacksmiths and casters also provided a source of power for elites in the fortified settlements. Their highly developed craft allowed for the improvement of the complex technology and substantial resources necessary to build two-wheeled vehicles (Chechushkov et al. 2018).

The fortifications of Sintashta represent only a portion of the population (also evidenced by the lack of them in Potapovka), whereas ordinary semi-mobile people, dedicated to herding—the main subsistence economy—inhabited the outside part of fortifications during the winter. This way, herds were grazed during the summer, and protected in portable shelters during the winter, in the best (fortified) spots dominated by the elites. Their activities and lack of rich assemblages suggest a less prestigious status of herders. Kuzmina (1994) cited a connection of the common Indo-Aryan word for a permanent village, *grā́mas*, earlier meaning a circle of mobile wagon homes, situated together for defensive purposes for an overnight camp (Chechushkov 2018), which is compatible with an evolution of the word from highly mobile herders to its adoption as the designation of a permanent settlement.

Elites were imbued of a high social prestige that could be transferred to their children. This is reflected in the elaborate tombs (Figure 89) and sculptures, suggesting supernatural powers and ritual roles as much more important bases of their social prominence than control or accumulation of wealth, which seems nevertheless to have been prevalent within fortifications. Semi-mobile herders possibly represented ca. 30–60% of the population, while the local community represented ca. 40–70%. About 5% of them seem to have had the right to be buried under kurgans, and elites represented no more than 2–3% of the population, based on their extremely rich assemblages (Chechushkov 2018).

The social system of Sintashta (and probably also Potapovka) demonstrate a three-part social order, which seems to follow the same order of the Varna system of ancient India (similar also the ancient Iranian system) which consisted of priests (Brahmanis), rulers and warriors (Kshatriyas), free producers (Vaishyas) and laborers and service providers (Shudras) (Kuzmina 1994). In Sintashta–Petrovka chiefdoms, the elite consisted of priests and warriors (2-5%), dominating over local dependent producers (48-55%) and mobile herders (ca. 50–60%) of lower social rank (Chechushkov 2018).

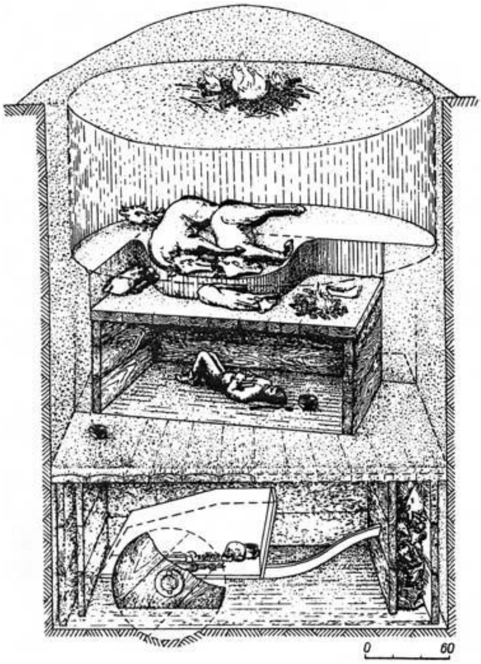

Figure 89. Aristrocratic burial at Sintashta in the southern Urals (ca. 2200–1800 BC). The warrior lies in the chariot with solid wheels, beneath two horses accompanied by the groom or charioteer. Image modified from Gering et al. 1992: 154, fig. 72, as it appears in Parpola and Carpelan (2005).

This social organisation, apart from being inherited from the similar Late Proto-Indo-European system, was reorganised into a system that favoured incoming Abashevo settlers, who were already skilled craftsmen, and probably emerged as the elite of warriors and priests among leading clans in each fortification. This happened probably during the aridification period and the associated massive migration of Poltavka herders north into the previous forest-zone, and east into the southern Urals, zones which became dominated by Abashevo settlers.

Sintashta–Potapovka emerged thus as a transcultural phenomenon associated with predominant clans of craftsmen—under the jurisdiction of warrior and priest elites—in what was most likely a social organisation based on local chiefdoms. Their variety of reinterpreted cultural traditions incorporated to local funeral rites and ceramic complexes point to interregional family and marriage relations, in particular with Abashevo and (in Sintashta) with quasi-Eneolithic cultures of the southern Urals and northern Kazakhstan (Vinogradov 2018)

To the west, Abashevo influence is felt especially in the eastern part of the Multi-Corded Ware tradition, near the Don–Volga interfluve, which points to the limit of the massive southward migration of Corded Ware-related groups (mostly from Abashevo) into the Pontic–Caspian steppe cultures since the mid–3rd millennium BC. Rituals performed for people of distinctive position have been excavated in kurgans along the Don River within the traditional Abashevo area, in particular the Filatovka and Vlasovo cemeteries, characterised by the composition of elements connected with the Late Catacomb and Multi-Cordoned Ware cultures, as well as to Sintashta and Alakul (Koryakova and Epimakhov 2007).

From the social point of view, these Filatovka-like burials display distinctive elements of a system of prestige good and warrior attributes, and have been interpreted as a western 'back-migration' of eastern Abashevo groups, as a Potapovka-related version of the Sintashta tradition, or as a component of the Novokumaksky horizon, representing in any of these cases a westward movement of Abashevo-related peoples from the Volga–Ural area. The newcomers possessed a powerful social and political organisation, as well as chariots, and probably encountered Late Catacomb and Abashevo settlers in the Don area. They most likely represent the original population from which early Srubna formed in its Pokrovka (east) and Berezhnovka (west) variants (Koryakova and Epimakhov 2007).

The phenotypic change in the steppe during this time is mentioned as the clearest example (since the Neolithic and until the Iron Age) of race—and thus probably ethnic—mixing of heterogeneous groups in Sintashta and Potapovka, compared to Yamna. Some other noticeable phenotypic changes occur related to 'eastern' features of the Trans-Uralian steppes arriving in Sintashta, possibly through the Seima–Turbino phenomenon, but also through its expansionist waves to the east (Khokhlov 2016).

VIII.18.2. Andronovo

Pottery, weapons, bone cheek-pieces for chariot driving, and graves of Sintashta style evolved into Petrovka ceramics, weapons, and ornaments, which in turn represent the origin of Alakul (ca. 2000 – 1700 BC), the earliest phase of Andronovo, which was mainly distributed in the whole steppe and forest-steppe of the Trans-Urals and northern, western and central Kazakhstan and Chorasmia (Anthony 2016).

Alakul represents thus the expansion of a cattle- and sheep-herding economy everywhere in the grasslands east of the Urals. It continued thus many customs and styles inherited from Sintashta, such as small family kurgan cemeteries, settlements with 10–40 houses built closely together, similar spear and dagger types, ornaments, and the same decorative motifs on pottery, such as meanders, hanging triangles, "pine-tree" figures, stepped pyramids and zig-zags (Anthony 2007). The petroglyph tradition of Andronovo people consists of depictions of everyday life, showing the importance of the wheeled transport (Novozhenov 2012).

Bearers of the Alakul tradition assimilated all the Trans-Uralian forest-steppe cultures included in its northern area, evidenced by burial rituals, and in the south it was limited by the steppe zone. Alakul settlements are located on the first river terraces or in the low lake banks, usually close to a large valley, and only rarely on high ground. The biggest settlements are located in the eastern territory, with general settlement surface not exceeding 10,000 m^2. Their planning structure is linear, houses organised into one or (rarely) two rows running along the river bank. Houses are rectangular postframe constructions, with internal space divided into partitions, containing wells, storage pits, and fireplaces, including metallurgical furnaces (Koryakova and Epimakhov 2007).

Alakul cemeteries involve some dozens of kurgans or multigrave funeral sites with one or two big graves in the centre, and many others in the periphery. They appear in the same area as settlements, without a visible demarcation of the “world of dead” and “world of living”, as in Sintashta. Pottery in assemblages have flat bottoms with a ledge between the neck and shoulder, and their surface carefully treated, with more than half decorated, usually in the neck and shoulder with flat or comb stamps. The dominant burial rite is inhumation. Sacrifices are connected to large burials, and are represented by separate animal bones, usually head and extremities, with a composition similar to Petrovka: first cattle, then sheep, then horse. Dog sacrifices are characteristic of the Trans-Urals region, and fire played a significant role in Alakul rituals (Koryakova and Epimakhov 2007).

The Andronovo horizon then included the (at least partially unrelated) Fëdorovo style (ca. 1850–1450 BC), which covered essentially the whole of Turkmenistan and Kazakhstan, connected in the north to the forest-steppe, and in the west to eastern Kazakhstan and the Upper Yenissei. Fëdorovo ceramic and grave types represented an eastern or northern style with which the Alakul style interacted in many regions. Stratigraphic sequences show either Alakul turning into Fëdorovo, or mixed Alakul and Fëdorovo traits, which support the earlier appearance of the Alakul tradition. Alakul showed inhumation beneath earth kurgans, while Fëdorovo showed cremation graves with stone constructions (Anthony 2016).

The Fëdorovo shape and ornamentation are nevertheless distinct from the preceding Okunevo culture (ca. 2400–1950 BC), and continue therefore at least in part the Petrovka tradition from the southern Urals into northern, central, and eastern Kazakhstan, to the east into Tian Shan and Xingjian, mostly through the southern Siberia, connected to forest-steppe landscapes. It is found among Alakul sites in eastern Kazakhstan, Altai, and the Minusinsk lowland, and with mixed Alakul appearance in central Kazakhstan. It is also found to the south into southern Turkmenistan, which points to a long-range migration, possibly with the aim of obtaining control of local copper and tin resources, important for the production of high quality weapons (Parzinger 2006).

Known settlements are found on the first river terraces, near large river valleys, and can comprise several dozen houses following a linear pattern. Inhabited constructions vary from 30–300 m^2, having usually storage pits, niches, wells, and hearths. There are two building types: daylight framework dwellings, proper of central Asia (evidenced by pottery of Namazga tradition), and big, semi-subterranean multiroomed buildings of local origin. Metal objects include socketed arrowheads, chisels, awls, hooked sickles, knife–daggers, etc. and bone inventory include instruments for wool and leather processing, and bone arrowheads (Koryakova and Epimakhov 2007).

Kurgan cemeteries, containing dozens to hundreds of mounds, occupy the flat banks of water reservoirs, in contrast to the previously preferred flat terraces. They are usually surrounded by circular or rectangular fences, made of stone by cyst or masonry lying, or covered by an earthen mound along the outer contour. Fëdorovo kurgans are oval-shaped barrows smaller than Alakul mounds but with better expressed relief, containing one rectangular grave pit. Burials include cremation, when the deceased was burned somewhere outside the area and remains and ashes were placed into a grave (Koryakova and Epimakhov 2007).

The characteristic Fëdorovo material culture are well-made pots, thin-sided and with a smooth profile, with a technique that involved starting with the body (whereas Alakul vessels were manufactured on a model), with surfaces carefully treated, sometimes polished. The Fëdorovo decorative system, consisting of three zones, was designed according to a canon. Fëdorovo also shows imported central Asian pots made with white or red clay fabrics, largely undecorated, in forms such as pedestaled dishes, which point to the creation of stable, long-range exchange routes (Koryakova and Epimakhov 2007).

The expansion of the early Srubna–Andronovo pan-continental, macro-cultural horizon over central Asia (see Figure 90) brought innovations like bronze casting, chariotry, and aspects of pastoral economy and sedentary settlement types (based on year-round residence in timber houses) that connected territories isolated until then. The Andronovo cultural-historical community, or horizon, is the eastern branch of this entity, although mixed Srubna–Alakul settlements are found in the Cis-Ural region (Anthony 2016).

Interregional networks include trade of copper, tin, and horses, while material culture shows a patchier diffusion, with differences in rituals and distinctive elite behaviours suggesting also distinct ethnolinguistic groups. In the east, it interacted with north-western China across Tian Shan during the rise of the earliest Chinese state (Quijia, Erlitou, and early Shang periods), and with central Asia during the declining period (ca. 1800–1600 BC) of the BMAC and Namazga VI cultures (Anthony 2016).

The idea of simplistic ‘waves’ of eastward movement creating ‘cultural clusters’ is not clear, though, based on the quite early radiocarbon dates from eastern sites of the Fëdorovo type, which may range from ca. 2000 BC. Nevertheless, typological definitions of Fëdorovo can be ambiguous. The long-term localised regional development; the disparate distribution and technological patterns for metal artefacts, ceramics, burial practices and architectural styles; and local variations dependent on specific microregions, all question the validity of a simple demic diffusion model for all Andronovo-type material cultures in central Asia (Jia et al. 2017). Similarly, early Alakul-type funeral rituals included Abashevo elements in the Trans-Urals region, which suggests a multi-ethnic expansion of the culture, supported by the emergence of the Andronovo-like cultural horizon in the Trans-Uralian forest zone (Koryakova and Epimakhov 2007).

Continuation of the social organisation based on elites and kinship is reflected in indirect data: while labour invested in funeral rituals is reduced, symbols of prestige (maces, spearheads, axes, and chariotry complexes) maintain a similar trend, and cemeteries suggest a lineage-based organisation: in Alakul, based on the contraposition of central and peripheral burials. Bones of horses are found more often accompanying adults in central graves, while cattle are found accompanying adults and juveniles, while sheep and goats appear with infants (Koryakova and Epimakhov 2007).

Andronovo settlements in Kazakhstan were generally larger and more organised than those of Srubna in the Volga–Ural region. Pottery from settlements usually show multiple ceramic phases, interpreted as indicating a cyclical pattern of abandonment and reoccupation. In Andronovo settlements studied to date, the diet was based mainly on sheep–goats and cattle (with conflicting reports as to which predominated in which area), then horses; this suggests a more mobile pastoralism east of the Urals, based at least in part on sheepherding, in contrast to the mainly cattle-breeding economy in Srubna (Kuzmina 2008).

While livestock breeding was the main subsistence economy for both Alakul and Fëdorovo, and agriculture was not essential, fishing and hunting (basically elk) played quite a notable role in the northern zone. Around ca. 1400–1200 BC, steppe herders from central Asia were cultivating grain, including pastoralists of semi-alpine pastures of the Karasuk culture in the western Altai. The oldest evidence of agriculture in Andronovo comes from Tasbas in the Dzhungarian Mountains of eastern Kazakhstan This trend continued into the Iron Age (Koryakova and Epimakhov 2007).

Metallurgy was quite advanced and concentrated in several centres, whose products were distributed throughout temperate Eurasia. Tin–bronzes are prevalent in Andronovo (more than 90%), contrasting with Srubna (Chernykh 1992) probably due to central Asian tin deposits like those of the Zeravshan Valley near BMAC settlements, and on the middle Irtysh River in the western

Altai piedmont near Cherkaskul settlements. Large copper mines exploited during this period include Atasu and Dzezkazgan (Koryakova and Epimakhov 2007).

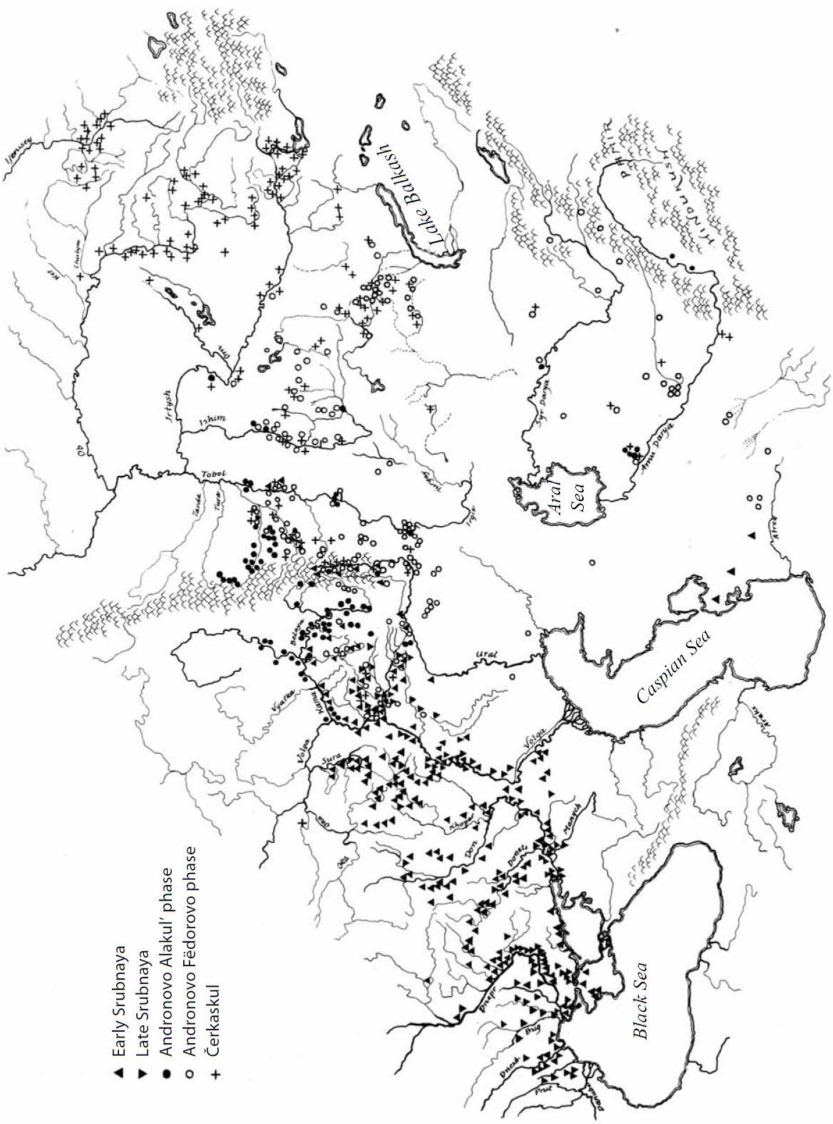

Figure 90. Distribution of the Srubnaya, Alakul Andronovo, Fëdorovo Andronovo and Cherkaskul monuments. Image modified from Parpola (2015): 62 Fig. 7.6, based on Chlenova 1984: map facing page 100.

VIII.18.3. Chemurchek

The Chemurchek culture (late 3rd – early 2nd millennium BC) emerged in the northern Xinjiang region of China, between eastern Kazakhstan and western Mongolia. It shows connections with Afanasevo, Okunevo, Andronovo and Karasuk, but represents a different Bronze Age culture. Relevant features described to date include (Jia and Betts 2010):

- Rectangular enclosures built using large stone slabs, with a size varying from 28 x 30 m to 10.5 x 4.4 m.
- Almost life-sized anthropomorphic stelae erected along one side of the stone enclosures.
- Single enclosures tend to contain one or more than one burial, all or some with stone cist coffins usually built with five large stone slabs (four for the sides and one on the top), sometimes with painted designs on the inside.
- Primary and secondary burials, with two potential orientations (of ca. 20^{o} or 345^{o}), sometimes decapitated bodies (up to 20) associated with the main burial, and bodies placed on the back or side with legs drawn up.
- Grave goods include stone and bronze arrowheads, hand-made gray or brown round-bottomed ovoid jars (together with clay lamps) and small numbers of flat-bottomed jars.
- Complex incised decoration in ceramics is common, but some vessels are undecorated.
- Stone vessels distinctive for the high quality of manufacture.
- Stone moulds show a relatively sophisticated metallurgical expertise.
- Some artefacts are made of pure copper.
- Sheep knucklebones (astragali) imply a tradition of keeping them for ritual or other purposes, indicating an economy based on domestic sheep.

viii.18.1. Late Indo-Iranians

Sintashta eventually transformed into the Petrovka–Alakul economy as part of eastward-expanding Andronovo horizon, while Potapovka and western groups evolved into Pokrovka and the expanding early Srubna culture. The identification of Srubna and some Andronovo complex-related groups with expanding Proto-Iranians, and the expansion of Proto-Indo-Aryans coincident with other groups of the Andronovo complex leads to a direct identification of the emergence of Sintashta–Potapovka–Filatovka cultures as the classic Proto-Indo-Iranian community (Anthony 2007; Mallory and Adams 2007; Beekes 2011).

This origin of the Sintashta–Potapovka–Filatovka population in Abashevo migrants mixing with indigenous East Yamna and Catacomb/Poltavka herders is evidenced by the intrusive Corded Ware-like ancestry and R1a1a1b-Z645 lineages (mainly of R1a1a1b2-Z93 subclades) in an area previously dominated by Yamna ancestry and R1b1a1b1b-Z2103 lineages. Nevertheless, there seems to be a clear genetic difference between eastern (southern Urals) and western (Volga–Ural) groups coincident with cultural ones (Allentoft et al. 2015; Narasimhan et al. 2018).

Four Potapovka samples from the Samara region, from Utyevka and Grachevka (ca. 2200–1800 BC), one reported as of hg. R1-M173, another R1a1a1b-Z645, form a wide cluster between Yamna and Corded Ware samples (Allentoft et al. 2015; Narasimhan et al. 2018). The admixture and PCA shift of Potapovka–Srubna samples relative to Sintashta–Andronovo individuals is compatible with more WHG and less EEF (ca. 28%) contribution (Wang et al. 2019), as found in north Pontic forest-steppe and probably forest samples near the Middle and Upper Dnieper regions.

Eight Sintashta–Petrovka individuals from varied settlements of the southern Urals (ca. 2200–1750 BC), one of hg. R1a1a1b2a2-Z2124 from Bulanovo, another R1a1a1b2a2a1-Z2123 from Stepnoe, form a tight cluster close to central European Corded Ware samples (Mathieson et al. 2015;

Narasimhan et al. 2018), with elevated EEF ancestry (ca. 42%), which may suggest less admixture of certain eastern Abashevo groups with forest-steppe peoples. Forty individuals from the Kamennyi Ambar V cemetery (ca. 2130–1750 BC) form also part of this cluster, with fifteen samples of hg. R1a1-M459, probably most R1a1a1b2-Z93; two R1b-M343, probably R1b1a1b1b-Z2103; and one I2-M438, probably I2a1b1a2a2-Y5606 (Narasimhan et al. 2018).

Ten outliers out of fifty individuals, usually interred on the margins of investigated kurgans, evidence the heterogeneity of the Kamennyi Ambar population, consistent with its interaction with neighbouring populations (Narasimhan et al. 2018). Increased Steppe ancestry is found in four individuals (ca. 2000–1700 BC), three brothers of 1–5 years, moderate outliers, probably of hg. R1a1a1b2-Z93, and one young male, a full outlier clustering with Yamna and Afanasevo, probably of hg. R1b1a1b1b3-Z2106. Ancestry related to Khvalynsk Eneolithic individuals is found in two males (ca. 2050–1650 BC), one of hg. R1b1a1-P297, the other R1b1a1a-M73, without archaeological context (see *§ii.3. Indo-Uralians* and *§viii.21.1. Yukaghirs*). West Siberian Neolithic ancestry is found in four individuals (ca. 2130–1750 BC), one probably of hg. R1b1a1b-M269, two Q1a2-M25, probably related to eastern populations with elevated 'Siberian' component, found later in steppe LBA samples. All these outliers with elevated proportions of different ancestries (and direct dates that are contemporaneous with the other individuals) show that this fortified site harboured peoples of diverse ancestries living side–by–side (Narasimhan et al. 2018).

Based on later samples from Iranian peoples in the steppes and Indo-Aryans from central Asia, and considering that sampled Sintashta–Potapovka individuals come from fortified settlements and higher status burials (most showing animal sacrifices), commoners of the Sintashta–Potapovka–Filatovka community were probably mainly descendants of Poltavka herders, and thus mainly of R1b1a1b1-L23 and I2a1b1a2a2-Y5606 subclades, whereas elites were mainly descendants of Abashevo migrants, and showed thus an increasing Y-chromosome bottleneck under R1a1a1b-Z645 lineages, in particular R1a1a1b2-Z93 subclades.

This integration of Abashevo elites, originally Uralic speakers, among Poltavka herders, of Pre-Proto-Indo-Iranian language, is conceivable in a region of highly fortified settlements, evolving through alliances of different groups against each other, akin to the situation found in Bronze Age Europe: a minority of Abashevo chiefs and their families would dominate over certain successful fortified settlements and wage war against other, neighbouring tribes for control over the best economic areas. After a certain number of generations, where the majority of the population—including commoners, females among the elites, and possibly slaves— retained the original Poltavka culture, the integrated elites would have replaced the paternal lineages of the region.

This explains the language shift of Corded Ware lineages from Abashevo in the steppe, and is supported by the archaeological continuity of Sintashta-Potapovka with Poltavka in terms of material and symbolic culture (Anthony 2007). The strong influence of Uralic speakers on Indo-Iranian pronunciation, visible in the characteristic phonetic Uralisms of Proto-Indo-Iranian, have to be put in relation with the strong influence of Indo-Iranian loanwords on northern Abashevo peoples—who probably maintained close contacts with their southern relatives as they became bilingual—visible in Finno-Ugric loanwords (see *§viii.15. Mordvins and Mari-Permians*).

The Andronovo cultural complex represents a complex historical phenomenon encompassing a large number of cultures from the Eurasian steppes, between the Ural Mountains in the west and the Minusinks Basin in the east, without clear ethnolinguistic borders. The most important Andronovo cultures, probably to be identified roughly with expanding Indo-Iranians, are Alakul and Fëdorovo, from central Kazakhstan to the Yenisei river in present-day Russia. Different genetic clusters have been found among Andronovo-related groups (Narasimhan et al. 2018), some of them likely representing distinct ethnolinguistic communities.

A common cluster with Sintashta–Petrovka is found in most Andronovo samples of the Trans-Urals steppes (ca. 2000–1400 BC). This “Western Steppe MLBA” cluster shows similar EEF contribution (ca. 26%) and haplogroup distribution. A subcluster of “Eastern Steppe MLBA” peoples is formed by certain samples which show statistically significant differences with the Western Steppe MLBA cluster, consisting mainly of additional West Siberian HG ancestry contribution (ca. 8%), suggesting that peoples of Western Steppe MLBA admixed with West Siberian HG-related peoples as they spread further east (Narasimhan et al. 2018).

Western Steppe MLBA samples include, apart from those of Sintashta–Petrovka, mainly samples from Alakul and derived groups: from central-east Kazakhstan, there is one from Ak Moustafa (ca. 1770 BC), of hg. R1a1a1b-Z93; six from Kairan, near the Ak-Koitas and Kara-Koitas mountain in Karaganda (ca. 1930–1630 BC), two of hg. R-M207; seven from Maitan (ca. 1880–1640 BC), including three likely R1a1a1b-Z645; one from Satan (ca. 1780 BC), of hg. R1a1a1b-Z93; one female from Alpamsa (ca. 1550 BC); three males from Karagash (ca. 1880–1600 BC), of hg. R1a1a1b-Z93. Other samples include two from Lisakovskiy, northern Kazakhstan (ca. 1870–1690 BC); six from Oy-Dzhaylau, southern Kazakhstan (ca. 1900–1400 BC), three of them likely R1a1a1b-Z93; one from Solyanka, western Kazakhstan (ca. 1640 BC); and four from Aktogai, south-east Kazakhstan (ca. 1600–1500 BC), three of them hg. R1a-M420, probably R1a1a1b-Z93 (Narasimhan et al. 2018). Other Western Steppe MLBA samples include individuals of the Mezhovska culture (see *§viii.17. Ugrians and Samoyeds*).

Eastern Steppe MLBA samples include four from Kytmanovo in the Altai Krai (ca. 1700–1300 BC), one of hg. R1a1a1b2a2-Z2124 (Allentoft et al. 2015); three from Dali (ca. 1900–1300 BC), one of hg. R1a1a1b2-Z93; four from Kazakh Mys (ca. 1730–1530), two likely of hg. R1a1a1b-Z645; one from

Zevakino (ca. 2000 BC) of hg. R1a1a1b2-Z93, before the Fëdorovo stage; fifteen from the easternmost area in Orak Ulus and near the Minusinsk Basin in Krasnoyarsk (ca. 1900–1400 BC), with eleven samples of hg. R-M207, ten of them probably R1a1a1b-Z645, including at least three R1a1a1b2-Z93, and a clear outlier from the Orak Ulus site (ca. 2000–900 BC), of hg. Q-M242, clustering with West Siberian Neolithic samples (Narasimhan et al. 2018).

Other likely Eastern Steppe MLBA samples include a group north of the Altai (ca. 1800–1400 BC), one of hg. R1a1a-M198 from Oust-Abakansty, Khakassia, one of hg. R1a1a-M198 from Solenoozernaya IV, Krasnoyarsk, and one of hg. C-M130(xC2-M217) from Tatarka cemetery, Charypovsky (Keyser et al. 2009); one from Mityurino in the central steppe (ca. 1590 BC) showing contribution from East Asian populations (de Barros Damgaard, Marchi, et al. 2018).

viii.18.2. Tocharians

It has been suggested that Afanasevo and Chemurchek find their "missing link" with the migration of Tocharians to the Tarim Basin in the sites of Gumuguo and Xiaohe in the Taklamakan desert of southern Xinjiang, based on the *Caucasoid* features of the investigated individuals. The finding of haplogroup R1a1a1b-Z645 (xR1a1a1b2-Z93) in 11 out of 12 investigated Tarim Basin mummies of the Xiaohe necropolis (Li et al. 2010), dated probably ca. 1700–1400 BC (Qiu et al. 2014), increases the doubts of the connection of these mummies to Afanasevo on one hand, and to speakers of Tocharian on the other (Mallory 2015). In fact, the penetration of Andronovo cultural influence is found in the western Tian Shan and the Ili River valley, but also further east and south (Kuzmina 2007).

If the Tarim Basin mummies actually belonged to ancestors of later Tocharian speakers, this would support a cultural assimilation of Pre-Tocharian peoples into expanding Asian clans of R1a1a1b-Z645 lineages (see above), and also that the migration of the Proto-Tocharian language to the Tarim Basin was coincident with the Andronovo expansion, which "had transformed the steppes from a series of isolated cultural ponds to a corridor of communication" (Anthony 2007). The likely presence of early contacts between Tocharian and Samoyedic (to the north), as well as the especially intense contacts with Indo-Iranian, support the close interactions of these groups around the Tian Shan and Altai mountains during the Bronze Age.

In particular, there are early contacts of Common Tocharian with one or several unknown Old Iranian dialects (which are not Avestan or Old Persian), which must date to the 2nd millennium BC, before the contacts of Tocharians with Middle Iranian languages (like Khotanese, Sogdian, and Bactrian). The prevalent terms related to specific concepts of merchandise or administration indicate that Iranians influenced Tocharians by imposing an administrative infrastructure (Carling 2005).

Investigated samples of the Sagsai tombs ("Mongun Taiga" culture for Russian archaeologists) from the Altai show an early sample from Takhilgat-Uzuur 5 (ca. 2700 BC), contemporary with late Afanasevo, of hg. Q-M242, with western and eastern genetic components, which supports an early infiltration of steppe ancestry in the region. Later individuals of the Middle and Late Bronze (ca. 1400–900 BC) show four samples of hg. R1b1a1b1-Z93, and three samples of hg. Q1b1a-L54, apart from a late one of hg. C-M130, which supports the arrival of R1b1a1b1-Z93 lineages in the region during the MBA (Hollard et al. 2014).

Nevertheless, from the paternal lineages found in modern Uyghurs (Zhong et al. 2013), those of haplogroup R1b1a1b-M269 could be explained only by either Afanasevo or Indo-Iranian R1b1a1b1b-Z2103 lineages. The presence of R1b1a1b-M269 (23%) among modern Yaghnobis of the Upper Zeravshan Valley (Cilli et al. 2019) also support the ancient distribution of this haplogroup in central Asia, potentially related to the Tocharian expansion.

VIII.19. Pontic–Caspian steppes

VIII.19.1. Multi-Cordoned Ware

The Babino or Multi-Cordoned Ware (MCW) culture succeeds the Catacomb culture in the north Pontic area, and is characterised by ceramics with cord-marked decorations (horizontal lines, diagonally hatched triangles) on their upper surfaces. It continues in the same region as Catacomb, expanding northward into the southern forest area of the Middle Dnieper culture. Metal objects show continuity with Catacomb tradition, but become more developed. Bronze adzes are longer, slimmer, and more curved, as are bronze shaft–hole axes, flange-hilted daggers, and polished stone axes. Round disc-toggles and extensively retouched flint arrowheads feature also prominently (Parzinger 2013).

Some of these objects—e.g. flange-hilted daggers, shaft–hole axes, round disc-toggles and flint arrowheads—have correlates in Sintashta burials. The leading MCW form is the outwardly round, in cross-section curved, bone disc with a large centre hole and an additional hole bored in the side, which occurs in the Abashevo culture. Both Abashevo and Sintashta are synchronous developments of the Pontic–Caspian steppe and forest-steppe regions, pointing to their interwoven cultural dynamics, probably through the expansionist Abashevo population (Parzinger 2013).

Kurgan earth-banks are not very high, and as a rule contain one to three burials in a pit with vertical walls. Stone cists and timber fittings in building-block fashion anticipate the construction of the succeeding Srubna culture. The dead are not uniformly orientated or placed, with supine and crouched on the side being frequent positions. Grave goods are scarce, as is ceramic (Parzinger 2013).

The number of settlements increases compared to previous periods, primarily on river terraces, with occasional fortified settlements on elevations pointing to more sedentary centres and higher interregional conflict than in previous periods. Houses include sunken earth-houses and ground-level wooden-post buildings with a rectangular plan. Animal husbandry is the main subsistence economy—mainly cattle, also sheep, goats, horses, and pigs—with no evidence of agriculture. Bridle cheek-pieces prove the use of horses for transport, probably to reach further pastures (Parzinger 2013).

VIII.19.2. Srubna and Sabatinovka

The LBA starts in the Eurasian steppes ca. 1900–1800 BC, contemporary with the central European Únětice EBA and Middle Helladic cultures of the Aegean MBA, and is represented by the rapid spread of a settled form of agropastoralism from a previous Sintashta–Potapovka–Filatovka core over a vast area to the east of the Urals, into the western Tian Shan and Altai Mountains, and to the west into the Danube River. This developing Srubna–Andronovo horizon has the Ural River and southern Ural steppes as its rough boundary, with some Andronovo (Alakul-type) materials on eastern Srubna settlements, and mixed Andronovo–Srubna settlements on the easternmost headwaters of the Samara River (Anthony 2016).

In the forest-steppe and steppe zones of the Don–Volga interfluve, reaching as far as the Samara Valley, the latest variant of Abashevo is often referred to as the Pokrovka type, dating to ca. 2000–1700 BC. Both the Abashevo culture and Pokrovka type are often seen as, respectively, the formative and terminal periods of the same cultural complex, successor of the Corded Ware culture and predecessor of the Timber Grave phenomenon. However, its relationship with the Catacomb, Fatyanovo, Balanovo and Sintashta is widely debated (Chechushkov and Epimakhov 2018).

The Pokrovka or early Srubna burials appeared first in the Middle Volga region as a transition of Potapovka pottery shapes, fabrics, and decorative motifs, representing thus an evolution of Potapovka potters. Pokrovka pottery and bronze weapon styles and grave types spread from the Volga–Ural steppes westward into the north Pontic steppes ca. 1800–1700 BC, probably thanks to the new warrior technology and also through intermarriages, as suggested by the adoption of local pottery-making customs. Compared to the previous period, it represents a transition to sedentary life, with the first permanent settlements, at the same time as pottery evolves to simpler ceramic types (Mochalov 2008).

The group shows usually several kurgans in each cemetery, with each kurgan displaying one to three burials, being the first period in the region with cemeteries containing entire social groups, individuals of both sexes and all ages. Burial pits are rectangular, and they tend to be fairly large in size. Bodies are usually interred placed on their left side in a contracted position, with their arms bent and hands in front of their faces, and orientated to the north. Burials are often lined with organic mats, and remains of large domesticated animals and ochre (and sometimes chalk) are frequent (Popova, Murphy, and Khokhlov 2011).

Some elite burials are marked by vessels with elaborated decoration and animal remains, and each separate cemetery seems to have vessels that copy ornamentation from bone rings found in burials with weapons. Burials of those with social power and prestige (such as Staroyurievo Cemetery, the Filatovka kurgan, etc.) are also accompanied by weapons, the insignia of power, and gold jewellery, and are conspicuously different from the rest of the graves of ordinary people. The same graves provide indirect evidence of the wide use of wheeled transport, such as bones of domesticated horse as draft animal, and studded elk-antler cheekpieces, the earliest artefacts of this kind in Eastern Europe, ca. 2000–1700 BC. Pokrovka is thus seen as an important part of the 'chariot horizon', representing a rapid extension of the chariot complex to vast areas of North Eurasia (Chechushkov and Epimakhov 2018).

The Srubna or Timber-Grave culture (ca. 1600–1200 BC) represents thus a unified culture of the Pontic–Caspian steppes after the expansion of Pokrovka groups from the Volga replaced the previous cultures up to Crimea (Suppl. Fig. 13). In the east, most Pokrovka settlements continue to be occupied during the mature Srubna period. In the west, Srubna settlements appear in steppe and forest-steppe regions, in areas previously occupied by Multi-Corded Ware groups; to the north, southern Abashevo groups are replaced by Srubna. Further north, northern Abashevo groups—from the forest region between the Oka and Vetluga rivers—transition to the Pozdnyakovo culture (Parzinger 2013).

Srubna (and Pozdnyakovo) pottery show vessel shape and ornamentation in common with Andronovo–Fëdorovo ware, although there is also some regional continuity of Srubna with Abashevo and MCW traditions. Ceramic comprises round to hour-glass shaped cups, bowls, and pots, as well as shoulder decorated (carved, pricked, impressed) with triangles, diamonds, and zigzag bands. Pottery shows homogeneous features with little regional or temporal variation, which is also common in Andronovo–Fëdorovo. The synchronous appearance and similarities of Pozdnyakovo (ca. 1850 BC) to the north of the forest-steppe in the Upper Don, Srubna to the west of the Urals, and Andronovo–Fëdorovo to the east, point to an expansion of related populations in eastern Europe (Parzinger 2013).

Copper objects like spearheads, hooked sickles, flange-hilted daggers, narrow shaft–hole axes, and bracelets with spiral ends may have been made with copper from Kargaly in the Urals, where there was intensive copper mining (as previously in Yamna). Kargaly may have been the largest mining complex in the 2nd millennium BC Europe, which implies a substantial export trade. Arsenical and antimony bronzes predominate in Srubna, in contrast to the tin–bronzes prevalent in Andronovo, which are probably responsible in part for the tin–bronzes (ca. 25% of the total bronze objects) found in Srubna, especially in elite burials (Chernykh 1992).

The scale of mining and metalworking displayed by Srubna–Andronovo materials suggest a complex organisation of the subsistence economy and trade networks beyond a simple herding economy. Kargaly copper was probably traded with help from wagons and traction animals (as suggested by specific pathologies) and through waterways up to Troy and the Aegean. Bone bridle attachments and bone discs with wavy ornamentation shows connections with the Mycenaean world through LBA cultures from the Carpathian Basin (Parzinger 2013).

Common burial rite includes simple earth pits covered with an earth mound. Some burials show timber-lined grave chambers, while others show simple branches covering the grave. Bodies were in the contracted position on the side, orientated to the north, and few grave goods if any are deposited. Elites are not marked in the burial ritual, and only rarely are richer graves with weapons found (Parzinger 2013). The Srubna society was probably hierarchical in nature, dominated by tribal chiefs, although the specialised organisation probably determined different, equally important heterarchical relationships.

This period represents a stabilisation of the population, with increased average life span (ca. 20 years, with men ca. 37 years, women ca. 39 years) compared to the previous period. A lesser proportion of children (ca. 30%) compared to the previous period and high survivorship to adolescence bring this period closer to those previous to the Sintashta–Potapovka crisis (Khokhlov 2016).

In the north Pontic area, agriculture remained important, with Noua–Sabatinovka showing full agropastoral economy with a wide variety of cultivated grains. To the east of the Dnieper and on the Donets, some settlements were also agropastoral, but agriculture featured less importantly in the subsistence economy, and domestic grains were mostly millet. Settlements in the west show fortifications—either embankments or trenches—with farmstead-like clusters of houses (Figure 91) which could be earth-houses, dugouts (*zemlyanki*), built in partially sunken areas (*poluzemlyanki*), or ground-level wooden-post buildings (Parzinger 2013).

In the east, settlements are small and unplanned, suggesting an extended family at each site. Herders from three or four distinct permanent settlements could occupy the same herding seasonal camps. Riverine bottomlands near marshes are preferred, either on the floodplain or on the first terrace. Subsistence economy in the Volga–Ural area does not show indications of agricultural diet, with agriculture having probably faded completely in this period. The main diet was cattle (50–60%), sheep, and goats for meat and dairy products (and occasionally pigs), apart from rare gathering and hunting traits, which frequently involve wolfs (Anthony 2016).

Figure 91. Reconstruction of house from Berezhnovka Srubna culture, between the Dnieper and the Volga, in the Ternopil history museum. Photo by Vodnik.

Srubna shows a multiscalar regional organisation represented by three circles of relationship, namely *obligation* (for copper mining), *cooperation* (for herding), and *affiliation* (for shared rituals). For example, a mining settlement would be supported by surrounding pastoral communities, and would contribute in turn ore to surrounding communities which had firewood for smelting (Anthony 2016). Long-ranging contacts are supported by the presence of Srubna settlers in the Low Amu-Dary'a (Chorasmia), where Srubna elements appear mixed with the Alakul material culture, representing the Tazabagyab culture, the southernmost extension of the culture (Koryakova and Epimakhov 2007).

The earliest date for horseback riding in warfare seems to have originated in this period, because of the rod-shaped artefacts (evolved from the tubular-bone-made cheekpieces used for chariots in Sintashta), suitable for rigid control of a ridden horse. The earliest specimens of that class, along with metal bits and weapons of a mounted warrior, date back to ca. 1200–1000 BC, which points to the Bronze Age as the emergence of this use (Chechushkov, Epimakhov, and Bersenev 2018). The first signs of bronze snaffle bit, improving control for horseback riding in more stressful and difficult activities (such as warfare), and developing horse dentistry among nomadic pastoralists ca 750 BC (Taylor, Bayarsaikhan, et al. 2018), point to continued innovations in the north-east Asian steppes after the expansion of Andronovo.

Their repeated violation of the canid-eating taboo across generations, at least in the Volga–Ural region, point to the connection of dog/wolf–as–warrior myth associated with violent death and war, identified with the symbol of the savage fury that the warrior desired in battle (Anthony and Brown 2017). This tradition was thus more likely associated with war–bands, but maybe also with the Indo-European myth of dogs guarding the entrance to the afterlife, and thus with the ancient dog–as–death symbolism.

The Sabatinovka culture (ca. 1500–1200 BC) appears as a western continuation of Srubna—overlapping with it—bounded by the steppe zone, from the Sea of Azov across the lower Dnieper until the lower Danube Valley. Ceramics show dishes, pots, and storage vessels with conical or slightly curved sides, simple bowls, and single and double-lugged vessels. The Noua culture (appearing ca. 1400–1300 BC) in the forest-steppes from the Dniester to Transylvania, appears at the same time as Sabatinovka, and with extensive similarities to it (see *§VIII.11. Balkan province*) supporting their common origin as part of the Srubna-like population expanding to the west (Parzinger 2013).

Beaded decoration on the neck and shoulders links the Sabatinovka culture to the Sargary–Alekseevka culture (part of Andronovo) east of the Urals, and other western Siberian groups ca. 1500–900 BC. The European custom of depositing bronze objects in hoards gained acceptance in the Pontic–Caspian steppe and forest-steppe regions reaching as far as the Urals, probably through the intermediary Noua culture in the west (Parzinger 2013).

Settlements in the north Pontic steppe and forest-steppe continued the previous MCW trend to grow, with houses becoming larger, multi-roomed complexes, and settlements divided in living and working quarters. Agriculture becomes part of the subsistence economy. Kurgans and flat cemeteries with the dead lying on the side (usually the left one) and head orientated to the east are the standard. Only exceptional rich warrior graves are seen (Parzinger 2013).

VIII.19.3. Simple-Relief-Band Ware

Around 1200 BC, new cultures emerge in the Pontic–Caspian region and beyond, showing largely continuity with the previous period, and an expansion of a common type pottery called Simple-Relief-Band Ware (SRBW), also *roller pottery* (*valikovaya keramika*), the steppes and into Central Asia (Suppl. Fig. 13). This period is coincident with Hallstatt A in central Europe and sub-Mycenaean materials in Greece. It is characterised by an increased aridity that may have caused a crisis of the subsistence economy, with a gradual extension of seasonal herding movements eventually leading to a decline in settled pastoralism, increased residential mobility (Parpola 2013).

SRBW cultures expanded the Srubna area westwards, northwards (to the Kamar River basin) and eastwards. In the east, the Alekseevka or Sargary culture (ca. 1500–900 BC) appeared in the steppe and forest steppe, with roller pottery remains occupying the whole Kazakhstan and Turkmenistan – previously occupied by the Andronovo culture (Parpola 2013).

In southern and central Asia, the Yaz I-related cultures (ca. 1450–1000 BC) replace the BMAC, but continue many of its traditions, among them fortifications, evidenced in Tillya Tepe. No burials are found in south-central Asia between ca. 1500–500 BC, which suggests that these cultures adopted the custom of exposing their dead to vultures and other carrion animals, a practice common in Zoroastrianism, whose first text—the Avesta, oldest Iranian composition known—is supposed to have been composed in this region at the end of the 2nd millennium BC (Parpola 2013).

The large-scale adoption of horse-riding warfare in central Asia and in the Iranian plateau, replacing chariotry, is probably associated with the rapid spread of the SRBW culture, and thus early Iranian languages. Terracotta figurines of horse rider in Pirak (ca. 1500 BC), in Pakistani Baluchistan, show anthropomorphic riders with bird's beaks, which has been related to pointed felt caps of mounted Saka warriors from frozen tombs of the Altai mountains (ca. 500–200 BC) featuring at the top the shape of a bird's head (Parpola 2013).

In the Pontic–Caspian steppes, this period is associated with a movement northward away from the steppe border, and the first evidence of agriculture (already ca. 1400–1200 BC) in the Don–Volga–Ural region as part of the subsistence economy. The volume of mining and metal production also declined (Kuzmina 2008).

The Belozerka culture (1200–900 BC) is a north Pontic culture with settlements scattered from the Don to the Danube. It shows partial continuity with Srubna-related traditions, but new ceramics are distinguishable, such as pot decoration with engraved, incised, and pricked diagonally hatched bands, or multi-line zigzag patterns. Also new are one- and two-looped curved brooches made of fine wire, while socketed axes, spearheads with semicircular blades, and grip-tongue daggers with lancet-shaped blades continue the Sabatinovka tradition (Parzinger 2013).

Settlements lay on high terraces above rivers and estuaries, with traditional *poluzemlyanki* houses coexisting with a new type, ground-level wattle-and-daub houses with stone cladding. Animal husbandry continues as the main subsistence economy, while agriculture is uncertain. Burial rite consist of flat inhumation cemeteries and kurgans, with side-crouched position predominant and scarce grave goods, also continuing the Sabatinovka culture (Parzinger 2013).

The Belogrudovka culture (ca. 1200–1000 BC) of the forest-steppe between the Dnieper and the Dniester shows inhumation and cremation in kurgans or flat cemeteries, with pottery continuing Noua and Sabatinovka traditions, while small and later finds show similarities with Belozerka in the steppe (Parzinger 2013).

Between the Dnieper and the Don, the forest-steppe and adjacent forest areas are occupied by the Bondarikha culture, with the eastern Prikazanskaya culture corresponding to the same tradition in the Volga–Kama region. It shows a distinct pottery with pricked- and comb–stamped traditions, but also clear connections with Belozerka and Belogrudovka wares in its round-bellied cylindrical-necked vessels and biconical pots with hatched triangles and angular multi-lined patterns (Parzinger 2013).

VIII.19.4. Scythians and Sarmatians

In the Early Iron Age, Simple-Relief-Band Ware cultures of the Eurasian steppes were succeeded by the early phases of likely Iranian-speaking mounted nomads (Suppl. Fig. 15).

The Proto-Scythian period in the north Pontic steppe features the appearance of horse-riding nomads associated with Cimmerian assemblages. These early groups are represented by the Chernogorovka tradition (ca. 1000–800 BC) and by Novochrekassk (ca. 800–700 BC), with differences based on grave construction, deposition of the body, and artefact form, with the later period showing Assyrian-influenced finds in warrior elite graves (Parzinger 2013).

To the north, in the Dnieper forest-steppes, Belogrudovka is replaced by the Chernoles culture, contemporaneous with Chernogorovka. It is in turn replaced by Zhabotin I (ca. 900–800 BC), contemporaneous with Novochrekassk, and contains pottery connecting it with the late Chernoles culture but also to the Cozia-Sakharna and Bessarabi I cultures of the lower

Danube. Zhabotin II forms a bridge to Bessarabi II, while Zhabotin III (beginning ca. 700 BC) represents a bridge into the early Scythian period, with the first Greek imported ceramics (Parzinger 2013).

On the Volga, the appearance of horse-borne nomads is identified as the Pre-Sauromatian tradition, characterised by weapons, horse harness, clothing, and pottery associated with the early Ananyino culture of the Middle Volga and traditions from the north Pontic area.

At the beginning of the Iron Age (ca. 850 BC) a rapid cooling and humidification of the steppes provided a fertile region that allowed for an increasingly mobile pastoral economy to expand into steppe regions that were too arid to exploit. The Early Scythian period in southern Siberia (ca. 800–700 BC) represents a new form of nomadic pastoralism based on cavalry-based warfare, armed with new recurve bows and mass-produced socketed arrowheads. Scythians expand rapidly from Tian Shan and the Altai Mountains to the Pontic–Caspian steppes and the Kuban region during the early 7th century BC (Koryakova and Epimakhov 2007).

This period is marked by broadly shared artistic styles (the "Animal Style"), and styles of horse trappings and weapons; by a return of the Pontic–Caspian steppes to mobile settlements in wagon camps; and is especially marked by lavish graves (Figure 92) of princes and kings (Parzinger 2013; Anthony 2016). Different groups (including Sarmatians and Saka) show cultural similarities but also differences in settlement, subsistence economy, political organisation, and mobility. For example, certain Scythian groups in the north Pontic forest-steppe apparently form some non-mobile, agriculturally-orientated urban societies concentrated in fortified settlements.

Scythians and Sarmatians are traditionally identified as eastern Iranian peoples, judging from personal and god names and words attested from Greek and Persian sources, as well as by toponyms in the steppes and archaeological remains that correlate with rituals specified in later Persian texts (Parpola 2018).

Figure 92.Scythian warriors drawn after figures on an electrum cup from the Kul'Oba kurgan burial (ca. 400–350 BC) near Kerch. The man on the leftwearing a diadem is likely to be the Scythian king. Hermitage Museum, St. Petersburg.

To the north, the Gorodets culture from the forest-steppe zone (north and west of the Volga) shows fortified settlements during the Iron Age. Incursions of Gorodets iron makers into the Samara valley are seen by deposits of their typical pottery and a bloom or iron in the region (Kuznetsov and Mochalov 2016). This attests to continued contact between forest and steppe in the Cis-Ural region.

viii.19. Iranians

The language spoken by peoples of the Pokrovka–Srubna culture of the Pontic–Caspian steppes, developed from Potapovka–Filatovka and late Abashevo groups, was most likely Iranian. The presence of some early Proto-Iranian loanwords in Finno-Ugric supports the continued presence of early Iranian tribes in contact with the north-eastern European forest zone, and the absence of clear Proto-Indo-Aryan borrowings suggests that this community was already separated, probably expanding with Andronovo into central Asia.

Sampled individuals of Srubna include one of the Pokrovka phase from Mikhailovsky, in Samara (ca. 1900–1750 BC), of hg. R1a1a1b2-Z93, clustering close to Srubna and Sintashta samples, showing the first lineage of *Yersinia pestis* that possessed all vital genetic characteristics required for flea-borne transmission of plague in rodents, humans and other mammals. It belongs to a different strain from that found in European samples associated with earlier steppe migrations (see *§vii.1. Western and Eastern Uralians*), suggesting a further development and origin of expansion of the disease in the Bronze Age Pontic–Caspian steppes (Spyrou et al. 2018).

Classical Srubna individuals from Samara (ca. 1900–1200 BC) show a continuation of the wide Potapovka cluster, with slightly more EEF ancestry than Potapovka (ca. 32%), consistent with increased Abashevo-related contribution. The ancestry of Srubna samples show an intermediate position between Sintashta and Yamna (Mathieson et al. 2015; Narasimhan et al. 2018; Krzewińska, Kılınç, et al. 2018; Järve et al. 2019), with a slight 'northern' shift relative to Sintashta-Andronovo, compatible with their increased WHG due to admixture with forest-steppe peoples, supported by the finding of an earlier north Pontic outlier close to Neolithic samples (see *§VI.2.2. Catacomb*).

Reported haplogroups are dominated by R1-M173, in particular R1a1a1b2-Z93 (seven samples), with one R1a1a1b2a2-Z2124, one R1a1a1b2a2a1-Z2123. Two outliers from the Samara region, one from Barinovka, of hg. R1a1a1b2-Z93, and one from Spiridonovka (ca. 1850 BC), show more ANE ancestry, clustering closer to Afontova Gora (Mathieson et al. 2015), in line with West Siberian-like outliers of Sintashta (see *§viii.18.1. Late Indo-Iranians*).

Most Srubna–Alakul samples from Kazburun and Muradym in the Trans-Volga forest-steppe (ca. 1900–1600 BC) show high genetic diversity, and an admixture similar to Srubna samples from Samara, clustering with them. All five Srubna–Alakul samples are reported of hg. R1a1-M459, two are probably of hg. R1a1a1b1a2-Z280^{+}, and four of hg. R1a1a1b2-Z93^{+}, including one R1a1a1b2a-Z94^{+}, one R1a1a1b2a2a1-Z2123^{+}, and one R1a1a1b2h-YP5585^{+}. This heterogeneity of lineages, including 'northern' R1a1a1b1a2-Z280, probably reflects closer contacts of this region with neighbouring Abashevo and Balanovo settlers, also consistent with the longer contacts of Iranian with Finno-Ugric.

There is a Srubna–Alakul outlier (ca. 1745–1620 BC) showing more Near Eastern ancestry, clustering between modern Mordovians and northern Caucasus, in a new Iranian Steppe cluster 'south' of Yamna, later shared also by some Cimmerians, most Sarmatians, and some Scythians (Krzewińska, Kılınç, et al. 2018). The admixture found in this late outlier may be thus related to the expansion of Srubna peoples into the Lower Danube, evidenced by the contribution of EEF ancestry and 'south-eastern' PCA position of samples from Merichleri (ca. 1690 BC), and from Szólád, Hungary (ca. 1900 BC), of subclade R1a1a1b2-Z93 (Mathieson et al. 2018) and R1a1a1b2a2a1-Z2123 (Amorim et al. 2018) respectively, both most likely related to vanguard Srubna settlers that developed the Noua–Sabatinovka culture (see *§viii.11. Thracians and Albanians*).

Whereas Srubna probably represented part of the earliest Proto-Iranian community, at the same time as other (probably early Western Iranian) groups migrated to the south into the Zeravshan valley (see *§viii.20. Dravidians and Indo-Aryans*), it is likely that early Eastern Iranian tribes like Scythians or Sarmatians emerged from regions near the southern Urals (Krzewińska, Kılınç, et al. 2018), given the contribution of WSHG ancestry (up to 25%) found. Similar ancestry is found to the east in different Andronovo sites, mainly east Alakul or Fëdorovo individuals from east Kazakhstan and the Altai: two outliers from Alakul Maitan (ca. 1880–1640 BC), two from Kairan (ca. 1750–1550 BC), and two from Oy-Dzhaylau, one early male (ca. 1675 BC) of hg. R1a1a1b2-Z93, and one female (ca. 1500 BC); and Zevakino in eastern Kazakhstan, continuing previous Fëdorovo stage with one MLBA male (ca. 1500 BC) of hg. R1a1a1b2-Z93, and six later LBA–Iron Age individuals (ca. 1200–900 BC), four of hg. R1a1a1b-Z645, including two R1a1a1b2-Z93, one of hg. R1b-M173, and one Q-M242.

Sampled Cimmerians from the north Pontic steppe show a correspondingly increased amount of Siberian component, sharing more drift with the far eastern Karasuk population compared to the geographically closer Srubna. Pre-Scythian nomads from the Pontic–Caspian steppes include one from Mokra (ca. 923 BC), one from Glinoe Sad (ca. 873 BC), of hg. Q1a1a1a-Y558, and one individual from the Mezőcsát culture (ca. 980–830 BC), of hg. N-M231

(Gamba et al. 2014). Three more recently reported samples include a Thraco-Cimmerian one clustering with south-east Europeans in the PCA, but with 55% of 'Asian' alleles; and two samples from Ukraine clustering between Srubna and Saka samples, of hg. R1a1a1b-Z645 and R1a1a1b2a2-Z2124 (Järve et al. 2019). The distinct ancestry and divergence of lineages may support the existence of a 'Karasuk-Cimmerian cultural-historical community' clearly distinct from East Iranian peoples (Krzewińska, Kılınç, et al. 2018).

There is thus more genetic diversity in Cimmerians compared to earlier and later groups of the steppe, with increasing Near Eastern admixture through time reflecting admixture with Srubna-like populations, and the most recent sample from Glinoe Sad (ca. 860 BC) showing the typical Iranian Steppe cluster and hg. R1a1a1b2-Z93. The heterogeneity of Cimmerians and their original genetic links to Karasuk and East Asians obscure their ethnolinguistic identification, although the relationship of this culture with the emergence of Ananyino in the Middle Volga may be related to certain Altai traits in Uralic languages, including the spread of some N-M231(xN1a1-Tat) lineages among Cis-Urals (Finno-Permic) and Trans-Urals (Ugric) populations, up to Hungary.

Early Scythians show a corresponding loose cluster between Okunevo and Karasuk samples (see *§viii.17. Ugrians and* Samoyeds), evidencing the admixture of Steppe MLBA with WSHG. Early Scythians include those from the Zevakino-Chilikta group (ca. 9th–7th c. BC), early Central Sakas (ca. 800–750 BC), one of hg. E-M96; later Central Sakas, of the Tasmola culture (ca. 760–680 BC), two of hg. R1a1a1b2a2-Z2124; and individuals from Andy Bel (ca. 7th–6th c. BC). There is a clear separation in admixture between eastern and western Scythians, and among Inner Asian groups, with Central Sakas showing the highest WSHG admixture (ca. 50%), supporting the confederal nature of the Scythian organisation (de Barros Damgaard, Marchi, et al. 2018).

Forty-four later samples from Pazyryk in eastern Kazakhstan (ca. 4th–3rd c. BC), one of hg. R1a1a1b2a2-Z2124^{+}, and ten Sakas from the Tian Shan region (ca. 450–80 BC), including two R-M207, three R1-M173, and one R1a1-M459, show contributions from CHG/IN-related ancestry (ca. 5%), apart from Steppe MLBA (ca. 70%) and WSHG (ca. 25%), with a corresponding ‘southern’ shift in the PCA (Unterländer et al. 2017). This is compatible with the migration of peoples from Turan into the Kazakh steppes and forest-steppe region in the mid–2nd millennium BC (see *§viii.20. Dravidians and Indo-Aryans*), since this ancestry is also found in the Mezhovska culture from the Trans-Urals forest region (ca. 1500 BC, see *§viii.17. Ugrians and Samoyeds*), and later among Scythians from the southern Trans-Urals and north Pontic area, in a “Southern Steppe MLBA cluster” (de Barros Damgaard, Marchi, et al. 2018).

Other two Pazyryk samples from a “frozen grave” in Ak-Alakha-1, both presumably of a high social status, show hg. N (Pilipenko, Trapezov, and Polosmak 2015), with haplotypes shared with modern Yakutian populations (Tikhonov et al. 2019), which may indicate the infiltration of this haplogroup (possibly N1a1a1a1a-L392) among Scythian populations close to Lake Baikal. Similarly, sampled Scytho-Siberians of Aldy-Bel and Sagly show typically East Asian mtDNA compared to western Scythians, and more diverse mitochondrial haplotypes close to southern Siberia. In terms of Y-DNA, they show nine R1a-M420, at least two of them R1a1a1b2a-Z93, probably five Q1b1a3-L330, and one N-M231. This diversity has been interpreted as proof of the multicultural nature of eastern Scythian groups, with those close to the Altai potentially representing Altaic speakers (Tikhonov et al. 2019).

Sampled *Scythians* from Kazakhstan are more spread out and drawn towards East Asian populations, although still positioned ‘west’ of the Central Saka—despite originating from neighbouring burial mounds of the same Tasmola culture—and most of the Eastern Scythians, itself a very heterogeneous group both culturally and genetically (Järve et al. 2019). The shift to east Asian ancestry compared to Srubna is accompanied by mtDNA lineages, which show equal proportion of east and west Eurasian origin in eastern Scythians, but increasing eastern origin in western Scythians, from zero in early samples to 18-26% in later periods (Unterländer et al. 2017).

Sampled Scythians from Nadezhdinka, in the Samara region (ca. 375–203 BC), of hg. R1a1a1b2a2a1-Z2123 (Mathieson et al. 2015), as well as three sampled Scythians from the north Pontic region near the Dnieper (ca. 790–115 BC), one of hg. R1a1a1b2a2a1-Z2123^{+}, form part of the Iranian Steppe cluster, although one shows a high genetic drift with previous Srubna samples. This Western Iranian Steppe cluster is also shared by the previous Mezőcsát sample from Hungary, and have East Asian ancestry shared with Cimmerians and Sarmatians.

North Pontic Scythians close to the described Southern Steppe MLBA cluster, showing more Near Eastern ancestry, includes one South-Eastern Steppe cluster, in common with south-eastern Europeans, one of hg. R1b1a1b1b3-Z2106^{+}, one E1b1b1a1b1-L618^{+}; and an intermediate cluster between Iranian Steppe and south-eastern Europeans, with one hg. R1b1a1b1a2c-Z2103^{+} and one I2a1b1a2a1b-Y7219^{+}. A northern European cluster among Scythians, including one sample of hg. R1b1a1b1a1a2-P312^{+}, suggests close contacts of the north-west Pontic area with Celtic populations from Hallstatt. Similar clusters can be seen in Scythian samples from Ukraine, which show four hg. R1a1a1-M417 (one of them R1a1a1b-Z645, another R1a1a1b2a-Z93), one hg. J2a1a1a2b1b-M319, and one Q1b1a3-L330 (Järve et al. 2019).

This high intragroup diversity compared to Bronze Age groups is also found in sampled Hungarian Scythians (ca. 756-370 BC), one of hg. R1-M173, who falls between Iranian Steppe, South-Eastern Steppe, and northern European clusters (de Barros Damgaard, Marchi, et al. 2018), while recently sampled Scythians from south-central Ukraine form part of three similarly described clusters (Järve et al. 2018). This temporal and geographical transect of Scythians offers a picture of variable admixture in the north Pontic area, proper of migrating nomadic settlers interacting with local populations, and of cultural dominance rather than population replacement (see *§viii.21.2. Turkic peoples and Mongols* for more on central Asian nomads).

Sampled Sarmatians from the southern Urals show a cluster similar to the described Iranian Steppe one, showing genetic continuity over centuries despite the supposed cultural shift and suspected earlier population replacement between early and middle/late Sarmatians (Krzewińska, Kılınç, et al. 2018). Assessed individuals include Early Sarmatians from Pokrovka in the southern Urals (ca. 500–100 BC), one of hg. R1b1a1b1b-Z2103 (Veeramah et al. 2018); Sarmatians from the central Asian steppe (ca. 50–15 BC), one of hg. I2b-L415, from the Caspian steppe (ca. 85 BC – AD 15), three of hg. R1-M173, one of hg. R1a1a1b2a2a-Z2125 (de Barros Damgaard, Marchi, et al. 2018); and late Sarmatians from the south-east and south-west Urals (ca. AD 55–320), three of hg. R1a1a1b2a2-Z2124^{+}, one R1a1a1b2a2a1-Z2123^{+} and the other R1a1a1b2a2b-Z2122^{+} (Krzewińska, Kılınç, et al. 2018). Other reported Scythian-Sarmatian samples from the southern Urals show a very compact cluster (except for one outlier drawn to East Asia), poisitioned between Scythians from Ukraine and Tagar samples; three of them are of hg. R1a1a1b-Z645, and one hg. E2b1-M90, and they cluster close to a Sarmatian sample from the North Caucasus, of hg. Q1b1a3-L330 (Järve et al. 2019).

The Wusun and Kangju are probably also East Iranian groups that became isolated after the expansion of Xiongnu-related nomads, and re-emerged into the central steppe from south-east of the Tian Shan mountains, evidenced by their Iran Neolithic-related ancestry and the lack of East Asian admixture compared to Iron Age Sakas. This interpretation of resurging East Iranian population is also supported by their position in the PCA, between Sarmatians and Sakas (de Barros Damgaard, Marchi, et al. 2018).

Ancient Alans (AD 4th–14th c.) and individuals of Saltovo-Mayatsk culture (AD 8–10th c.) from the northern Caucasus and Middle Don basin cluster with Near Eastern / Caucasus individuals. Saltovo-Mayatsk shows six samples of hg. G2-P287, one J2a-M410, and two R1-M173, one among them R1a1a1b2a2-Z2124. Among six samples from the northern Caucasus one shows hg. R1a1a1b2a2a3-S23592^{+} (de Barros Damgaard, Marchi, et al. 2018); and among two other samples also from North Ossetia (AD 300-400), there is one of hg. R1a1a1b2a2-Z2124, and one G2a-P15 (Afanas'ev et al. 2014).

VIII.20. Turan and South Asia

The Namazga culture of farming towns (Namazga, Anau, Altyn-Depe, Geoksur) was situated on alluvial fans where rivers that flowed off the Iranian plateau emerged in central Asia. Turquoise deposits were found in middle Zeravshan, near the farming colony of Sarazm (founded before ca. 3500 BC).

Late Kelteminar (ca. 3000–2000 BC) pottery was found there, and it had turquoise workshops in the desert near Lower Zeravshan, as well as metal deposits of copper, lead, silver, and tin. Turquoise was traded—along with sources in north-eastern Iran—into Mesopotamia, the Indus Valley, and even Maikop. Arsenical bronze is found, but objects show mostly pure copper, while tin-copper appear only rarely if at all.

The Bactria and Margiana Archaeological Complex (BMAC), also called Oxus Civilisation (ca. 2200–1450 BC), was a hierarchical society based on intensive agriculture and specialised craft production of metal and precious stone objects for prestige display and long-distance exchange. Their economy based on water management was likely favoured by the aridification event ca. 4.2 ka BP that also affected Europe (Luneau 2019). Immigrants probably came from the northern Iranian plateau to colonise the Murghab River delta, with their early pottery showing similarities with Namazga V-types. They built large towns surrounded by thick yellow-brick walls, with narrow gates and high corner towers. In the centre of walled palaces or citadels, temples were also built (Anthony 2007).

The early BMAC colonisation phase was followed by a much richer period ca. 2000–1800 BC, with new walled towns spreading to the upper Amu Darya valley. Trade and crafts flourished in the crowded streets of fortified towns, with metalsmiths making beautiful objects of bronze, lead, silver, and gold, such as metal figures, crested bronze shaft–hole axes with down-curved blades, tanged daggers, mirrors, pins, and distinctive metal compartmented seals (Anthony 2007).

A mixed agropastoral economy including cattle and goat emerges in Turan at least ca. 2200 BC, transitioning from the previously prevalent sheep–goat herding economy (Taylor, Shnaider, et al. 2018). Evidence of the appearance of horses in funeral rites and imagery—but never for meat consumption—is seen from ca. 2100–2000 BC, with scattered samples of Sintashta- and Abashevo-type pottery in the Zeravshan Valley. Until that moment, the typical BMAC equids were onagers, as in most of the Near East, and wagons—found in funeral remains—were pulled by cattle (Anthony 2007). The colonisation of the Ili delta in southern Kazakhstan had begun before 2000 BC by groups of hunter-fishermen and early shepherds, possibly semi-settled in niches of the upper course, while the bulk of the Bronze Age findings belongs to a second phase after 2000 BC, with groups already acquainted with seasonal transhumances between summer camps in mountain meadows, autumn and spring transitions across piedmonts, and winter camps in the green alluvial plains of the lower part of the delta system (Deom, Sala, and Laudisoit 2019).

The BMAC culture expanded to the Gorgan area of northern Iran, where a horse-drawn chariot is depicted on a cylinder seal from Tepe Hissar III B. Tin–bronze appear especially in Bactria, closer to Zeravshan, after ca. 2000 BC, suggesting an establishment or expansion of tin mines of Zeravshan during this time. With the emergence of tin trade between BMAC and Assyrians from Cappadocia, in the 20th century BC, the horse-drawn chariot appeared in the Near East. This expansion from south-central Asia through northern Iran into the Near East has been associated with the arrival of Mitanni Aryans into Syria (Parpola 2013).

Contacts with steppe pastoralists becomes evident ca. 1900–1800 BC, with materials of early Andronovo (Alakul) types among tin miners. Also, an elite grave on the Zeravshan Valley in Tajikistan (Figure 93) shows a horse-drawn chariot with Sintashta–Arkaim-type bits and bone cheek-pieces, as well as a bronze sceptre topped with the image of a horse, but typically BMAC ceramics (Bochkarev 2010). It is likely that Petrovka had a metalworking colony at

Tugai already ca. 1900 BC, with steppe tribes eventually taking control of the ore sources of Zeravshan (Anthony 2007).

Between 2000–1800 BC, BMAC styles and objects (small jars made of carved steatite) appear in sites and cemeteries across the Iranian plateau, with many elements on the border between the Harappan and Elamite Civilisations suggesting a movement of BMAC peoples into Baluchistan. Chariots were simultaneously introduced in BMAC, Iran and the Near East ca. 2000–1900 BC (Anthony 2007).

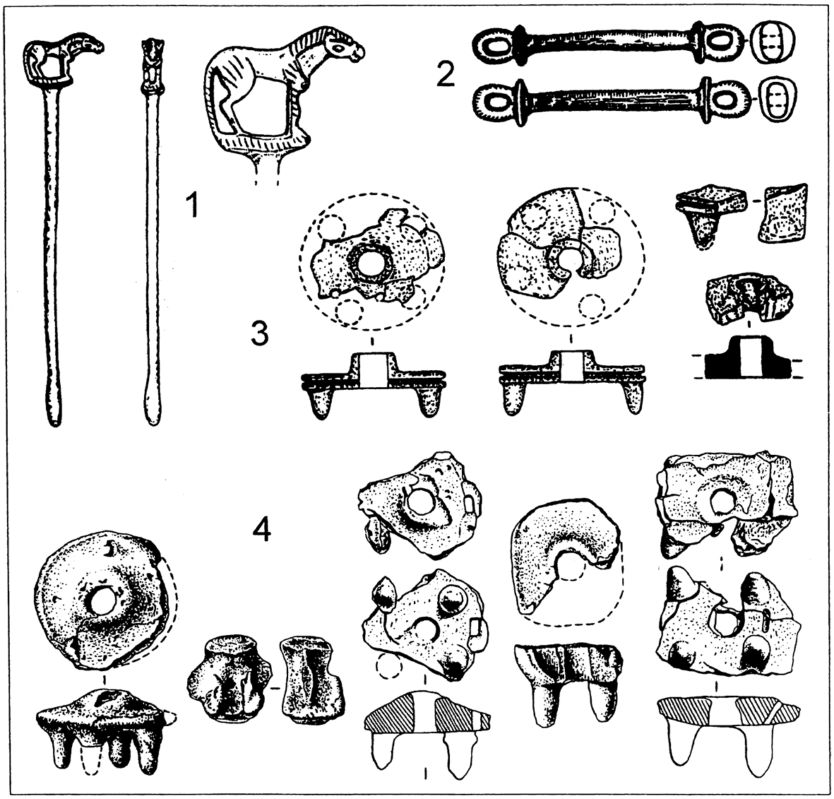

Figure 93. Materials from an aristocratic burial at Zardcha Khalifa in the Zeravshan Valley. (1) Horse-head sceptre pin of bronze of the same type as those found in Sintashta (4) [not to scale]. (2) two horse bits of bronze. (3) fragments of cheek-pieces of bone. Modified from Parpola and Carpelan (2005), where images from Bobomulloev 1997 and Gening et al. 1992 are used.

By 1800 BC, political centralisation fades, suggesting loosening of state-level structures. The late BMAC period (ca. 1800–1600 BC) shows a shift from a tiered system of urban centres, villages and hamlets to a more dispersed pattern of smaller-scale agricultural settlements. Walled towns decrease sharply in size, with each settlement developing its own pottery, and Andronovo–Tazabagyab coarse-incised pottery appearing widely in the BMAC countryside (Anthony 2007).

The first evidence of campsites with a distinct ceramic tradition supports an influx of mobile pastoralists from the central Eurasian steppes and foothills—and thus farmer-pastoralist interactions—appearing rather early, at the end of the 2nd millennium BC, but increasing sharply during this period (Rouse and Cerasetti 2018).

The increasing number of small campsites suggests stronger interactions with the new agricultural settlements. Mixed pottery found in kurgan cemeteries of the highlands above Bactrian oases in modern Tajikistan (Vaksh and Bishkent). This is a period of combined control of mineral trade (copper, tin, turquoise) and pastoral economy (horses, dairy, leather) in the region, with an eventual social, political and military integration (Anthony 2007). Their common evolution for hundreds of years, with interactions in subsistence economy, technology, and ideology, attests nevertheless also to the lack of assimilation, and thus a conscious attempt to maintain distinct farmer and pastoralist identities (Rouse and Cerasetti 2018).

By 1600 BC, a change is seen in access to water—essential for life in the region—in the transition from the Late Bronze Age to the Iron Age (Yaz I), evidence of a political–economic system that was shifting toward territorial management. This period is characterised by a combination of sand encroachment from the north, shifts in known watercourses, and a possible decrease in flows, as well as the invasion of people represented by 'steppe' pottery, with declines and abandonment of major population centres (Rouse and Cerasetti 2016).

Many settlements of the old BMAC region, as well as trading settlements and outposts in eastern Iran, are abandoned. Sites remaining in the agricultural heartland of the southern Mughab region are campsites with non-Oxus pastoral economy, although some evidence exists as to the persistence of some agricultural activities (Rouse and Cerasetti 2018).

Pastoral economies spread across Iran and into Baluchistan, and are followed by the Gurgan Buff Ware (ca. 1100–1000 BC), which appears in south-central Asia, probably an expansion of the Yaz-I related cultures. This is followed by the Late West Iranian Buff Ware, which appeared ca. 950 BC in the regions where Median and Old Persian were first attested (Parpola 2013).

BMAC-related settlements expand to the borderlands of south Asia, including the Gandhara Grave culture (ca. 1600–900 BC) around the Swat Valley, the first local culture to have domesticated horses. The horse and chariot are essential in Rigvedic hymns, which were potentially composed ca. 1200–1000 BC in the northern Indus Valley (Parpola 2013).

viii.20. Dravidians and Indo-Aryans

Thirteen individuals of the Chalcolithic–to–Bronze Age urban settlement from Tepe Hissar in eastern Iran (ca. 3700–2000 BC) show homogeneous Iran Neolithic-like ancestry without significant genetic drift over the whole period, suggesting little impact of migrations and a substantial population size. In spite of this, varied haplogroups have been reported, including J2a-M410, T1a-M70, L2-L595, all with connections to the Fertile Crescent area (Narasimhan et al. 2018).

Two samples from Sarazm (ca. 3600–3500 BC), and twelve samples of the East Anau group of tribes from the Geoksiur Oasis (ca. 3500–3000 BC), three of hg. J-M304, one of hg. I2-M438, and one of hg. Q-M242, also belong to this Iranian Neolithic-like cluster, and evidence the likely dispersal of tribes from south-eastern Iran. Samples from the Sumbar Valley also show a similar ancestry, from the Eneolithic to the LBA Sumbar culture, in samples from Tepe Anau (ca. 4000–3000 BC), two of hg. R2-M479; from Parkhai (ca. 3500–1000 BC), one of hg. G-M201; and one from Sumbar (ca. 1300 BC), of hg. R2a-M124. A Bronze Age Turan sample from Darra-i-kur (ca. 2700 BC), probably of hg. R1b1a1a-M73, and two from Shahr-i-Sokhta, Iran (ca. 2800–2500 BC), of hg. J2a1-L26, also show similar ancestry (Narasimhan et al. 2018).

A cline of Anatolian agriculturalist-related admixture ranging from ca. 70% in Chalcolithic Anatolia, to ca. 33% in eastern Iran, to ca. 3% in far eastern Turan was probably established early, consistent with the spread of wheat and barley agriculture from west to east (ca. 7th–6th millennia BC), which suggests that Anatolian agriculturalists may have contributed to spreading farming economies into central Asia as they contributed to Early European farmers (Narasimhan et al. 2018).

Two outliers from Shahr-i-Sokhta, one early (ca. 3100 BC) the other late (ca. 2500 BC), both of hg. J-M304, show a distinctive ancestry found also in a BMAC outlier from Gonur (ca. 2300 BC), with AASI-related ancestry (ca. 14-

42%) and the rest related to Iran Neolithic and West Siberian Neolithic, without Anatolian Neolithic ancestry. Based on later samples from the Swat region, these early outliers, so-called Indus Periphery samples, are the best proxies for the population of the Indus Valley Civilisation, with an ancestry formed from Iranian Neolithic migrants—likely originating from an eastern region, given the lack of Anatolia Neolithic-related ancestry—and a population migrating from South Asia (Narasimhan et al. 2018).

The admixture of both groups is estimated ca. 4700–3000 BC (Narasimhan et al. 2018), which is consistent with the migration of populations from eastern Iran into territories occupied by AASI-like people causing the emergence of the Harappan Civilisation. The language spoken in the Indus Valley was probably Proto-Dravidian, based on the later finding of this ancestry to the south, and on the dispersal of the culture (ca. 2000 BC) coinciding with linguistic guesstimates of the proto-language. It is unclear if this language was brought by migrants from Iran, or if it was adopted by them from the local AASI-like populations, especially without a proper sampling and reported haplogroups directly from the culture, although the former seems a priori more likely, based on the different languages associated with AASI in south Asia.

Sixty-eight individuals belonging to the BMAC culture show a genetic cluster similar to preceding groups in Turan, showing Iran Neolithic ancestry (ca. 60%) with lesser contributions of Anatolian Neolithic (ca. 21%) and WSHG ancestry (ca. 13%), suggesting that the culture emerged from preceding pre-urban populations in Turan, in turn likely from earlier eastward migrations from Iran. A close cluster with little Steppe ancestry is found in thirty-four samples from Gonur Depe (ca. 2300–1600 BC), including three of hg. J-M304, two E1b1-P2, one I2-M438, and one R-M207; seven samples from Dzharkutan (one ca. 2100–1800 BC, six ca. 1750–1450 BC), one of hg. R1b-M343; thirteen samples from the MBA Sapalli Tepe (ca. 2000–1600 BC), two of hg. J-M304, two of hg. R2-M479, one of hg. G-M201, and one of hg. L-M20; and six samples from the Bustan catacomb-type burials of a culture similar to

Dzharkutan, but with a complex funerary ritual related to the usage of fire, including one early individual (ca. 1900–1700 BC), of hg. L-M20, and five post-BMAC MBA samples (ca. 1600–1300 BC), three of hg. J-M304, one G-M201 (Narasimhan et al. 2018).

Two early BMAC outliers (ca. 2500–2000 BC), one of hg. J-M304, show significant amounts of WSHG ancestry, including one female from a pit, and one female from a large rectangular pit in the 'Royal Cemetery'. This ancestry comes probably from indigenous populations of the Kelteminar culture, native hunter-gatherers of the region before the emergence of BMAC, and represent thus the most likely donors of the WSHG ancestry present in BMAC (Narasimhan et al. 2018).

Substantial Steppe ancestry is found in two outliers from Gonur, a male from a shaft tomb (ca. 2150 BC), of hg. P-M45 (hence potentially R-M207), and a female from a pit (ca. 2050 BC); in two early outliers from Dzharkutan (ca. 2100–1800 BC), both females; and in one individual from Sapalli (ca. 2000–1600 BC), of hg. Q-M242. This clearly documents a southward movement of steppe migrants through the region (Suppl. Graph. 13), with an admixture starting probably at the turn of the $2^{nd}/1^{st}$ millennium BC (Narasimhan et al. 2018).

At the same time as steppe migrants were moving further south, three sites to the north of BMAC showed evidence of significant admixture with Iranian Neolithic-related populations (ca. 1600–1500 BC), suggesting mobility of disintegrating BMAC peoples north and south through the Inner Asian Corridor. Samples include three steppe individuals from Dashti-Kozy, near Sarazm (ca. 1700–1400 BC); one late sample from Kyzlbulak, southern Kazakhstan (ca. 1570 BC), of hg. Q-M242, contrasting with an earlier female (ca. 1680 BC), of Steppe ancestry; and one ancient metallurgist of Taldysay, in central Kazakhstan (ca. 1500 BC), of hg. J-M304, contrasting with another later male from the same site (ca. 1300 BC), of hg. R1a-M420 and Steppe ancestry (Narasimhan et al. 2018). Especially interesting is the temporal transect depicted by Taldysay and Kyzlbulak, suggesting the start and the end to the incursion of Turan-related peoples into the southern steppes.

Early samples from the Swat Valley in northern Pakistan (ca. 1200–800 BC) are genetically very similar to Indus Periphery individuals, but harbouring Steppe MLBA ancestry (ca. 22%), which supports the integration of steppe peoples in south Asian groups likely coincident with the appearance of this ancestry in early BMAC samples. Later samples from the Swat Valley of the 1st millennium BC had higher proportions of Steppe MLBA and AASI ancestry, more similar to that found in the modern Indian cline, supporting the intrusion of more Steppe ancestry in the region and additional admixture with Ancestral South Indians (see below).

Swat proto-historic graves (SPGT) from the Gandhara Grave culture include twenty-one individuals from Udegram (ca. 1200–800 BC), nine likely of hg. E1b1-P2, two from Gogdara (ca. 1300–900 BC), one of hg. H1a-M69, apart from individuals from sites with similar grave architecture, burial features, and grave furnishing (ca. 1000–800 BC): four from Katelai, one of hg. J-M304, another R2-M479; one from Arkoktila; and four from the southern site of Barikot, one of hg. H-L901. Other samples include nine individuals from Loebanr, one early (ca. 1300–1000 BC), of hg. L-M20, eight late (ca. 1000–800 BC), two of hg. L-M20, one R1b-M343, one R2-M479, one Q-M242, one C-M130; one from Aligrama (ca. 1000–500 BC). Samples from Aligrama also include non-SPGT samples (ca. 970–550 BC), one of hg. G2a-P15, one R2a-M124.

Early historic graves of the Swat Valley include twelve individuals from the Buddhist site of Saidu Sharif I (ca. 500–300 BC), one R1a1a1b-Z645, one Q-M242, one L-M20, with one outlier showing mainly Iran Neolithic and AASI ancestry; and five later samples from Butkara (ca. 200 BC – AD 100), including two of hg. J1-L255. While the arrival of R1a1a1b2-Z93 lineages and subsequent Y-chromosome bottleneck in India remains unexplored, the Turan region hosted communities with a majority of hg. R1a1a1b2-Z93 already since the Late Bronze Age, as evidenced by two samples of the late Kayrakkum culture (Ferghana variant of Andronovo) from Kashkarchi (ca. 1200–1000 BC), both of hg. R1a1a1b-Z645 with fully Western Steppe MLBA ancestry.

The modern Indian Cline can be modelled as a mixture of two populations, Ancestral North Indian (ANI) and Ancestral South Indian (ASI), none of them existing today in unmixed form, and both contributing a variable amount of the ancestry of South Asians (Reich et al. 2009). ANI can be modelled as a mix of ancestry related to both Iranian farmers and people from the Bronze Age Eurasian steppe, close to Middle Easterners, Central Asians, and Europeans (Lazaridis et al. 2016). The maximum Indus Periphery ancestry found in ANI is ca. 72%, with a population from northern Pakistan, the Kalash, close to the minimum, and Steppe MLBA ancestry (ca. 50%) close to modern eastern Europeans.

ASI can be modelled as a mixture of Iranian farmers and AASI, harbouring a minimum of 39% Indus Periphery ancestry, with the closest groups to maximum Indus Periphery contribution found in four Dravidian tribal groups from southern India: Palliyar, Ulladan, Malayan and Adiyan (Narasimhan et al. 2018). Among ethnolinguistic and social groups, there seems to be an influence of north Eurasian admixture (potentially from ancient Indo-European-speaking populations) in forward castes, diminishing in backward castes and Dravidian-speaking peoples (Bose et al. 2017).

Using admixture linkage disequilibrium, the Palliyar and the Kalash show that their admixture was largely unformed at the beginning of the 2^{nd} millennium BC, and imply that ASI—and thus the expansion of Dravidian languages—may have formed either with the spread of West Asian domesticates into peninsular India (starting ca. 3000 BC), or alternatively in association with the spread of material culture from the Indus Valley after the Harappan Civilisation declined.

This spread to the south-east is also supported by the finding of a higher ratio of AASI–to–Iranian farmer-related ancestry in Austroasiatic-speaking groups in India (like the Juang) than the ASI (Narasimhan et al. 2018), with an early admixture of AASI with a south-east Asian substrate—and prevalent O2a-M95 lineages—suggesting an arrival in the 3rd millennium BC (Tätte et al. 2018), coinciding with hill cultivation systems (Silva et al. 2018).

The modern distribution of R1a1a1b2-Z93 lineages shows a clear division between western and eastern subclades, with basal R1a1a1b2-Z93 located east of the Andronovo horizon (Underhill et al. 2015). Whereas the western R1a1a1b2a1a-L657 subclade has an expected peak in the northern part of the Indian subcontinent, broadly coincident with the spread of Proto-Indo-Aryan and Indo-Aryan languages, the eastern R1a1a1b2a2-Z2124 subclade peaks at the core of the Proto-Iranian Yaz culture and East Iranian expansion (of languages related to old Bactrians, Sogdians, and Scytho-Sarmatian peoples). The spread of Iranian to the west into the Iranian Plateau, however, was probably complicated by this region's higher demographic density, as is the case with the genetic make-up of the Balkans.

A quite late expansion of Indo-Aryans from a southern Turan region, suggested by the available ancient DNA samples, is also consistent with the greater linguistic diversity in the Hindu Kush–Himalayan area, including: Burushaski, a language isolate, with a majority of R1a1a1b2-Z93 and R2a-M124 subclades among the modern Burusho people (Thangaraj et al. 2010); the controversial *centum* nature of the Bangani language or its substrate; the presence of a third Indo-Iranian branch, Nuristani, in the southern Hindukush mountains; and the likely expansion of West Iranian languages from the Yaz core area, to the west of the Hindu Kush. This region seems also potentially at the origin of the distinction between expansions of R1a1a1b2a2-Z2124 to the north and R1a1a1b2a1a-L657 to the south-west (Underhill et al. 2015).

The simplified linguistic situation to the south-west, dominated by Indo-Aryan languages, is consistent with the Y-chromosome bottleneck of R1a1a1b2a1a-L657 lineages representing recently expanding Indo-Aryan speakers. Nevertheless, modern populations from the Indus Valley show a high proportion (ca. 41–76%) of South Asian lineages like C1b1a1-M356, H1a-M69, R2a-M124, J-M172, L-M11, or Q-M242 (Pathak et al. 2018; Ullah et al. 2017), which supports the mixture of haplogroups in the expanding early Indo-Aryan community, or their expansion from a south-eastern source. Supporting this interpretation is the distribution of Y-chromosome haplogroups among modern Yaghnobis of the Upper Zeravshan Valley, who show J2-M172 (30%), R1a1a-M198 (30%), R1b1a1b-M269 (23%), and K-M9 (12%), apart from other minor lineages (Cilli et al. 2019). The multiple ANI-related admixture events are probably coincident with population movements associated with the complex caste organisation based on the Indo-European-like varna and indigenous jati systems of social stratification.

Whereas the prevalent presence of R1a1a1b2-Z93, especially R1a1a1b2a2-Z2124, among modern populations of Xinjiang—who also show typical central Asian lineages—may support the early expansion of Indo-Iranian or Iranian peoples from the east, the finding of R1a1a1b2a1a L657.1 (ca. 8%) in the western site of Dolan (Liu et al. 2018) may be related to a recent expansion of the Indo-Aryan Gāndhārī to the region.

VIII.21. Siberia

VIII.21.1. West Siberia

The Middle Bronze Age Pre-Andronovo cultural horizon of the beginning of the 2nd millennium BC in south-western Siberia was constituted by all of the forest-steppe and southern forests from the Trans-Urals to the Yenisei River, which were occupied by several cultures and groups: Tashkovo (Middle Tobol), Loginovo (Middle Ishim), Odino, Krotovo, and Elunino (the Middle Irtysh, Upper Ob', and Altai areas), as well as the Samus' culture (Tom–Chulym rivers) (Koryakova and Epimakhov 2007).

They display clear evidence of the diversified economy contributed by the productive and non-productive branches. Their similar pottery morphology and decoration shows alternating holed and combed motifs that cover the entire pot's surface and reach back to an earlier epoch when they were dominant. These cultures remained rather distinctive and were only slightly touched by steppe influence (Koryakova and Epimakhov 2007).

The Tashkovo and Krotovo are more significant, contributing to later cultural formations in western Siberia, with the latter continuing into the Late Bronze Age. The Tashkovo culture is represented by villages with a circular or semi-circular layout, of ten to twelve houses on the banks of small rivers or lakes, whereas Krotovo shows open dispersed settlements with one- or two-chamber houses of the semisubterranean type and flat burial grounds (Koryakova and Epimakhov 2007).

The eastern Krotovo–Elunino territory (Middle Irtysh and Upper Ob') shows flat burial grounds situated on elevated riverbanks or terraces, with sprinkled ochre, burials of separated skulls or skeletons without skulls, collective multi-layered burials, and secondary fractured burials. Some graves show rich metal objects, among which are some of Seima–Turbino type (Koryakova and Epimakhov 2007).

The arrival of Andronovo-like cultural horizon in the forest-steppe and southern forest regions replaced these cultures or displaced them to the north and east into the taiga.

viii.21.1. Yukaghirs

Based on proposed Indo-Uralic community (Kortlandt 2002; Kloekhorst 2008; Hyllested 2009), a macro-family formed by Indo-European, Uralic, and Yukaghir is quite likely to have migrated back from the Trans-Urals region with hunter-gatherer pottery (see *§ii.3. Indo-Uralians*). Remnant populations from this migration probably include two Sintashta outliers of Khvalynsk Eneolithic-like ancestry (ca. 2000–1650 BC), one R1b1a1-P297, the other R1b1a1a-M73 (Narasimhan et al. 2018), both lineages probably related to westward migrations through the Urals. Similarly, there is a possible sample of hg. R1b1a1-P297 in Darra-e Kūr, Afghanistan (ca. 2700 BC), with fully Iran Neolithic-like ancestry. The presence of hg. R1b1a1a-M73 lineages among diverse central Asian populations, in particular among Turkic-speaking groups (see below), also suggest potential remnant groups of hg. R1b1a1-P297 in West Siberia during the Neolithic.

Nevertheless, the continuous population expansions and replacements in Siberia have obscured the potential migration routes for Yukaghirs, whose language has been recorded only recently. Ancient DNA sampled from historical central Siberian peoples show certain discordances with a simplistic model of a macro-Yeniseian community in the taiga zone and southern Siberia up to the Altai–Sayan zone (Kim et al. 2018), and this complexity is in turn compatible with ancient Eurasian and Indo-Uralic population movements through Siberia . Modern Yukaghirs show among ten sampled individuals—in a similar distribution to Tungusic Evenks and Evens—four hg. C2-M217, three N1a-L279, two R1a-M420, as well as (not present in Tungusic peoples) one I2a-L460 and one O-M175 (Fedorova et al. 2013).

Four samples of the Bronze Age Glazkovo culture, from the Lake Baikal (ca. 18th–13th c. BC), one of hg R1-M173, show ancestry compatible with modern north-east Siberian populations, compatible with their later described spread to the north (de Barros Damgaard, Marchi, et al. 2018).

A medieval individual near the Yana river (ca. AD 1350) shows hg. N1a1a1a1a4a1-M1993 (formed ca. 1700 BC, TMRCA ca. AD 450), and falls within the widespread Neosiberian cline evidenced by a recent sample from Ust'Belaya (ca. AD 1300) near Lake Baikal (Sikora et al. 2018). The prevalent presence of N1a1a1a1a4-M2019 (formed ca. 4400 BC, TMRCA 1700 BC) in central Siberia and Yakutia, and at lower frequencies in Khants and Mansis (Ilumae et al. 2016), is most likely the result of the expansion of Yukaghir-and Altaic-related languages with acculturated Palaeosiberian clans.

The complex evolution of north-east Asia can be seen in the replacement of lineages from Ekven Iron Age samples (ca. 400 BC – AD 400), predominantly of hg. Q-M242, at least one within the Q1b1a1a-M3 tree (formed ca. 13200 BC, TMRCA ca. 11400 BC), prevalent in the Americas, and two samples of hg. C2a-L1373, at least one within the C2a1a1a2-F3918 tree (formed ca. 12400 BC, TMRCA ca. 10800 BC), prevalent today in Eurasian populations likely related to Altaic expansions (Sikora et al. 2018).

The expansion of Yukaghir was probably then coincident with Bronze Age migrations, likely continued to the east with N1a1a1a1a4a-M1993 during the Iron Age–Early Middle Ages, as Ugrians and Samoyeds expanded to the north (see *§viii.17. Ugrians and Samoyeds*). This later expansion probably displaced populations of mainly N1a1a1a1a3b-B202 lineages (formed ca. 2800, TMRCA ca. 600 BC) to the extreme north-eastern Siberia, where they retained their Chukotko-Kamchatkan languages, supported by their prevalent N1a1a1a-L708 lineages (ca. 92%).

Turkic-speaking Evenks cluster together and overlap with Yukaghirs, and both in turn cluster closely to Nganasans from the Taymyr Peninsula and to Chukchi-speaking Koryaks, revealing a complex acculturation of different East Asian peoples in recent times (Karafet et al. 2018). The wide cluster formed by modern Yukaghirs, including southern Samoyedic speakers in the west and Chukotko-Kamchatkan speakers in the east (see Suppl. Graph. 15) further supports the relatively recent expansion of Yukaghir into the Circum-Arctic region.

viii.21.2. Turkic peoples and Mongols

Cultures succeeding Afanasevo in the Altai region show different lineages and the partial resurgence of WSHG ancestry coupled with different Afanasevo-, Steppe MLBA-, AP-, and AEA-related contributions, suggesting the emergence of different local West Siberian populations (Hollard et al. 2018): the Chemurchek culture (ca. 2300–1800 BC), with one hg. C-M130; the Okunevo culture (ca. 2300–1800 BC), with one hg. R1b1a1b1-L23, three likely N-Z4813, and three likely Q1b1a-L54; the Elunino culture (ca. 2300–1700 BC), with one hg. Q-M242, and one Q1b-M346; the Munkh-Khairkhan culture (ca. 1700–1400 BC), with two N-M231 lineages; and the Sagsai culture (ca. 1400–800 BC), with four hg. Q1b1a-L54, four R1a1a1b2-Z93, and one C-M130.

MBA sites Takhilgat Uzuur and Tsagaan Asga in the Mongolian Altai Mountains also show apparent succeeding replacements from hg. Q1b1a-L54 in the 3rd millennium BC to R1a1a1b2-Z93 in the late 2nd millennium BC, to C-M130 in the early 1st millennium BC (Hollard et al. 2014).

To the east, near Lake Baikal, a resurgence of AP ancestry (up to ca. 50%) coupled with Afanasevo-related ancestry (ca. 10%) found in EBA individuals is continued during the LBA. Samples of the Deer Stone-Khirigsuur Complex from Khövsgöl in northern Mongolia (ca. 1200–800 BC) show a slightly higher contribution of AP ancestry evidenced by a 'northern' shift in the PCA, similar to Karasuk or Okunevo samples (Jeong, Wilkin, et al. 2018). In terms of haplogroups, there are ten probably Q1b-L56, possibly all of Q1b1a-L54 subclade Q1b1a3-L330 (formed ca. 16000 BC, TMRCA ca. 5900 BC), with an estimated successful dispersal of these subclades starting in the Mesolithic ca. 6300 BC from central Asia (Grugni et al. 2019), possibly initially accompanying Dene-Yeniseian-related languages (see *§v.8. Palaeosiberians*).

A small contribution of Steppe MLBA ancestry (ca. 4-7%) suggests close contacts with Andronovo-related peoples. In particular, the presence of one outlier (ca. 1130–900 BC), of hg. R1a1a1b2a2a1-Z2123, is consistent with the appearance of admixed forest-steppe populations of Eastern Steppe MLBA ancestry like Karasuk in the Altai (ca. 1200–800 BC). Supporting these contacts of Karasuk with eastern Asian steppes is also the Karasuk outlier and the sample of hg. Q1a2a-L712. This points to the spread of pastoralism in the region mediated by acculturation and exogamy more than population replacement (Jeong, Wilkin, et al. 2018). Another sample (ca. 1420-1130 BC) of hg. N1a1a-M178, mtDNA U5a2d1, suggests—like the different groups succeeding Afanasevo in the Altai region—the acculturation of northern Eurasian communities with post-Neolithic expansions.

To the south-east of Lake Baikal, in the Houtaomuga site from Manchuria, there is genetic continuity from ca. 10000 BC until the Iron Age, but haplogroup N1b1-CTS582, found in the Early Neolithic (ca. 5430–5320 BC), is replaced in the Bronze Age by C2b-L1373, which continues in the Early Iron Age (Ning 2018). Twelve Donghu individuals from the Jinggouzi site (ca. 770–476 BC) show C2a1a-F4032 lineages (formed ca. 12700 BC, TMRCA ca. 12300 BC), as do four samples from Xianbei (ca. AD 4^{th}–10^{th} c.) (Zhang, Wu, et al. 2018; Li et al. 2018). The expansion of the Donghu seems to have caused the expansion of C2-M217 lineages in the Trans-Baikal area.

The first Turkic-speaking community is usually identified with the Xiongnu confederation, with ancient Y-chromosomal data indicating a heterogeneous multi-ethnic cultural organisation, likely emerging initially from local East Asian groups to the east of the Tian Shan Mountains, who showed admixture with central steppe nomads. A more recent West Eurasian ancestry is found among western Xiongnu groups, with Central Sakas being the closest source for their admixture (de Barros Damgaard, Marchi, et al. 2018).

Sampled Xiongnu individuals (ca. 300 BC – AD 200) include hg. R1a1a-M198 and C2-M217 in Duurlig Nars, and hg. N1a1-Tat and Q-M52 and in Egyin Gol Valley (Kim et al. 2010; Petkovski 2006); two likely hg. O2a2b-P164 from Omnogobi, one early sample from the West Xiongnu in Khövsgöl (ca. 330 BC), of hg. R1b2-PH155, and one from an aristocratic burial in Arkhangai (ca. AD 1), likely of hg. R1b2b-PH200⁺ (de Barros Damgaard, Marchi, et al. 2018).

The homeland of Turkic peoples is difficult to pinpoint based on scarce samples through wide temporal transects, due to the multiple population replacements in the central and eastern Asian steppes, forest-steppes, and forests, and to the linguistic data and complex ethnogenesis legends pointing to a composite grouping of diverse elements since the reconstructible stage of the language (Golden 1992).

Based on Indo-European (Iranian and Tocharian) and Uralic influences, Proto-Turkic is supposed to have been spoken ca. 1000 BC in some area from the Trans-Urals area to the Altai, with the forest zones of West Siberia being the most likely candidate based on the Indo-Iranian expansions through the steppes, as well as the Uralic expansions through the forest-steppe and forest regions. From there, the ancestors of the Turks migrated east into the Baikal area, where the Xiongnu confederation eventually emerged, and Huns later migrated to West Eurasia (Golden 1992).

The two Sintashta outliers of Khvalynsk Eneolithic-like ancestry, of reported haplogroups R1b1a1-P297 and R1b1a1a-M73, probably correspond to ancient populations of R1b1a1a-M73 lineages widespread from the west in the southern Urals up to the Lake Baikal in the east since the Neolithic, following a WSHG ancestry cline. This is compatible with the Mesolithic expansion of Eurasian through Inner Asia (see *§ii.1. Eurasians*), and the isolated development of Altaic in the Neolithic (see *§v.8. Palaeosiberians*).

Haplogroup R1b1a1a-M73 is reported with low frequencies among modern Siberian populations, such as Ugric and Samoyedic peoples, especially southern Selkups (Tambets et al. 2018), and with increasing frequencies among south Siberian populations, in particular among Turkic-speaking Bashkirs (Jeong, Balanovsky, et al. 2018) and Teleuts near the Altai (Karafet et al. 2018), which suggests its presence among Turkic-speaking peoples before their expansion into the Trans-Baikal area and the creation of a community integrating diverse local populations.

The earlier emergence of Turkic-speaking peoples from the forming multi-ethnic groups in the Trans-Baikal area further supports that Turko–Mongolic, and not only Turkic, expanded from the west. Similarly, the link of different Altaic-related expansions since the early first millennium BC associated with bottlenecks of West Siberian N1a1a1a1a-L1026/L392 lineages (see *§v.8. Palaeosiberians*) further supports the connection of Altaic with the West Siberian forest-steppes. The adaptation of horseback riding for more stressful and difficult activities such as warfare—characteristic of these nomadic groups—in the eastern steppes, started probably at the end of the Deer Stone–Khirigsuur Complex or slightly later, evidenced by findings from the Altai to the Baikal region, including the appearance of the bronze snaffle bit and innovations in equine dentistry (Taylor, Bayarsaikhan, et al. 2018).

The Huns, likely representatives of the earliest Turkic-speaking groups in Eurasia, emerged following minor male-driven East Asian gene flow into the preceding Sakas that they invaded, ca. 2,000 years ago. They displaced Iranian-speaking groups (ancestors of the Wusun and Kangju) to the south-east of the Tian Shan mountains, where they became isolated (see *§viii.19. Iranians*). Sampled nomads from the Kargaly in the Tian Shan region include two early ones (ca. 800–700 BC), one of hg. Q-M242, clustering with Siberian peoples (close to Yeniseians), one intermediate (ca. 425 BC), of hg. R1a1a1b2a2-Z2124, and a later one (ca. 35 BC), of hg. R1b1a1a1b-Y20750 (formed ca. 5300 BC, TMRCA ca. 3300 BC), a subclade of R1b1a1a-M73 (de Barros Damgaard, Marchi, et al. 2018).

This variability is also found later among Huns from Tian Shan (ca. AD 60–600), with three hg. R1a1a1b2a2-Z2124, two R1-M173, one hg. R1b2b-PH200, one N1a1a-M178, and one Q1a2a1-L715^{+}, in contrast to Tian Shan Sakas, who were all of R1-M173 subclades. Nomads from the central steppe (ca. AD 360), either Huns or Sarmatians, show one sample of hg. R1a1a1b2-Z93. Huns sampled from the Carpathian Basin (AD 5th c.) show hg. Q1a2-M25, one R1b1a1b1a1a1-U106, and one R1a1a1b2a2-Z2124 (Neparáczki et al. 2019). All Huns show an increased shared drift with West Eurasians compared to Xiongnu (de Barros Damgaard, Marchi, et al. 2018).

A sample of the Mongolian Rouran Khaganate from Khermen Tal shows the continuation of haplogroup C2a1a-F4032 in the region (Li et al. 2018), probably expanding with Mongolian-speaking peoples in the eastern steppes. Samples from Baiyin Huangwan Han dynasty tombs from a north-western Chinese farming area near the Xiongnu states, spanning from the Western Han Dynasty (202 BC – AD 8) to the Eastern Han Dynasty (AD 25–220), show significant genetic contribution from the northern Eurasian populations, as well as an accommodation to the nomadic lifestyle, which supports the acculturation of the Xiongnu population to the Han culture (Li, Ma, and Wen 2018).

After the defeat of the Xiongnu (ca. AD 552), a part of their population migrated to Pannonia, where they became known as the Avars and allied with the Longobards to defeat the Gepids, creating the Avar Khaganate (AD 567-805). Two early female Avars from Szólád (ca. AD 540–640) show an ancestry similar to Eastern Europeans, with contributions of East Asian ancestry, clustering close to modern West Slavs, which justifies the Central Asian admixture found in a Gepid and a medieval Bavarian individual of the region (Amorim et al. 2018). Twenty-three individuals from a group of elite burials in Hungary (AD 7th–8th c.) show a majority of Inner Asian origin (up to 64%) of their mtDNA (Csáky et al. 2018), although there is high intergroup variation (Šebest et al. 2018).

In terms of Y-chromosome haplogroups, early Avars (ca. AD 570–660) show the intrusion of N1a1a-M178, found among six out of eleven males, with at least four of them subclades of N1a1a1a1a3-Y16323 (formed ca. 2900 BC, TMRCA ca. 2900 BC), in turn a subclade of N1a1a1a1a-L392 (formed ca. 4300 BC, TMRCA ca. 2900 BC). At least one of them estimated to be N1a1a1a1a3a-F4205^{+} (TMRCA ca. 500 BC), a haplogroup confirmed in all seventeen sampled males from the Avar Khaganate in the Danube–Tisza Interfluve (ca. 600–775 BC). Haplotypes confirm that these samples share their closes relatives today among Siberian populations, including Buryats, Mongolians, Yakuts, Mansis and Khants, in line with the presence of hg. N1a1a-M178 in Bronze Age Inner Mongolia and late medieval Yakuts (Csáky et al. 2019).

Two individuals from a secondary power centre east of the Tisza (ca. 650-700 BC) show hg. Q1a-F1096 and Q1b-M346, the latter of likely Altaian or South Siberian paternal origin (Csáky et al. 2019). Other early haplogroups include one C2-M217 and one R1a1a1b2a2-Z2124. All these samples support an original Siberian expansion of this haplogroup from a region close to Lake Baikal. Samples probably related originally to European paternal lines include one early Avar of hg. G2a-P15, and another one of hg. I1-M253 (Neparáczki et al. 2019).

Middle or Late Avar samples (ca. 650-710 BC) show one hg. C2-M217 and one N1a1a1a1a3-Y16323, showing continuity with the previous period, but also one E1b1b1a1b1a-V13. Given the nature of the Avar polity as a Slavic-speaking territory during the last century of its existence (ca. 700–800 BC), and the finding of E1b1b1a1b1a-V13 lineages later during the Hungarian Conqueror period (see *§viii.17.1. Ugrians*) and among early Slavs, it is highly likely that the expansion of hg. E1b1b1a1b1a-V13 from the Carpathian Basin is related to the Slavonic expansion to neighbouring regions (Neparáczki et al. 2019).

The Turkic Khaganate assumed military and political organisation of the steppes as the Hunnic Empire broke up and dispersed (AD 6th c.), following the emergence of the Turks, the blacksmiths of the Rourans (Suppl. Fig. 17). Their elite soldiers are genetically closer to East Asians than the preceding Huns of the Tian Shan mountains, with one sample from Berygavoya (ca. 690 BC), of hg. R1-M173. A genetic outlier of the central steppe (ca. AD 270), of hg. R1-M173, shows pronounced European ancestry, and thus ongoing contacts with Europe (de Barros Damgaard, Marchi, et al. 2018).

The Turkic Khaganate was eventually replaced by short-lived steppe cultures, such as the Kipchak and the Tungusik Kimak poulations, which spread southwards towards the Tian Shan mountains and westward towards the Ural Mountains to form the Kimak Khaganate in the central steppe (ca. 8th–11th c.). One sample from Kimak nomads of the Central Steppes (ca. AD 665), of hg. R1b1a1a1a-Y14051, does not show elevated East Asian ancestry (de Barros Damgaard, Marchi, et al. 2018).

The Kima Khaganate was replaced by local Kipchak groups allied with the Cuman of West Eurasia, hence probably originating near the area of Tuva. Two individuals dating to the Cuman–Kipchak alliance (ca. AD 1050) show one hg. C-M130 and increased East Asian ancestry, and the other one pronounced European ancestry, which is compatible with the incorporation of western and eastern steppe populations. The Karakhanid Khaganate from Turan incorporated some of these groups, with three samples (ca. AD 950–1250) showing further East Asian influx compared to earlier Turks (de Barros Damgaard, Marchi, et al. 2018).

Other unassigned early medieval Turkic samples show different proportions of East Asian ancestry, including nine from Tian Shan, among them one early (ca. AD 800–1000), of hg. J2a-M410, and one later (ca. AD 1170) of hg. C2a1a1b1b1-Y12825+ (formed ca. 1000 BC, TMRCA ca. 100 BC); one from the Central Steppe (ca. AD 735) of hg. R1b1a1a1a-Y14051+; and one from the Caspian Steppe (ca. AD 700) of hg. R1a1a1b2a2-Z2124+.

Among two samples (ca. AD 1250) of the medieval Jochi Khan's Golden Horde in the central steppes, there is one of clearly East Asian ancestry and corresponding PCA cluster, of hg. C2-M217, and one of West Eurasian descent, of hg. R1a1a1b1a2a-Z280, which is further proof of the assimilation of different groups into succeeding Turkic organisations (de Barros Damgaard, Marchi, et al. 2018).

Among modern Tatars, descendants from elite clans of the Golden Horde belong to haplogroup R1b1a1a-M73 (Akchurin et al. 2018). There seems to be a general trend during the Iron Age and medieval times to a distribution of R1a1a1b2a2-Z2124 lineages in the Pontic–Caspian steppes, of R1b1a1a-M73 lineages in the central steppes, and of R1-M173 (likely R1b2-PH155) and C2a1a1b1b1-Y12825 in the eastern steppes, which may reflect to some extent the different alliances formed by multi-ethnic groups since the time of the formation of the Xiongnu confederacy and the Hunnic expansion, although it may also reflect the initial contacts between peoples of the eastern steppe before the formation of the Xiongnu community. Modern peoples from investigated Xinjiang sites show hg. R1b-M343 including R1b1a1-P297, R1b1a1a-M73 (up to 9%), and R1b2-PH155 subclades, among a majority of typically central Asian lineages, including hg. R1a1a1b2-Z93, especially R1a1a1b2a2-Z2124 (Liu et al. 2018), whose origin cannot be properly interpreted without specific subclades.

Eventually, these khaganates were conquered by the Mongol Empire, which emerged through the unification of East Mongolian and Trans-Baikal tribes, expanding under the rule of Genghis Khan (ca. AD 13th c.). Modern Mongolian tribes show a mixture of East Asian lineages, mainly C2 subclades (ca. 42%), including C2b-F1067 (ca. 29%) and C2a-L1373 (ca. 13%), but also O-M175 (ca. 24%) and N-M231 (ca. 18%). In the PCA, Mongolians cluster in close genetic proximity to a group of North Asian Siberians, including Altaians, Tuvinians, Evenki, and Yakut, with eastern tribes Abaga, Khalkha, Oirat, and Sonid showing the least differentiation, with close interaction between northern Eurasian populations (Bai et al. 2018). Common Mongols likely expanded mainly with a Y-chromosome bottleneck of haplogroup C2a1a1c1-F3796 (TMRCA ca. 500 BC), whose expansion pattern is consistent with the diffusion of most Mongolic-speaking populations (Wei et al. 2018).

Manchu-Tungusic is proposed to have spread either from the Trans-Baikal area or from the Amur River region. Ancient samples from the West Liao River region shows high dynamism, similar to Trans-Baikal areas[39], which may support the emergence of Tungusic-speaking peoples from previous population movements through the eastern steppes. The presence of shared isoglosses with Turkic and Mongolic to the west, forming a likely Altaic family, and with Koreanic (and Japonic) to the east, with less clear links to Altaic, makes the identification of Tungusic still more complicated. The Proto-Tungusic society has been associated either with the Donghu or with an ancestral group from the Amur River region sharing links with eastern peoples. The potential attribution of vowel harmony in Proto-Tungusic to contacts with Mongolic languages (Ko, Joseph, and Whitman 2014) makes the identification of the language with one or the other group still harder.

Present-day Tungusic-speaking peoples, of varied lineages and ancestry, share a similar history to that found among Palaeosiberian peoples integrated among Finnic, Samic, Samoyedic, or Yukaghir-speaking populations, of acculturated Palaeosiberians adopting languages in recent times (Fedorova et al. 2013). This tradition of exogamy notwithstanding, it seems that the recent expansion of C2a1a1b1-M86 lineages among some southern Tungusic groups (as well as other C2-M217 lineages) may have been associated with their expansion from the south-east (Balanovska et al. 2018).

[39] Upcoming communication by Ning et al. at Eurasia3Angle conference (2019).

References

Ache, Mireia, Selina Delgado-Raack, Elena Molina, Roberto Risch, and Antoni Rosell-Melé. 2017. Evidence of bee products processing: A functional definition of a specialized type of macro-lithic tool. *Journal of Archaeological Science: Reports* 14:638-650.

Adamczak, Kamil, Stanisław Kukawka, and Jolanta Małecka-Kukawka. 2016-2017. North-eastern periphery of the Eastern group of the Funnel Beaker culture – 80 years later. In *Papers and materials of the Archaeological and Ethnographic Museum in Łódź*. Łódź.

Adamov, Dmitry, Vladimir M. Guryanov, Sergey Karzhavin, Vladimir Tagankin, and Vadim Urasin. 2015. Defining a New Rate Constant for Y-Chromosome SNPs based on Full Sequencing Data. *The Russian Journal of Genetic Genealogy (Русская версия)* 7 (1):68-89.

Adrados, F.R. 1998. La reconstrucción del indoeuropeo y de su diferenciación dialectal. In *Manual de lingüística indoeuropea*, edited by F. R. Adrados, A. Bernabé and J. Mendoza. Madrid: Ediciones clásicas.

Afanas'ev, G. E., M. V. Dobrovol'skaya, D. S. Korobov, and I. K. Reshetova. 2014. O kul'turnoi, antropologicheskoi i geneticheskoi spetsifike donskikh Alan. *Institut arkheologii RAN, Moskva*.

Aikio, Ante. 2012. An essay on Saami ethnolinguistic prehistory. In *A Linguistic Map of Prehistoric Northern Europe*. Helsinki.

Akchurin, M.M., M.R. Isheev, A.V. Belyakov, T.A. Abdurakhmanov, and R.R. Salikhov. 2018. Kasimov Tatars of the Kypchak tribe. *UDK* 94 (47):312-241.

Alizadeh, Karim, Siavash Samei, Kourosh Mohammadkhani, Reza Heidari, and Robert H. Tykot. 2018. Craft production at Köhne Shahar, a Kura-Araxes settlement in Iranian Azerbaijan. *Journal of Anthropological Archaeology* 51:127-143.

Allentoft, Morten E., Martin Sikora, Karl-Goran Sjogren, Simon Rasmussen, Morten Rasmussen, Jesper Stenderup, Peter B. Damgaard, Hannes Schroeder, Torbjorn Ahlstrom, Lasse Vinner, Anna-Sapfo Malaspinas, Ashot Margaryan, Tom Higham, David Chivall, Niels Lynnerup, Lise Harvig, Justyna Baron, Philippe Della Casa, Pawel Dabrowski, Paul R. Duffy, Alexander V. Ebel, Andrey Epimakhov, Karin Frei, Miroslaw Furmanek, Tomasz Gralak, Andrey Gromov, Stanislaw Gronkiewicz, Gisela Grupe, Tamas Hajdu, Radoslaw Jarysz, Valeri Khartanovich, Alexandr Khokhlov, Viktoria Kiss, Jan Kolar, Aivar Kriiska, Irena Lasak, Cristina Longhi, George McGlynn, Algimantas Merkevicius, Inga Merkyte, Mait Metspalu, Ruzan Mkrtchyan, Vyacheslav Moiseyev, Laszlo Paja, Gyorgy Palfi, Dalia Pokutta, Lukasz Pospieszny, T. Douglas Price, Lehti Saag, Mikhail Sablin, Natalia Shishlina, Vaclav Smrcka, Vasilii I. Soenov, Vajk Szeverenyi, Gusztav Toth, Synaru V. Trifanova, Liivi Varul, Magdolna Vicze, Levon Yepiskoposyan, Vladislav Zhitenev, Ludovic Orlando, Thomas Sicheritz-Ponten, Soren Brunak, Rasmus Nielsen, Kristian Kristiansen, and Eske Willerslev. 2015. Population genomics of Bronze Age Eurasia. *Nature* 522 (7555):167-172.

Altaweel, Mark, and Alessio Palmisano. 2018. Urban and Transport Scaling: Northern Mesopotamia in the Late Chalcolithic and Bronze Age. *Journal of Archaeological Method and Theory*.

Amorim, Carlos Eduardo G., Stefania Vai, Cosimo Posth, Alessandra Modi, István Koncz, Susanne Hakenbeck, Maria Cristina La Rocca, Balazs Mende, Dean Bobo, Walter Pohl, Luisella Pejrani Baricco, Elena Bedini, Paolo Francalacci, Caterina Giostra, Tivadar Vida, Daniel Winger, Uta von Freeden, Silvia Ghirotto, Martina Lari, Guido Barbujani, Johannes Krause, David Caramelli, Patrick J. Geary, and Krishna R. Veeramah. 2018. Understanding 6th-century barbarian social organization and migration through paleogenomics. *Nature Communications* 9 (1):3547.

Amzallag, Nissim. 2009. From Metallurgy to Bronze Age Civilizations: The Synthetic Theory. *American Journal of Archaeology* 113 (4):497-519.

Andrades Valtueña, Aida, Alissa Mittnik, Felix M. Key, Wolfgang Haak, Raili Allmäe, Andrej Belinskij, Mantas Daubaras, Michal Feldman, Rimantas Jankauskas, Ivor Janković, Ken Massy, Mario Novak, Saskia Pfrengle, Sabine Reinhold, Mario Šlaus, Maria A. Spyrou, Anna Szecsenyi-Nagy, Mari Tõrv, Svend Hansen, Kirsten I. Bos, Philipp W. Stockhammer, Alexander Herbig, and Johannes Krause. 2017. The Stone Age Plague: 1000 years of Persistence in Eurasia. *bioRxiv*.

Anthony, David. 2017. Archaeology and Language: Why Archaeologists Care About the Indo-European Problem--in European Archaeology as Anthropology. In *European archaeology as anthropology: essays in memory of Bernard Wailes* edited by P. J. Crabtree and P. I. Bogucki. Philadelphia: University of Pennsylvania Museum.

Anthony, David W. 1990. Migration in archeology: the baby and the bathwater. *American Anthropologist* 92 (4):895-914.

Repeated Author. 2006. Pontic-Caspian Mesolithic and Early Neolithic societies at the time of the Black Sea flood: a small audience and small effects. In *The Black Sea Flood Question: Changes in Coastline, Climate and Human Settlement*, edited by V. Yanko-Hombach, A. S. Gilbert, N. Panin and P. M. Dolukhanov. Dordrecht: Springer.

Repeated Author. 2007. *The Horse, the Wheel, and Language: How Bronze-Age Riders from the Eurasian Steppes Shaped the Modern World*. Princeton and Oxford: Princeton University Press.

Repeated Author. 2013. Two IE phylogenies, three PIE migrations, and four kinds of steppe pastoralism. *Journal of Language Relationship* (9):1-21.

Repeated Author. 2016. The Samara Valley Project and the Evolution of Pastoral Economies in the Western Eurasian Steppes. In *A Bronze Age Landscape in the Russian Steppes. The Samara Valley Project*, edited by D. W. Anthony, D. R. Brown, O. D. Mochalov, A. A. Khokhlov and P. F. Kuznetsov. Los Angeles: The Cotsen Institute of Archaeology Press at UCLA.

Anthony, David W., and Dorcas R. Brown. 2011. The Secondary Products Revolution, Horse-Riding, and Mounted Warfare. *Journal of World Prehistory* 24 (2-3):131-160.

Repeated Author. 2017. The dogs of war: A Bronze Age initiation ritual in the Russian steppes. *Journal of Anthropological Archaeology* 48:134-148.

Repeated Author. 2017. Molecular Archaeology and Indo-European linguistics: Impressions from new data. In *Usque ad Radices: Indo-European Studies in Honour of Birgit Anette Olsen*, edited by B. Simmelkjær, S. Hansen, A. Hyllested, A. R. Jørgensen, G. Kroonen, J. H. Larsson, B. N. Whitehead, T. Olander and T. M. Søborg. Copenhagen: Museum Tusculanum Press.

Anthony, David W., and Don Ringe. 2015. The Indo-European Homeland from Linguistic and Archaeological Perspectives. *Annual Review of Linguistics* 1 (1):199-219.

Arboledas-Martínez, Luis, and Eva Alarcón-García. 2018. Redefining the role of metal production during the Bronze Age of south-eastern Iberia. The mines of eastern Sierra Morena. *Documenta Praehistorica* 45:138-153.

Arbuckle, Benjamin S. . 2009. Chalcolithic Caprines, Dark Age Dairy and Byzantine Beef: A First Look at Animal Exploitation at Middle and Late Holocene Çadir Höyük, North Central Turkey. *Anatolica* 35:179–224.

Arbuckle, Benjamin S., and Emily L. Hammer. 2018. The Rise of Pastoralism in the Ancient Near East. *Journal of Archaeological Research*.

Archi, A. 2011. In Search of Armi. *Journal of Cuneiform Studies* 63:5-34.

Arranz-Otaegui, Amaia, Lara Gonzalez Carretero, Monica N. Ramsey, Dorian Q. Fuller, and Tobias Richter. 2018. Archaeobotanical evidence reveals the origins of bread 14,400 years ago in northeastern Jordan. *Proceedings of the National Academy of Sciences* 115 (31):7925-7930.

Artemova, S. N., D. S. Ikonnikov, and O. Ph. Prikazchikova. 2018. Historical and geo-ecological features of the formation of cultural landscapes of the Upper Possurie and Primokshanie during the Aeneolithic period. *Ekologiya* 6:1-11.

Asscher, Yotam, and Elisabetta Boaretto. 2018. Absolute Time Ranges in the Plateau of the Late Bronze to Iron Age Transition and the Appearance of Bichrome Pottery in Canaan, Southern Levant. *Radiocarbon*:1-25.

Ávila-Arcos, María. 2015. Assessment of Whole-Genome capture methodologies on single-and double-stranded ancient DNA libraries from Caribbean and European archaeological human remains. In *Biology of Genomes*. Cold Spring Harbor, New York.

Bai, Haihua, Xiaosen Guo, Narisu Narisu, Tianming Lan, Qizhu Wu, Yanping Xing, Yong Zhang, Stephen R. Bond, Zhili Pei, Yanru Zhang, Dandan Zhang, Jirimutu Jirimutu, Dong Zhang, Xukui Yang, Morigenbatu Morigenbatu, Li Zhang, Bingyi Ding, Baozhu Guan, Junwei Cao, Haorong Lu, Yiyi Liu, Wangsheng Li, Ningxin Dang, Mingyang Jiang, Shenyuan Wang, Huixin Xu, Dingzhu Wang, Chunxia Liu, Xin Luo, Ying Gao, Xueqiong Li, Zongze Wu, Liqing Yang, Fanhua Meng, Xiaolian Ning, Hashenqimuge Hashenqimuge, Kaifeng Wu, Bo Wang, Suyalatu Suyalatu, Yingchun Liu, Chen Ye, Huiguang Wu, Kalle Leppälä, Lu Li, Lin Fang, Yujie Chen, Wenhao Xu, Tao Li, Xin Liu, Xun Xu, Christopher R. Gignoux, Huanming Yang, Lawrence C. Brody, Jun Wang, Karsten Kristiansen, Burenbatu Burenbatu, Huanmin Zhou, and Ye Yin. 2018. Whole-genome sequencing of 175 Mongolians uncovers population-specific genetic architecture and gene flow throughout North and East Asia. *Nature Genetics*.

Baker, Jennifer L., Charles N. Rotimi, and Daniel Shriner. 2017. Human ancestry correlates with language and reveals that race is not an objective genomic classifier. *Scientific Reports* 7 (1):1572.

Balanovska, E. V., Y. V. Bogunov, E. N. Kamenshikova, O. A. Balaganskaya, A. T. Agdzhoyan, A. A. Bogunova, R. A. Skhalyakho, I. E. Alborova, M. K. Zhabagin, S. M. Koshel, D. M. Daragan, E. B. Borisova, A. A. Galakhova, O. V. Maltceva, Kh Kh Mustafin, N. K. Yankovsky, and O. P. Balanovsky. 2018. Demographic and Genetic Portraits of the Ulchi Population. *Russian Journal of Genetics* 54 (10):1245-1253.

Bátora, Jozef. 2006. *Štúdie ku komunikácii medzi strednou a východnou Európou v dobe bronzovej*. Bratislava: Petrus Publ.

Battaglia, Vincenza, Simona Fornarino, Nadia Al-Zahery, Anna Olivieri, Maria Pala, Natalie M. Myres, Roy J. King, Siiri Rootsi, Damir Marjanovic, Dragan Primorac, Rifat Hadziselimovic, Stojko Vidovic, Katia Drobnic, Naser Durmishi, Antonio Torroni, A. Silvana Santachiara-Benerecetti, Peter A. Underhill, and Ornella Semino. 2008. Y-chromosomal evidence of the cultural diffusion of agriculture in southeast Europe. *European Journal Of Human Genetics* 17:820.

Beekes, R.S.P. 2003. *The Origin of the Etruscans*. Amsterdam: Koninklijke Nederlandse Akademie vanWetenschappen.

Beekes, Robert S.P. 2011. *Comparative Indo-European Linguistics. An introduction*. 2nd ed. Amsterdam / Philadelphia: John Benjamins.

Bender, M. Lionel. 2007. The Afrasian lexion reconsidered. In *Studies in Semitic and Afroasiatic Linguistics Presented to Gene B. Gragg*, edited by C. L. Miller. Illinois: The University of Chicago.

Bennett, Casey C., and Frederika A. Kaestle. 2010. Investigation of Ancient DNA from Western Siberia and the Sargat Culture. *Human Biology* 82 (2):143-156.

Beridze, Tengiz. 2019. The 'Wheat Puzzle' and Kartvelians route to the Caucasus. *Genetic Resources and Crop Evolution*.

Bernabò Brea, M. 2009. Le terramare nell'Età del Bronzo. In *Acqua e civiltà nelle terramare. La vasca votiva di Noceto*, edited by M. Bernabò Brea and M. Cremaschi. Milan: Skira.

Bertemes, François, and Volker Heyd. 2002. Der Übergang Kupferzeit / Frühbronzezeit am Nordwestrand des Karpatenbeckens - kulturgeschichtliche und paläometallurgische Betrachtungen. In *Die Anfänge der Metallurgie in der Alten Welt*, edited by M. Bartelheim. Rahden/Westfalen: Leidorf.

Repeated Author. 2015. Innovation or Evolution: Genesis of the Danubian EBA. In *2200 BC – A climatic breakdown as a cause for the collapse of the old world?*

7th Arch. Conference Central Germany, Oct. 23–26, 2014. Halle: Tagungen Landesmus. Vorgesch.

Berthon, William, Balázs Tihanyi, Luca Kis, László Révész, Hélène Coqueugniot, Olivier Dutour, and György Pálfi. 2018. Horse Riding and the Shape of the Acetabulum: Insights from the Bioarchaeological Analysis of Early Hungarian Mounted Archers (10th Century). *International Journal of Osteoarchaeology* 0 (ja).

Besse, Marie. 2014. Common Ware during the third Millenium BC in Europe. In *Similar but Different: Bell Beakers in Europe*, edited by J. Czebreszuk. Leiden: Sidestone Press.

Biagi, Paolo , and Dmytro Kiosak. 2010. The Mesolithic of the northwestern Pontic region. New AMS dates for the origin and spread of the blade and trapeze industries in southeastern Europe. *Eurasia antiqua: Zeitschrift für Archäologie Eurasiens* 16:21-41.

Biagini, Simone Andrea, Neus Solé-Morata, Elizabeth Matisoo-Smith, Pierre Zalloua, David Comas, and Francesc Calafell. 2019. People from Ibiza: an unexpected isolate in the Western Mediterranean. *European Journal of Human Genetics*.

Bietti Sestieri, Anna Maria. 2013. The Bronze Age in Sicily. In *The Oxford Handbook of the European Bronze Age*, edited by H. Fokkens and A. Harding. Oxford: Oxford University Press.

Bietti Sestieri, Anna Maria 2013. Peninsular Italy. In *The Oxford Handbook of the European Bronze Age*, edited by H. Fokkens and A. Harding. Oxford: Oxford University Press.

Bilger, Michael. 2019. Der Glockenbecher in Europa – eine Kartierung. *Journal of Neolithic Archaeology* (Special Issue 4): Think Globla, Act Local! Bell Beakers in Europe:203-270.

Bilgi, Ö. 2001. Bİkiztepe Kazılarının 2000 Dönemi Sonuçları. *Kazı Sonuçları Toplantısı* 23:245-254.

Repeated Author. 2005. Distinguished Burials of the Early Bronze Age Graveyard at İkiztepe in Turkey. *İstanbul Üniversitesi Edebiyat Fakültesi Anadolu Araştırmaları Dergisi* XVIII (2):15-113.

Binney, Heather, Mary Edwards, Marc Macias-Fauria, Anatoly Lozhkin, Patricia Anderson, Jed O. Kaplan, Andrei Andreev, Elena Bezrukova, Tatiana Blyakharchuk, Vlasta Jankovska, Irina Khazina, Sergey Krivonogov, Konstantin Kremenetski, Jo Nield, Elena Novenko, Natalya Ryabogina, Nadia Solovieva, Kathy Willis, and Valentina Zernitskaya. 2017. Vegetation of Eurasia from the last glacial maximum to present: Key biogeographic patterns. *Quaternary Science Reviews* 157:80-97.

Blanco-González, A., K. T. Lillios, J. A. López-Sáez, and B. L. Drake. 2018. Cultural, Demographic and Environmental Dynamics of the Copper and Early Bronze Age in Iberia (3300–1500 BC): Towards an Interregional Multiproxy Comparison at the Time of the 4.2 ky BP Event. *Journal of World Prehistory* 31 (1):1-79.

Blasco Ferrer, Eduardo. 2010. *Paleosardo: Le radici linguistiche della Sardegna neolitica*. Edited by G. Holtus, *Beihefte zur Zeitschrift für romanische Philologie*. Berlin/New York: Walter de Gruyter.

Blažek, Václav. 2010. On the Classification of Berber. *Folia Orientalia* 47:245-266.

Repeated Author. 2014. Phoenician/Punic loans in Berber languages and their role in chronology of Berber. *Folia Orientalia* 51:275-293.

Blevins, Juliette. 2018. *Advances in Proto-Basque Reconstruction with Evidence for the Proto-Indo-European-Euskarian Hypothesis*. Edited by C. Bowern, *Routledge Studies in Historical Linguistics*: Routledge.

Bochkarev, Vadim Sergeevich. 2010. *Koni, kolesnitsy i kolesnichie stepej Evrazii / Horses, chariots and chariot's drivers of Eurasian steppes.* . Yekaterinburg, Samara, Donetsk: Rossijskaja Akademija Nauk, Uralʹskoe Otdelenie, Institut Ėkologii Rastenij i Životnych.

Bogdanov, S. V. 2004. *Jepoha medi stepnogo priural'ja*. Ekaterinburg: Tipografija UrO RAN.

Bogdanowicz, W., M. Allen, W. Branicki, M. Lembring, M. Gajewska, and T. Kupiec. 2009. Bogdanowicz, W. et al. (2009), Genetic identification of putative remains of the famous astronomer Nicolaus Copernicus, Proceedings of the National Acadamy of Sciences of the USA (Published online before print July 7, 2009). *Proceedings of the National Academy of Sciences* 106 (30):12279-12282.

Bomhard, Alan R. 2017. *The Origins of Proto-Indo-European: The Caucasian Substrate Hypothesis*. Charleston, SC.

Bonechi, M. 1990. Aleppo in età arcaica; a proposito di un'opera recente. *Studi Epigrafici e Linguistici sul Vicino Oriente Antico* 7:15-37.

Boroffka, Nikolaus. 2013. Romania, Moldova, and Bulgaria. In *The Oxford Handbook of the European Bronze Age*, edited by H. Fokkens and A. Harding. Oxford: Oxford University Press.

Bose, Aritra, Daniel E. Platt, Laxmi Parida, Peristera Paschou, and Petros Drineas. 2017. Dissecting Population Substructure in India via Correlation Optimization of Genetics and Geodemographics. *bioRxiv*.

Brace, S., Y. Diekmann, T. Booth, O. Craig, C. Stringer, D. Reich, M. Thomas, and I. Barnes. 2018. Ancient DNA and the peopling of the British Isles – pattern and process of the Neolithic transition. Paper read at 8th International Symposium on Biomolecular Archaeology ISBA 2018. 18th – 21st September, at Jena, Germany.

Brace, Selina, Yoan Diekmann, Thomas J. Booth, Lucy van Dorp, Zuzana Faltyskova, Nadin Rohland, Swapan Mallick, Iñigo Olalde, Matthew Ferry, Megan Michel, Jonas Oppenheimer, Nasreen Broomandkhoshbacht, Kristin Stewardson, Rui Martiniano, Susan Walsh, Manfred Kayser, Sophy Charlton, Garrett Hellenthal, Ian Armit, Rick Schulting, Oliver E. Craig, Alison Sheridan, Mike Parker Pearson, Chris Stringer, David Reich, Mark G. Thomas, and Ian Barnes. 2019. Ancient genomes indicate population replacement in Early Neolithic Britain. *Nature Ecology & Evolution* 3 (5):765-771.

Bramanti, B., M. G. Thomas, W. Haak, M. Unterlaender, P. Jores, K. Tambets, I. Antanaitis-Jacobs, M. N. Haidle, R. Jankauskas, C.-J. Kind, F. Lueth, T. Terberger, J. Hiller, S. Matsumura, P. Forster, and J. Burger. 2009. Genetic Discontinuity Between Local Hunter-Gatherers and Central Europe's First Farmers. *Science* 326 (5949):137-140.

Brandt, G., W. Haak, C. J. Adler, C. Roth, A. Szecsenyi-Nagy, S. Karimnia, S. Moller-Rieker, H. Meller, R. Ganslmeier, S. Friederich, V. Dresely, N. Nicklisch, J. K. Pickrell, F. Sirocko, D. Reich, A. Cooper, K. W. Alt, and

Consortium Genographic. 2013. Ancient DNA reveals key stages in the formation of central European mitochondrial genetic diversity. *Science* 342 (6155):257-61.

Brierley, Chris, Katie Manning, and Mark Maslin. 2018. Pastoralism may have delayed the end of the green Sahara. *Nature Communications* 9 (1):4018.

Briquel, D. 1999. *La civilisation etrusque*.

Brisighelli, F., C. Capelli, V. Alvarez-Iglesias, V. Onofri, G. Paoli, S. Tofanelli, A. Carracedo, V. L. Pascali, and A. Salas. 2009. The Etruscan timeline: a recent Anatolian connection. *Eur J Hum Genet* 17 (5):693-6.

Brodie, N. 2001. Technological frontiers and the emergence of the Beaker Culture. In *Bell Beakers today: pottery, people, culture, symbols in prehistoric Europe*, edited by F. Nicolis. Trento: Servicio Beni Culturali, Provincia Autonoma di Trento.

Broushaki, Farnaz, Mark G Thomas, Vivian Link, Saioa López, Lucy van Dorp, Karola Kirsanow, Zuzana Hofmanová, Yoan Diekmann, Lara M. Cassidy, David Díez-del-Molino, Athanasios Kousathanas, Christian Sell, Harry K. Robson, Rui Martiniano, Jens Blöcher, Amelie Scheu, Susanne Kreutzer, Ruth Bollongino, Dean Bobo, Hossein Davudi, Olivia Munoz, Mathias Currat, Kamyar Abdi, Fereidoun Biglari, Oliver E. Craig, Daniel G Bradley, Stephen Shennan, Krishna R Veeramah, Marjan Mashkour, Daniel Wegmann, Garrett Hellenthal, and Joachim Burger. 2016. Early Neolithic genomes from the eastern Fertile Crescent. *Science*.

Brück, Joanna, and Alex Davies. 2018. The Social Role of Non-metal 'Valuables' in Late Bronze Age Britain. *Cambridge Archaeological Journal* 28 (4):665-688.

Brunel, Samantha. 2018. Paléogénomique des dynamiques des populations humaines sur le territoire Français entre 7000 et 2000, Bio Sorbonne Paris Cité (BIOSPC) & Institut Jaques Monod, Sorbonne Paris Cité, Paris.

Brunet, Frédérique. 2012. The Technique of Pressure Knapping in Central Asia: innovation or Diffusion? In *The Emergence of Pressure Blade Making: From Origin to Modern Experimentation*, edited by P. M. Desrosiers. New York: Springer.

Bryce, Trevor. 2011. The Late Bronze Age in the West and the Aegean. In *The Oxford Handbook of Ancient Antolia 10,000-323 B.C.E.*, edited by S. R. Steadman and G. McMahon. Oxford: Oxford University Press.

Bueno Ramirez, Primitiva, Rodrigo de Balbín Behrmann, Rosa Barroso Bermejo, Enrique Cerrillo Cuenca, Antonio Gonzalez Cordero, and Alicia Prada Gallardo. 2011. Megaliths and stelae in the inner basin of Tagus River: Santiago de Alcántara, Alconétar and Cañamero (Cáceres, Spain). In *From the Origins: The Prehistory of the Inner Tagus Region*, edited by P. B. Ramirez, E. C. Cuenca and A. G. Cordero.

Bulatović, Aleksandar. 2014. Corded Ware in the Central and Southern Balkans: A Consequence of Cultural Interaction or an Indication of Ethnic Change? *JIES* 42 (1 & 2).

Burmeister, Stefan. 2016. Archaeological Research on Migration as a Multidisciplinary Challenge. In *The Genetic Challenge to Medieval History and Archaeology*, edited by W. Pohl and A. Gingrich: Austrian Academy of Sciences Press.

Butler, J.J., S. Arnoldussen, and H. Steegstra. 2011/2012. Single-edged socketed Urnfield knives in the Netherlands and western Europe. *Palaeohistoria* 53/54:65-107.

Bycroft, Clare, Ceres Fernández-Rozadilla, Clara Ruiz-Ponte, Iéns Quintela-García, Ángel Carracedo, Peter Donnelly, and Simon Myers. 2018. Patterns of genetic differentiation and the footprints of historical migrations in the Iberian Peninsula. *bioRxiv*.

Campbell, Lyle. 1998. Nostratic: A Personal Assessment. In *Nostratic: Sifting the Evidence*, edited by J. C. Salmons and B. D. Joseph. Amsterdam/Philadelphia: John Benjamins.

Repeated Author. 2015. Do Languages and Genes Correlate? *Language Dynamics and Change* 5 (2):202-226.

Cardarelli, Andrea. 2009. The Collapse of the Terramare Culture and growth of new economic and social System during the late Bronze Age in Italy. In *Scienze dell'Antichità. Storia archeologia antropologia*. Roma: Quasar.

Carling, Gerd. 2005. Proto-Tocharian, Common Tocharian, and Tocharian - on the value of linguistic connections in a reconstructed language. Paper read at Proceedeings of the Sixteenth Annual UCLA Indo-European Conference, at Los Angeles.

Carpelan, Chr., and A. Parpola. 2001. Emergence, Contacts and Dispersal of Proto-Inda-European, Proto-Uralic and Proto-Aryan in Archaeological Perspective. In *Early Contacts between Uralic and Indo-European: Linguistic and Archaeological Considerations*, edited by A. Parpola and P. Koskikallio. Helsinki: Memoires de la Societé Finno-Ougrienne.

Carpelan, Christian, and Asko Parpola. 2017. On the emergence, contacts and dispersal of Proto-Indo-European, Proto-Uralic and Proto-Aryan in an archaeological perspective. In *Language and Prehistory of the Indo-European Peoples*, edited by A. Hyllested, B. N. Whitehead, T. Olander and B. A. Olsen. Copenhagen: Museum Tusculanum Press.

Cassidy, L. M., R. Martiniano, E. M. Murphy, M. D. Teasdale, J. Mallory, B. Hartwell, and D. G. Bradley. 2016. Neolithic and Bronze Age migration to Ireland and establishment of the insular Atlantic genome. *Proc Natl Acad Sci U S A* 113 (2):368-73.

Cassidy, Lara. 2018. A Genomic Compendium of an Island: Documenting Continuity and Change across Irish Human Prehistory, School of Genetics & Microbiology, Trinity College Dublin., Dublin.

Cavadas, Bruno, Nicole Pedro, Veronica Fernandes, Joana C Ferreira, Luisa Pereira, François-Xavier Ricaut, Nicolas Brucato, and Farida Alshamali. 2019. Genome-Wide Characterization of Arabian Peninsula Populations: Shedding Light on the History of a Fundamental Bridge between Continents.

Chadwick, Nora. 1970. *The Celts*. London: Folio Society.

Chazin, Hannah, Gwyneth W. Gordon, and Kelly J. Knudson. 2019. Isotopic perspectives on pastoralist mobility in the Late Bronze Age South Caucasus. *Journal of Anthropological Archaeology* 54:48-67.

Chechushkov, I. V., A. S. Yakimov, O. P. Bachura, Yan Chuen Ng, and E. N. Goncharova. 2018. Social Organization of the Sintashta-Petrovka Groups of the Late Bronze Age and a Cause for Origin of Social Elites (Based on Materials of the Settlement of Kamenny Ambar). *Stratum plus* 2:149-166.

Chechushkov, Igor V. 2018. Bronze Age Human Communities in the Southern Urals Steppe: Sintashta-Petrovka Social and Subsistence Organization, Graduate Faculty of The Dietrich School of Arts and Sciences, University of Pittsburgh, PIttsburgh.

Chechushkov, Igor V., and Andrei V. Epimakhov. 2018. Eurasian Steppe Chariots and Social Complexity During the Bronze Age. *Journal of World Prehistory*.

Chechushkov, Igor V., Andrei V. Epimakhov, and Andrei G. Bersenev. 2018. Early horse bridle with cheekpieces as a marker of social change: An experimental and statistical study. *Journal of Archaeological Science* 97:125-136.

Chekunova, E.M., N.V. Yartseva, M.K. Chekunov, and A.N. Mazurkevich. 2014. The First Results of the Genotyping of the Aboriginals and Human Bone Remains of the Archeological Memorials of the Upper Podvin'e. // Archeology of the lake settlements of IV—II Thousands BC: The chronology of cultures and natural environment and climatic rhythms. Paper read at Proceedings of the International Conference, Devoted to the 50-year Research of the Pile Settlements on the North-West of Russia., 13-15 November, at St. Petersburg.

Chernykh, E. N. 1992. *Ancient Metallurgy in the USSR.* Cambridge: Cambridge University Press.

Chiang, Charleston W. K., Joseph H. Marcus, Carlo Sidore, Arjun Biddanda, Hussein Al-Asadi, Magdalena Zoledziewska, Maristella Pitzalis, Fabio Busonero, Andrea Maschio, Giorgio Pistis, Maristella Steri, Andrea Angius, Kirk E. Lohmueller, Goncalo R. Abecasis, David Schlessinger, Francesco Cucca, and John Novembre. 2018. Genomic history of the Sardinian population. *Nature Genetics* 50 (10):1426-1434.

Cilli, Elisabetta, Stefania Sarno, Guido Alberto Gnecchi Ruscone, Patrizia Serventi, Sara De Fanti, Paolo Delaini, Paolo Ognibene, Gian Pietro Basello, Gloria Ravegnini, Sabrina Angelini, Gianmarco Ferri, Davide Gentilini, Anna Maria Di Blasio, Susi Pelotti, Davide Pettener, Marco Sazzini, Antonio Panaino, Donata Luiselli, and Giorgio Gruppioni. 2019. The genetic legacy of the Yaghnobis: A witness of an ancient Eurasian ancestry in the historically reshuffled central Asian gene pool. *American Journal of Physical Anthropology*:1-12.

Clackson, James. 2007. *Indo-European Linguistics. An Introduction*. Cambridge: Cambridge University Press.

Repeated Author. 2013. The Origins of the Indic Languages: the Indo-European model. In *Perspectives on the origin of Indian civilization*, edited by A. Marcantonio and G. N. Jha. New Delhi: D.K. Printworld

Clare, Lee, and Bernhard Weninger. 2016. Early Warfare and its Contribution to Neolithisation and Dispersal. In *Palaeoenviroment and the Development of Early Societies (Şanlıurfa / Turkey, 7 October 2012)*, edited by M. Reindel, K. Bartl, F. Lüth and N. Benecke. Rahden: Marie Leidorf.

Corboud , P. 2009. Les stèles anthropomorphes de la nécropole néolithique du Petit-Chasseur à Sion. *Bulletin d'études préhistoriques et archéologiques alpines* 20:1-89.

Coromines, Joan. 1976. Els ploms sorotàptics d'Arles. In *Entre dos llenguatges*, edited by J. Coromines. Barcelona: Curial Edicions Catalanes.

Cramp, Lucy J. E., Richard P. Evershed, Mika Lavento, Petri Halinen, Kristiina Mannermaa, Markku Oinonen, Johannes Kettunen, Markus Perola, Päivi

Onkamo, and Volker Heyd. 2014. Neolithic dairy farming at the extreme of agriculture in northern Europe. *Proceedings of the Royal Society B: Biological Sciences* 281 (1791).

Cruciani, F., B. Trombetta, D. Sellitto, A. Massaia, G. Destro-Bisol, E. Watson, E. Beraud Colomb, J. M. Dugoujon, P. Moral, and R. Scozzari. 2010. Human Y chromosome haplogroup R-V88: a paternal genetic record of early mid Holocene trans-Saharan connections and the spread of Chadic languages. *Eur J Hum Genet* 18 (7):800-7.

Csáky, Veronika, Dániel Gerber, István Koncz, Gergely Csiky, Balázs G. Mende, Antónia Marcsik, Erika Molnár, György Pálfi, András Gulyás, Bernadett Kovacsóczy, Gabriella M. Lezsák, Gábor Lőrinczy, Anna Szécsényi-Nagy, and Tivadar Vida. 2018. Inner Asian maternal genetic origin of the Avar period nomadic elite in the 7th century AD Carpathian Basin. *bioRxiv*.

Csáky, Veronika, Dániel Gerber, István Koncz, Gergely Csiky, Balázs G. Mende, Bea Szeifert, Balázs Egyed, Horolma Pamjav, Antónia Marcsik, Erika Molnár, György Pálfi, András Gulyás, Bernadett Kovacsóczy, Gabriella M. Lezsák, Gábor Lőrinczy, Anna Szécsényi-Nagy, and Tivadar Vida. 2019. Genetic insights into the social organisation of the Avar period elite in the 7th century AD Carpathian Basin. *bioRxiv*:415760.

Csányi, B., E. Bogácsi-Szabó, Gy Tömöry, Á Czibula, K. Priskin, A. Csõsz, B. Mende, P. Langó, K. Csete, A. Zsolnai, E. K. Conant, C. S. Downes, and I. Raskó. 2008. Y-Chromosome Analysis of Ancient Hungarian and Two Modern Hungarian-Speaking Populations from the Carpathian Basin. *Annals of Human Genetics* 72 (4):519-534.

Cui, Yinqiu, Hongjie Li, Chao Ning, Ye Zhang, Lu Chen, Xin Zhao, Erika Hagelberg, and Hui Zhou. 2013. Y Chromosome analysis of prehistoric human populations in the West Liao River Valley, Northeast China. *BMC Evolutionary Biology* 13 (1):216.

Curry, Andrew. 2016. Slaughter at the bridge: Uncovering a colossal Bronze Age battle. *Science News*.

Curta, Florin. 2001. *The Making of the Slavs: History and Archaeology of the Lower Danube Region, c. 500-700, Cambridge Studies in Medieval Life and Thought: Fourth Series*. Cambridge: Cambridge University Press.

Repeated Author. 2019. *Eastern Europe in the Middle Ages (500-1300), Brill's Companions to European History*. Leiden/Boston: Brill.

Czebreszuk, J. 2001. *Schyłek neolitu i początki epoki brązu w strefie południowozachodniobałtyckiej (III i początki II tys. przed Chr.). Alternatywny model kultur*. Poznań: Adam Mickiewicz University.

Czebreszuk, J., and M. Szmyt. 2004. Chronology of Central-European Influences within the Western Part of the Forest Zone during the 3rd Millenium BC. In *Проблемы хронологии и этнокультурных взаимодействий в неолите Евразии*, edited by V. I. Timofeev and G. I. Zayceva. Санкт-Петербург: ИИМК РАН.

Czebreszuk, Janusz. 1998. "Trzciniec". An alternative view. In *The Trzciniec area of the Early Bronze Age civilization: 1950-1200 BC*. Poznan.

Repeated Author. 2013. The Bronze Age in the Polish Lands. In *The Oxford Handbook of the European Bronze Age*, edited by H. Fokkens and A. Harding. Oxford: Oxford University Press.

Czebreszuk, Janusz, and Marzena Szmyt. 2008. Siedlungsformen des 3. Jahrtausends v. Chr. in der polnischen Tiefebene (Kulturen der Trichterbecher, Kugelamphoren und Schnurkeramik). Stand und Perspektiven der Untersuchungen. In *Umwelt – Wirtschaft – Siedlungen im dritten vorchristlichen Jahrtausend Mitteleuropas und Südskandinaviens. Internationale Tagung Kiel 4.–6. November 2005*, edited by W. Dörfler and J. Müller. Neumünster: Wachholtz.

Repeated Author. 2008. What lies behind 'Import' and 'Imitation'? Case Studies from the European Late Neolithic. In *Import and Imitation in Archaeology*, edited by F. Bertemes and A. Furtwängler. Langenweissbach: Beier & Beran.

Repeated Author. 2011. Identities, Differentiation and Interactions on the Central European Plain in the 3rd millennium BC. In *Sozialarchäologische Perspektive: Gesellschaftlicher Wandel 5000-1500 v. Chr. zwichen Atlantik und Kaukasus*, edited by S. Hansen and J. Müller. Darmstadt: philipp von Zabern.

Repeated Author. 2012. Bell Beakers and the cultural milieu of north European plain. In *Background to Beakers. Inquiries into regional cultural backgrounds of the Bell Beaker complex*, edited by H. Fokkens and F. Nicolis. Leiden: Sidestone Press.

D'Atanasio, Eugenia, Beniamino Trombetta, Maria Bonito, Andrea Finocchio, Genny Di Vito, Mara Seghizzi, Rita Romano, Gianluca Russo, Giacomo Maria Paganotti, Elizabeth Watson, Alfredo Coppa, Paolo Anagnostou, Jean-Michel Dugoujon, Pedro Moral, Daniele Sellitto, Andrea Novelletto, and Fulvio Cruciani. 2018. The peopling of the last Green Sahara revealed by high-coverage resequencing of trans-Saharan patrilineages. *Genome Biology* 19 (1):20.

Damlien, Hege, Inger Marie Berg-Hansen, Ilga Zagorska, Mārcis Kalniņš, Svein V. Nielsen, Lucia U. Koxvold, Valdis Bērziņš, and Almut Schülke. 2018. A technological crossroads: Exploring diversity in the pressure blade technology of Mesolithic Latvia. *Oxford Journal of Archaeology* 37 (3):229-246.

Damm, Charlotte. 2012. From entities to interaction. Replacing pots and people with networks of transmission. In *A Linguistic Map of Northern Europe*, edited by R.Grünthal and P.Kallio. Helsinki: The Finno-Ugrian Society.

Darmark, Kim. 2012. Surface Pressure Flaking in Eurasia: Mapping the Innovation, Diffusion and Evolution of a Technological Element in the Production of Projectile Points. In *The Emergence of Pressure Blade Making: From Origin to Modern Experimentation*, edited by P. M. Desrosiers. New York: Springer.

de Barros Damgaard, Peter, Nina Marchi, Simon Rasmussen, Michaël Peyrot, Gabriel Renaud, Thorfinn Korneliussen, J. Víctor Moreno-Mayar, Mikkel Winther Pedersen, Amy Goldberg, Emma Usmanova, Nurbol Baimukhanov, Valeriy Loman, Lotte Hedeager, Anders Gorm Pedersen, Kasper Nielsen, Gennady Afanasiev, Kunbolot Akmatov, Almaz Aldashev, Ashyk Alpaslan, Gabit Baimbetov, Vladimir I. Bazaliiskii, Arman Beisenov, Bazartseren Boldbaatar, Bazartseren Boldgiv, Choduraa Dorzhu, Sturla Ellingvag, Diimaajav Erdenebaatar, Rana Dajani, Evgeniy Dmitriev, Valeriy Evdokimov, Karin M. Frei, Andrey Gromov, Alexander Goryachev, Hakon Hakonarson, Tatyana Hegay, Zaruhi Khachatryan, Ruslan Khaskhanov, Egor Kitov, Alina Kolbina, Tabaldiev Kubatbek, Alexey Kukushkin, Igor Kukushkin, Nina Lau, Ashot Margaryan, Inga Merkyte, Ilya V. Mertz, Viktor K. Mertz, Enkhbayar

Mijiddorj, Vyacheslav Moiyesev, Gulmira Mukhtarova, Bekmukhanbet Nurmukhanbetov, Z. Orozbekova, Irina Panyushkina, Karol Pieta, Václav Smrčka, Irina Shevnina, Andrey Logvin, Karl-Göran Sjögren, Tereza Štolcová, Angela M. Taravella, Kadicha Tashbaeva, Alexander Tkachev, Turaly Tulegenov, Dmitriy Voyakin, Levon Yepiskoposyan, Sainbileg Undrakhbold, Victor Varfolomeev, Andrzej Weber, Melissa A. Wilson Sayres, Nikolay Kradin, Morten E. Allentoft, Ludovic Orlando, Rasmus Nielsen, Martin Sikora, Evelyne Heyer, Kristian Kristiansen, and Eske Willerslev. 2018. 137 ancient human genomes from across the Eurasian steppes. *Nature* 557 (7705):369-374.

de Barros Damgaard, Peter, Rui Martiniano, Jack Kamm, J. Víctor Moreno-Mayar, Guus Kroonen, Michaël Peyrot, Gojko Barjamovic, Simon Rasmussen, Claus Zacho, Nurbol Baimukhanov, Victor Zaibert, Victor Merz, Arjun Biddanda, Ilja Merz, Valeriy Loman, Valeriy Evdokimov, Emma Usmanova, Brian Hemphill, Andaine Seguin-Orlando, Fulya Eylem Yediay, Inam Ullah, Karl-Göran Sjögren, Katrine Højholt Iversen, Jeremy Choin, Constanza de la Fuente, Melissa Ilardo, Hannes Schroeder, Vyacheslav Moiseyev, Andrey Gromov, Andrei Polyakov, Sachihiro Omura, Süleyman Yücel Senyurt, Habib Ahmad, Catriona McKenzie, Ashot Margaryan, Abdul Hameed, Abdul Samad, Nazish Gul, Muhammad Hassan Khokhar, O. I. Goriunova, Vladimir I. Bazaliiskii, John Novembre, Andrzej W. Weber, Ludovic Orlando, Morten E. Allentoft, Rasmus Nielsen, Kristian Kristiansen, Martin Sikora, Alan K. Outram, Richard Durbin, and Eske Willerslev. 2018. The first horse herders and the impact of early Bronze Age steppe expansions into Asia. *Science*.

della Casa, Philippe. 2013. Switzerland and the Central Alps. In *The Oxford Handbook of the European Bronze Age*, edited by H. Fokkens and A. Harding. Oxford: Oxford University Press.

Demkina, T. S., A. V. Borisov, V. A. Demkin, T. E. Khomutova, T. V. Kuznetsova, M. V. El'tsov, and S. N. Udal'tsov. 2017. Paleoecological crisis in the steppes of the Lower Volga region in the Middle of the Bronze Age (III–II centuries BC). *Eurasian Soil Science* 50 (7):791-804.

Deom, Jean-Marc, Renato Sala, and Anne Laudisoit. 2019. The Ili River Delta: Holocene Hydrogeological Evolution and Human Colonization. In *Socio-Environmental Dynamics along the Historical Silk Road*, edited by L. E. Yang, H.-R. Bork, X. Fang and S. Mischke. Cham: Springer International Publishing.

Dergachev, V.A. 2007. *O skipetrakh, o loshadjakh, o voine: etjudy v zashchitu migratsionnoi kontseptsii M. Gimbutas*. Sankt-Peterburg: Nestor-Istorija.

Di Cristofaro, Julie, Stéphane Mazières, Audrey Tous, Cornelia Di Gaetano, Alice A. Lin, Paul Nebbia, Alberto Piazza, Roy J. King, Peter Underhill, and Jacques Chiaroni. 2018. Prehistoric migrations through the Mediterranean basin shaped Corsican Y-chromosome diversity. *PLOS ONE* 13 (8):e0200641.

di Lernia, Savino. 2013. Places, monuments, and landscape: evidence from the Holocene central Sahara. *Azania: Archaeological Research in Africa* 48 (2):173-192.

Diakonoff, Igor M., and Sergei A. Starostin. 1988. Hurro-Urartian and East Caucasian Languages. In *Ancient Orient. Ethnocultural Relations*.

Díaz-Guardamino, Marta. 2014. Shaping Social Identities in Bronze Age and Early Iron Age Western Iberia: The Role of Funerary Practices, Stelae, and Statue-Menhirs. *European Journal of Archaeology* 17 (2):329-349.

Dietrich, Laura. 2011. Gânduri asupra dimensiunilor sociale ale vaselor de tip kantharos din cultura Noua (Gedanken über die sozialen Dimensionen der Kantharos-Gefäße der Noua-Kultur). In *Archaeology. Making of and practice. Studies in honor of Mircea Babeş at his 70th anniversary*, edited by D. Măgureanu, D. Măndescu and S. Matei. Piteşti: Ordessos.

Dolgikh, B.O. . 1960. *Rodovoi i plemennoi sostav narodov Sibiri v XVII veke [The clans and Tribes of the Peoples of Siberia in the 17th century]*. Moscow.

Repeated Author. 1962. *Rodovaya ekzogamiya y nganasan i entsev [The Clan Exogamy among the Nganasans and the Enets], Siberian Ethnographic Collection.* Moscow: Publishing house of the Academy of Sciences of the USSR.

Dolukhanov, P. M. 1989. Prehistoric ethnicity in the north-east of Europe. *Fennoscandia Archaeologica* 6:81-84.

Drake, Nick A., Roger M. Blench, Simon J. Armitage, Charlie S. Bristow, and Kevin H. White. 2011. Ancient watercourses and biogeography of the Sahara explain the peopling of the desert. *Proceedings of the National Academy of Sciences* 108 (2):458-462.

Dudás, Eszter, Andrea Vágó-Zalán, Anna Vándor, Anastasia Saypasheva, Péter Pomozi, and Horolma Pamjav. 2019. Genetic history of Bashkirian Mari and Southern Mansi ethnic groups in the Ural region. *Molecular Genetics and Genomics*.

Duffy, Paul R., Györgyi M. Parditka, Julia I. Giblin, and László Paja. 2019. The problem with tells: lessons learned from absolute dating of Bronze Age mortuary ceramics in Hungary. *Antiquity* 93 (367):63-79.

Dunkel, G.E. 1997. Early, Middle, Late Indo-European: Doing it My Way. *Incontri Linguistici* 20:29-44.

Dzięgielewski, Karol. 2017. Late Bronze and Early Iron Age communities in the northern part of the Polish Lowland (1000-500 BC). In *The Past Societies. Polish lands from the first evidence of human presence to the early Middle Ages. Volume 3: 2000–500 BC*, edited by U. Bugaj. Warszawa.

Earle, T., J. Ling, C. Uhnér, Z. Stos-Gale, and L. Melheim. 2015. The Political Economy and Metal Trade in Bronze Age Europe: Understanding Regional Variability in Terms of Comparative Advantages and Articulations. *European Journal of Archaeology* 18 (4):633-657.

Ebenesersdóttir, S. Sunna, Marcela Sandoval-Velasco, Ellen D. Gunnarsdóttir, Anuradha Jagadeesan, Valdís B. Guðmundsdóttir, Elísabet L. Thordardóttir, Margrét S. Einarsdóttir, Kristjan H. S. Moore, Ásgeir Sigurðsson, Droplaug N. Magnúsdóttir, Hákon Jónsson, Steinunn Snorradóttir, Eivind Hovig, Pål Møller, Ingrid Kockum, Tomas Olsson, Lars Alfredsson, Thomas F. Hansen, Thomas Werge, Gianpiero L. Cavalleri, Edmund Gilbert, Carles Lalueza-Fox, Joe W. Walser, Steinunn Kristjánsdóttir, Shyam Gopalakrishnan, Lilja Árnadóttir, Ólafur Þ. Magnússon, M. Thomas P. Gilbert, Kári Stefánsson, and Agnar Helgason. 2018. Ancient genomes from Iceland reveal the making of a human population. *Science* 360 (6392):1028-1032.

Eisenmann, Stefanie, Eszter Bánffy, Peter van Dommelen, Kerstin P. Hofmann, Joseph Maran, Iosif Lazaridis, Alissa Mittnik, Michael McCormick, Johannes Krause, David Reich, and Philipp W. Stockhammer. 2018. Reconciling material cultures in archaeology with genetic data: The nomenclature of clusters emerging from archaeogenomic analysis. *Scientific Reports* 8 (1):13003.

Emery, Matthew. 2018. Assessing Migration and Demographic Change in pre-Roman and Roman Period Southern Italy Using Whole-Mitochondrial DNA and Stable Isotope Analysis, Anthropology, McMaster University, Hamilton, Ontario.

Eriksson, Gunilla, Karin Margarita Frei, Rachel Howcroft, Sara Gummesson, Fredrik Molin, Kerstin Lidén, Robert Frei, and Fredrik Hallgren. 2018. Diet and mobility among Mesolithic hunter-gatherers in Motala (Sweden) - The isotope perspective. *Journal of Archaeological Science: Reports* 17:904-918.

Ethier, Jonathan, Eszter Bánffy, Jasna Vuković, Krassimir Leshtakov, Krum Bacvarov, Mélanie Roffet-Salque, Richard P. Evershed, and Maria Ivanova. 2017. Earliest expansion of animal husbandry beyond the Mediterranean zone in the sixth millennium BC. *Scientific Reports* 7:7146.

Fages, Antoine, Kristian Hanghøj, Naveed Khan, Charleen Gaunitz, Andaine Seguin-Orlando, Michela Leonardi, Christian McCrory Constantz, Cristina Gamba, Khaled A. S. Al-Rasheid, Silvia Albizuri, Ahmed H. Alfarhan, Morten Allentoft, Saleh Alquraishi, David Anthony, Nurbol Baimukhanov, James H. Barrett, Jamsranjav Bayarsaikhan, Norbert Benecke, Eloísa Bernáldez-Sánchez, Luis Berrocal-Rangel, Fereidoun Biglari, Sanne Boessenkool, Bazartseren Boldgiv, Gottfried Brem, Dorcas Brown, Joachim Burger, Eric Crubézy, Linas Daugnora, Hossein Davoudi, Peter de Barros Damgaard, María de los Ángeles de Chorro y de Villa-Ceballos, Sabine Deschler-Erb, Cleia Detry, Nadine Dill, Maria do Mar Oom, Anna Dohr, Sturla Ellingvåg, Diimaajav Erdenebaatar, Homa Fathi, Sabine Felkel, Carlos Fernández-Rodríguez, Esteban García-Viñas, Mietje Germonpré, José D. Granado, Jón H. Hallsson, Helmut Hemmer, Michael Hofreiter, Aleksei Kasparov, Mutalib Khasanov, Roya Khazaeli, Pavel Kosintsev, Kristian Kristiansen, Tabaldiev Kubatbek, Lukas Kuderna, Pavel Kuznetsov, Haeedeh Laleh, Jennifer A. Leonard, Johanna Lhuillier, Corina Liesau von Lettow-Vorbeck, Andrey Logvin, Lembi Lõugas, Arne Ludwig, Cristina Luis, Ana Margarida Arruda, Tomas Marques-Bonet, Raquel Matoso Silva, Victor Merz, Enkhbayar Mijiddorj, Bryan K. Miller, Oleg Monchalov, Fatemeh A. Mohaseb, Arturo Morales, Ariadna Nieto-Espinet, Heidi Nistelberger, Vedat Onar, Albína H. Pálsdóttir, Vladimir Pitulko, Konstantin Pitskhelauri, Mélanie Pruvost, Petra Rajic Sikanjic, Anita Rapan Papeša, Natalia Roslyakova, Alireza Sardari, Eberhard Sauer, Renate Schafberg, Amelie Scheu, Jörg Schibler, Angela Schlumbaum, Nathalie Serrand, Aitor Serres-Armero, Beth Shapiro, Shiva Sheikhi Seno, Irina Shevnina, Sonia Shidrang, John Southon, Bastiaan Star, Naomi Sykes, Kamal Taheri, William Taylor, Wolf-Rüdiger Teegen, Tajana Trbojević Vukičević, Simon Trixl, Dashzeveg Tumen, Sainbileg Undrakhbold, Emma Usmanova, Ali Vahdati, Silvia Valenzuela-Lamas, Catarina Viegas, Barbara Wallner, Jaco Weinstock, Victor Zaibert, Benoit Clavel, Sébastien Lepetz, Marjan Mashkour, Agnar Helgason, Kári Stefánsson, Eric Barrey, Eske Willerslev, Alan K. Outram, Pablo Librado, and Ludovic Orlando. 2019. Tracking Five Millennia of Horse Management with Extensive Ancient Genome Time Series. *Cell*.

Fedorova, Sardana A., Maere Reidla, Ene Metspalu, Mait Metspalu, Siiri Rootsi, Kristiina Tambets, Natalya Trofimova, Sergey I. Zhadanov, Baharak Hooshiar

Kashani, Anna Olivieri, Mikhail I. Voevoda, Ludmila P. Osipova, Fedor A. Platonov, Mikhail I. Tomsky, Elza K. Khusnutdinova, Antonio Torroni, and Richard Villems. 2013. Autosomal and uniparental portraits of the native populations of Sakha (Yakutia): implications for the peopling of Northeast Eurasia. *BMC Evolutionary Biology* 13 (1):127.

Fedyunin, I. V. 2015. The Mesolithic of the Forest-Steppe Don Area: Retrospective and Prospective Reviews1. *Archaeology, Ethnology and Anthropology of Eurasia* 43 (1):16-27.

Feldman, Michal, Eva Fernández-Domínguez, Luke Reynolds, Douglas Baird, Jessica Pearson, Israel Hershkovitz, Hila May, Nigel Goring-Morris, Marion Benz, Julia Gresky, Raffaela A. Bianco, Andrew Fairbairn, Gökhan Mustafaoğlu, Philipp W. Stockhammer, Cosimo Posth, Wolfgang Haak, Choongwon Jeong, and Johannes Krause. 2019. Late Pleistocene human genome suggests a local origin for the first farmers of central Anatolia. *Nature Communications* 10 (1):1218.

Fernandes, D. M., D. Strapagiel, P. Borówka, B. Marciniak, E. Żądzińska, K. Sirak, V. Siska, R. Grygiel, J. Carlsson, A. Manica, W. Lorkiewicz, and R. Pinhasi. 2018. A genomic Neolithic time transect of hunter-farmer admixture in central Poland. *Scientific Reports* 8 (1):14879.

Fernandes, Daniel M., Alissa Mittnik, Iñigo Olalde, Iosif Lazaridis, Olivia Cheronet, Nadin Rohland, Swapan Mallick, Rebecca Bernardos, Nasreen Broomandkhoshbacht, Jens Carlsson, Brendan J. Culleton, Matthew Ferry, Beatriz Gamarra, Martina Lari, Matthew Mah, Megan Michel, Alessandra Modi, Mario Novak, Jonas Oppenheimer, Kendra A. Sirak, Kirstin Stewardson, Stefania Vai, Edgard Camarós, Carla Calò, Giulio Catalano, Marian Cueto, Vincenza Forgia, Marina Lozano, Elisabetta Marini, Margherita Micheletti, Roberto M. Miccichè, Maria R. Palombo, Damià Ramis, Vittoria Schimmenti, Pau Sureda, Luís Teira, Maria Teschler-Nicola, Douglas J. Kennett, Carles Lalueza-Fox, Nick Patterson, Luca Sineo, David Caramelli, Ron Pinhasi, and David Reich. 2019. The Arrival of Steppe and Iranian Related Ancestry in the Islands of the Western Mediterranean. *bioRxiv*:584714.

Fitzpatrick, A. P. 2011. *The Amesbury Archer and the Boscombe Bowmen. Bell Beaker Burials on Boscombe Down, Amesbury, Wiltshire*. Salisbury: Wessex Archaeology.

Flegontov, P., P. Changmai, A. Zidkova, M. D. Logacheva, N. E. Altinisik, O. Flegontova, M. S. Gelfand, E. S. Gerasimov, E. E. Khrameeva, O. P. Konovalova, T. Neretina, Y. V. Nikolsky, G. Starostin, V. V. Stepanova, I. V. Travinsky, M. Triska, P. Triska, and T. V. Tatarinova. 2016. Genomic study of the Ket: a Paleo-Eskimo-related ethnic group with significant ancient North Eurasian ancestry. *Sci Rep* 6:20768.

Fokkens, Harry, and David Fontijn. 2013. The Bronze Age in the Low Countries. In *The Oxford Handbook of the European Bronze Age*, edited by H. Fokkens and A. Harding. Oxford: Oxford University Press.

Forni, Gianfranco. 2013. Evidence for Basque as an Indo-European Language. *JIES* 41 (1 & 2):1-142.

Fóthi, E., T. Fehér, Á. Fóthi, and C. Keyser. 2019. Európai És Ázsiai Apai Genetikai Vonalak A Honfoglaló Magyar Törzsekben. *Avicenna Institute of Middle Eastern Studies*.

Frangipane, Marcella. 2015. Different types of multiethnic societies and different patterns of development and change in the prehistoric Near East. *Proceedings of the National Academy of Sciences* 112 (30):9182-9189.

Frangipane, Marcella, Federico Manuelli, and Cristiano Vignola. 2017. Arslantepe, Malatya: Recent Discoveries in the 2015 and 2016 Seasons. In *The Archaeology of Anatolia Volume II: Recent Discoveries (2015-2016)*, edited by S. R. Steadman and G. McMahon. Newcastle: Cambridge Scholars Publishing.

Fraser, Magdalena, Federico Sanchez-Quinto, Jane Evans, Jan Storå, Anders Götherström, Paul Wallin, Kjel Knutsson, and Mattias Jakobsson. 2018. New insights on cultural dualism and population structure in the Middle Neolithic Funnel Beaker culture on the island of Gotland. *Journal of Archaeological Science: Reports* 17:325-334.

Fraser, Magdalena, Per Sjödin, Federico Sanchez-Quinto, Jane Evans, Gustaf Svedjemo, Kjel Knutsson, Anders Götherström, Mattias Jakobsson, Paul Wallin, and Jan Storå. 2018. The stone cist conundrum: A multidisciplinary approach to investigate Late Neolithic/Early Bronze Age population demography on the island of Gotland. *Journal of Archaeological Science: Reports* 20:324-337.

Freder, Janine. 2010. Die mittelalterlichen Skelette von Usedom. Anthropologische Bearbeitung unter besonderer Berücksichtigung des ethnischen Hintergrundes, Fachbereich Biologie, Chemie, Pharmazie, Freie Universität Berlin, Berlin.

Fregel, Rosa, Fernado L. Mendez, Youssef Bokbot, Dimas Martin-Socas, Maria D. Camalich-Massieu, Maria C. Avila-Arcos, Peter A. Underhill, Beth Shapiro, Genevieve L Wojcik, Morten Rasmussen, Andre E. R. Soares, Joshua Kapp, Alexandra Sockell, Francisco J. Rodriguez-Santos, Abdeslam Mikdad, Jonathan Santana, Aioze Trujillo-Mederos, and Carlos D. Bustamante. 2017. Neolithization of North Africa involved the migration of people from both the Levant and Europe. *bioRxiv*.

Fregel, Rosa, Fernando L. Méndez, Youssef Bokbot, Dimas Martín-Socas, María D. Camalich-Massieu, Jonathan Santana, Jacob Morales, María C. Ávila-Arcos, Peter A. Underhill, Beth Shapiro, Genevieve Wojcik, Morten Rasmussen, André E. R. Soares, Joshua Kapp, Alexandra Sockell, Francisco J. Rodríguez-Santos, Abdeslam Mikdad, Aioze Trujillo-Mederos, and Carlos D. Bustamante. 2018. Ancient genomes from North Africa evidence prehistoric migrations to the Maghreb from both the Levant and Europe. *Proceedings of the National Academy of Sciences* 115 (26):6774-6779.

Frînculeasa, Alin, Bianca Preda, and Volker Heyd. 2015. Pit-Graves, Yamnaya and Kurgans at the Lower Danube: Disentangling late 4th and early 3rd Millennium BC Burial Customs, Equipment and Chronology. Praehistorische Zeitschrift 90/1-2, 2015, 45-113. *Praehistorische Zeitschrift* 90 (1-2):45-113.

Fu, Q., H. Li, P. Moorjani, F. Jay, S. M. Slepchenko, A. A. Bondarev, P. L. Johnson, A. Aximu-Petri, K. Prufer, C. de Filippo, M. Meyer, N. Zwyns, D. C. Salazar-Garcia, Y. V. Kuzmin, S. G. Keates, P. A. Kosintsev, D. I. Razhev, M. P. Richards, N. V. Peristov, M. Lachmann, K. Douka, T. F. Higham, M. Slatkin, J. J. Hublin, D. Reich, J. Kelso, T. B. Viola, and S. Paabo. 2014. Genome sequence of a 45,000-year-old modern human from western Siberia. *Nature* 514 (7523):445-9.

Fu, Q., C. Posth, M. Hajdinjak, M. Petr, S. Mallick, D. Fernandes, A. Furtwangler, W. Haak, M. Meyer, A. Mittnik, B. Nickel, A. Peltzer, N. Rohland, V. Slon, S. Talamo, I. Lazaridis, M. Lipson, I. Mathieson, S. Schiffels, P. Skoglund, A. P. Derevianko, N. Drozdov, V. Slavinsky, A. Tsybankov, R. G. Cremonesi, F. Mallegni, B. Gely, E. Vacca, M. R. Morales, L. G. Straus, C. Neugebauer-Maresch, M. Teschler-Nicola, S. Constantin, O. T. Moldovan, S. Benazzi, M. Peresani, D. Coppola, M. Lari, S. Ricci, A. Ronchitelli, F. Valentin, C. Thevenet, K. Wehrberger, D. Grigorescu, H. Rougier, I. Crevecoeur, D. Flas, P. Semal, M. A. Mannino, C. Cupillard, H. Bocherens, N. J. Conard, K. Harvati, V. Moiseyev, D. G. Drucker, J. Svoboda, M. P. Richards, D. Caramelli, R. Pinhasi, J. Kelso, N. Patterson, J. Krause, S. Paabo, and D. Reich. 2016. The genetic history of Ice Age Europe. *Nature* 534 (7606):200-5.

Furholt, Martin. 2014. Upending a 'Totality': Re-evaluating Corded Ware Variability in Late

Neolithic Europe. *Proceedings of the Prehistoric Society* 80:67-86.

Repeated Author. 2017. Massive Migrations? The Impact of Recent aDNA Studies on our View of Third Millennium Europe. *European Journal of Archaeology* 21 (2):159-191.

Furmanek, Mirosław, Agata Hałuszko, Maksym Mackiewicz, and Bartosz Myslecki. 2015. New data for research on the Bell Beaker Culture in Upper Silesia, Poland. In *2200 BC – Ein Klimasturz als Ursache für den Zerfall der Alten Welt? 2200 BC – A climatic breakdown as a cause for the collapse of the old world? 7. Mitteldeutscher Archäologentag vom 23. bis 26. Oktober 2014 in Halle (Saale)*, edited by H. Meller, H. W. Arz, R. Jung and R. Risch. Halle (Saale).

Gakuhari, Takashi, Shigeki Nakagome, Simon Rasmussen, Morten Allentoft, Takehiro Sato, Thorfinn Korneliussen, Blánaid Ní Chuinneagáin, Hiromi Matsumae, Kae Koganebuchi, Ryan Schmidt, Souichiro Mizushima, Osamu Kondo, Nobuo Shigehara, Minoru Yoneda, Ryosuke Kimura, Hajime Ishida, Yoshiyuki Masuyama, Yasuhiro Yamada, Atsushi Tajima, Hiroki Shibata, Atsushi Toyoda, Toshiyuki Tsurumoto, Tetsuaki Wakebe, Hiromi Shitara, Tsunehiko Hanihara, Eske Willerslev, Martin Sikora, and Hiroki Oota. 2019. Jomon genome sheds light on East Asian population history. *bioRxiv*:579177.

Gallego Llorente, M., E. R. Jones, A. Eriksson, V. Siska, K. W. Arthur, J. W. Arthur, M. C. Curtis, J. T. Stock, M. Coltorti, P. Pieruccini, S. Stretton, F. Brock, T. Higham, Y. Park, M. Hofreiter, D. G. Bradley, J. Bhak, R. Pinhasi, and A. Manica. 2015. Ancient Ethiopian genome reveals extensive Eurasian admixture in Eastern Africa. *Science* 350 (6262):820.

Gamba, C., E. R. Jones, M. D. Teasdale, R. L. McLaughlin, G. Gonzalez-Fortes, V. Mattiangeli, L. Domboroczki, I. Kovari, I. Pap, A. Anders, A. Whittle, J. Dani, P. Raczky, T. F. Higham, M. Hofreiter, D. G. Bradley, and R. Pinhasi. 2014. Genome flux and stasis in a five millennium transect of European prehistory. *Nat Commun* 5:5257.

Gardner, A.R:. 2002. Neolithic to Copper Age woodland impacts in northeast Hungary? Evidence from the pollen and sediment chemistry records. *The Holocene* 12 (5):541-553.

Gaunitz, Charleen, Antoine Fages, Kristian Hanghøj, Anders Albrechtsen, Naveed Khan, Mikkel Schubert, Andaine Seguin-Orlando, Ivy J. Owens, Sabine Felkel, Olivier Bignon-Lau, Peter de Barros Damgaard, Alissa Mittnik, Azadeh F. Mohaseb, Hossein Davoudi, Saleh Alquraishi, Ahmed H. Alfarhan, Khaled A. S. Al-Rasheid, Eric Crubézy, Norbert Benecke, Sandra Olsen, Dorcas Brown, David Anthony, Ken Massy, Vladimir Pitulko, Aleksei Kasparov, Gottfried Brem, Michael Hofreiter, Gulmira Mukhtarova, Nurbol Baimukhanov, Lembi Lõugas, Vedat Onar, Philipp W. Stockhammer, Johannes Krause, Bazartseren Boldgiv, Sainbileg Undrakhbold, Diimaajav Erdenebaatar, Sébastien Lepetz, Marjan Mashkour, Arne Ludwig, Barbara Wallner, Victor Merz, Ilja Merz, Viktor Zaibert, Eske Willerslev, Pablo Librado, Alan K. Outram, and Ludovic Orlando. 2018. Ancient genomes revisit the ancestry of domestic and Przewalski's horses. *Science* 360 (6384):111-114.

Gerling, C., E. Bánffy, J. Dani, K. Köhler, G. Kulcsár, A.W.G. Pike, V. Szeverényi, and V. Heyd. 2012. Immigration and transhumance in the Early Bronze Age Carpathian Basin: the occupants of a kurgan. *Antiquity* 86 (334):1097-1111.

Gibbs, Kevin, and Peter Jordan. 2013. Bridging the Boreal Forest: Siberian Archaeology and the Emergence of Pottery among Prehistoric Hunter-Gatherers of Northern Eurasia. *Sibirica* 12 (1):1-38.

Gilbert, Edmund, Seamus O'Reilly, Michael Merrigan, Darren McGettigan, Anne M. Molloy, Lawrence C. Brody, Walter Bodmer, Katarzyna Hutnik, Sean Ennis, Daniel J. Lawson, James F. Wilson, and Gianpiero L. Cavalleri. 2017. The Irish DNA Atlas: Revealing Fine-Scale Population Structure and History within Ireland. *Scientific Reports* 7 (1):17199.

Gimbutas, Marija. 1963. The Indo-Europeans: Archeological Problems. *American Anthropologist* 65 (4):815-836.

Repeated Author. 1977. The first wave of eurasian pastoralists into copper age europe. *JIES* 5 (4):277-338.

Repeated Author. 1993. The Indo-Europeanization of Europe: the intrusion of steppe pastoralists from south Russia and the transformation of Old Europe. *Word* 44 (2):205-222.

Gogaltan, Florin. 2012. Ritual Aspects of the Bronze Age Tell-Settlements in the Carpathian Basin. A Methodological Approach. *Ephemeris Napocensis* 22:7-56.

Golden, Peter B. 1992. The Türk Empires of Eurasia. In *An Introduction to the History of the Turkic Peoples. Ethnogenesis and State-Formation in Medieval and Early Modern Eurasia and the Middle East*. Wiesbaden: Otto Harrasowitz.

González-Fortes, G., F. Tassi, E. Trucchi, K. Henneberger, J. L. A. Paijmans, D. Díez-del-Molino, H. Schroeder, R. R. Susca, C. Barroso-Ruíz, F. J. Bermudez, C. Barroso-Medina, A. M. S. Bettencourt, H. A. Sampaio, A. Grandal-d'Anglade, A. Salas, A. de Lombera-Hermida, R. Fabregas Valcarce, M. Vaquero, S. Alonso, M. Lozano, X. P. Rodríguez-Alvarez, C. Fernández-Rodríguez, A. Manica, M. Hofreiter, and G. Barbujani. 2019. A western route of prehistoric human migration from Africa into the Iberian Peninsula. *Proceedings of the Royal Society B: Biological Sciences* 286 (1895):20182288.

González-Fortes, Gloria, Eppie R. Jones, Emma Lightfoot, Clive Bonsall, Catalin Lazar, Aurora Grandal-d'Anglade, María Dolores Garralda, Labib Drak, Veronika Siska, Angela Simalcsik, Adina Boroneanţ, Juan Ramón Vidal Romaní, Marcos Vaqueiro Rodríguez, Pablo Arias, Ron Pinhasi, Andrea Manica, and Michael Hofreiter. 2017. Paleogenomic Evidence for Multigenerational Mixing between Neolithic Farmers and Mesolithic Hunter-Gatherers in the Lower Danube Basin. *Current Biology* 27 (12):1801-1810.

Gopalan, Shyamalika, Richard E. W. Berl, Gillian Belbin, Christopher Gignoux, Marcus W. Feldman, Barry S. Hewlett, and Brenna M. Henn. 2019. Hunter-gatherer genomes reveal diverse demographic trajectories following the rise of farming in East Africa. *bioRxiv*:517730.

Górski, Jacek. 2012. Transcarpathian elements in the Trzciniec culture Wanderings of people or ideas? In *Václav Furmánek a doba bronzová : zborník k sedemdesiatym narodeninám*, edited by R. Kujovský and V. Mitáš: Nitra.

Grugni, V., V. Battaglia, B. Hooshiar Kashani, S. Parolo, N. Al-Zahery, A. Achilli, A. Olivieri, F. Gandini, M. Houshmand, M. H. Sanati, A. Torroni, and O. Semino. 2012. Ancient migratory events in the Middle East: new clues from the Y-chromosome variation of modern Iranians. *PLoS One* 7 (7):e41252.

Grugni, Viola, Alessandro Raveane, Francesca Mattioli, Vincenza Battaglia, Cinzia Sala, Daniela Toniolo, Luca Ferretti, Rita Gardella, Alessandro Achilli, Anna Olivieri, Antonio Torroni, Giuseppe Passarino, and Ornella Semino. 2018. Reconstructing the genetic history of Italians: new insights from a male (Y-chromosome) perspective. *Annals of Human Biology* 45 (1):44-56.

Grugni, Viola, Alessandro Raveane, Linda Ongaro, Vincenza Battaglia, Beniamino Trombetta, Giulia Colombo, Marco Rosario Capodiferro, Anna Olivieri, Alessandro Achilli, Ugo A. Perego, Jorge Motta, Maribel Tribaldos, Scott R. Woodward, Luca Ferretti, Fulvio Cruciani, Antonio Torroni, and Ornella Semino. 2019. Analysis of the human Y-chromosome haplogroup Q characterizes ancient population movements in Eurasia and the Americas. *BMC Biology* 17 (1):3.

Guilaine, Jean. 2017. The Neolithic Transition: From the Eastern to the Western Mediterranean. In *Times of Neolithic Transition along the Western Mediterranean*, edited by O. García-Puchol and D. C. Salazar-García: Springer.

Gunther, T., C. Valdiosera, H. Malmstrom, I. Urena, R. Rodriguez-Varela, O. O. Sverrisdottir, E. A. Daskalaki, P. Skoglund, T. Naidoo, E. M. Svensson, J. M. Bermudez de Castro, E. Carbonell, M. Dunn, J. Stora, E. Iriarte, J. L. Arsuaga, J. M. Carretero, A. Gotherstrom, and M. Jakobsson. 2015. Ancient genomes link early farmers from Atapuerca in Spain to modern-day Basques. *Proc Natl Acad Sci U S A* 112 (38):11917-22.

Günther, Torsten, Helena Malmström, Emma Svensson, Ayça Omrak, Federico Sánchez-Quinto, Gülşah M. Kılınç, Maja Krzewińska, Gunilla Eriksson, Magdalena Fraser, Hanna Edlund, Arielle R. Munters, Alexandra Coutinho, Luciana G. Simões, Mário Vicente, Anders Sjölander, Berit Jansen Sellevold, Roger Jørgensen, Peter Claes, Mark D. Shriver, Cristina Valdiosera, Mihai G. Netea, Jan Apel, Kerstin Lidén, Birgitte Skar, Jan Storå, Anders Götherström, and Mattias Jakobsson. 2017. Genomics of Mesolithic Scandinavia reveal colonization routes and high-latitude adaptation. *bioRxiv*.

Gworys, Bohdan, Joanna Rosińczuk-Tonderys, Aleksander Chrószcz, Maciej Janeczek, Andrzej Dwojak, Justyna Bazan, Mirosław Furmanek, Tadeusz Dobosz, Małgorzata Bonar, Anna Jonkisz, and Ireneusz Całkosiński. 2013. Assessment of late Neolithic pastoralist's life conditions from the Wroclaw–Jagodno site (SW Poland) on the basis of physiological stress markers. *Journal of Archaeological Science* 40 (6):2621-2630.

Haak, W., O. Balanovsky, J. J. Sanchez, S. Koshel, V. Zaporozhchenko, C. J. Adler, C. S. Der Sarkissian, G. Brandt, C. Schwarz, N. Nicklisch, V. Dresely, B. Fritsch, E. Balanovska, R. Villems, H. Meller, K. W. Alt, A. Cooper, and Consortium Members of the Genographic. 2010. Ancient DNA from European early neolithic farmers reveals their near eastern affinities. *PLoS Biol* 8 (11):e1000536.

Haak, W., I. Lazaridis, N. Patterson, N. Rohland, S. Mallick, B. Llamas, G. Brandt, S. Nordenfelt, E. Harney, K. Stewardson, Q. Fu, A. Mittnik, E. Banffy, C. Economou, M. Francken, S. Friederich, R. G. Pena, F. Hallgren, V. Khartanovich, A. Khokhlov, M. Kunst, P. Kuznetsov, H. Meller, O. Mochalov, V. Moiseyev, N. Nicklisch, S. L. Pichler, R. Risch, M. A. Rojo Guerra, C. Roth, A. Szecsenyi-Nagy, J. Wahl, M. Meyer, J. Krause, D. Brown, D. Anthony, A. Cooper, K. W. Alt, and D. Reich. 2015. Massive migration from the steppe was a source for Indo-European languages in Europe. *Nature* 522 (7555):207-11.

Haber, M., M. Mezzavilla, Y. Xue, D. Comas, P. Gasparini, P. Zalloua, and C. Tyler-Smith. 2016. Genetic evidence for an origin of the Armenians from Bronze Age mixing of multiple populations. *Eur J Hum Genet* 24 (6):931-6.

Haber, Marc, Claude Doumet-Serhal, Christiana Scheib, Yali Xue, Petr Danecek, Massimo Mezzavilla, Sonia Youhanna, Rui Martiniano, Javier Prado-Martinez, Michał Szpak, Elizabeth Matisoo-Smith, Holger Schutkowski, Richard Mikulski, Pierre Zalloua, Toomas Kivisild, and Chris Tyler-Smith. 2017. Continuity and admixture in the last five millennia of Levantine history from ancient Canaanite and present-day Lebanese genome sequences. *bioRxiv*.

Haber, Marc, Massimo Mezzavilla, Anders Bergström, Javier Prado-Martinez, Pille Hallast, Riyadh Saif-Ali, Molham Al-Habori, George Dedoussis, Eleftheria Zeggini, Jason Blue-Smith, R. Spencer Wells, Yali Xue, Pierre A Zalloua, and Chris Tyler-Smith. 2016. Chad Genetic Diversity Reveals an African History Marked by Multiple Holocene Eurasian Migrations. *The American Journal of Human Genetics* 99 (6):1316-1324.

Haber, Marc, Y. Xue, C. Scheib, C. Doumet-Serhal, T. Kivisild, and C. Tyler-Smith. 2018. Mount Lebanon provides an opportunity to study DNA from the ancient Near East. Paper read at American Society of Human Genetics Annual Meeting 2018. October 16-20, at San Diego.

Häkkinen, Jaakko. 2009. Kantauralin ajoitus ja paikannus: perustelut puntarissa. *SUSA/JSFOu* 92:9-56.

Hanks, Bryan, Alicia Ventresca Miller, Margaret Judd, Andrey Epimakhov, Dmitry Razhev, and Karen Privat. 2018. Bronze Age diet and economy: New stable isotope data from the Central Eurasian steppes (2100-1700 BC). *Journal of Archaeological Science* 97:14-25.

Hänsel, B., and S. Zimmer. 1994. *Die Indogermanen und das Pferd: Festschrift für Bernfried Schlerath*. Edited by S. Bökönyi and W. Meid, *Archaeolingua*. Budapest: Archaeolingua Alapítvány.

Harding, Anthony F. 2011. The tumulus in European prehistory: covering the body, housing the soul. In *Burial mounds in the copper and Bronze ages (Central and Eastern Europe – Balkans – Adriatic – Aegean, 4th-2nd millennium B.C.)*, edited by E. Borgna and S. Müller-Celka. Lyon: Maison de l'Orient.

Harney, Éadaoin, Hila May, Dina Shalem, Nadin Rohland, Swapan Mallick, Iosif Lazaridis, Rachel Sarig, Kristin Stewardson, Susanne Nordenfelt, Nick

Patterson, Israel Hershkovitz, and David Reich. 2018. Ancient DNA from Chalcolithic Israel reveals the role of population mixture in cultural transformation. *Nature Communications* 9 (1):3336.

Harper, Thomas K., Aleksandr Diachenko, Yuri Ya Rassamakin, and Douglas J. Kennett. 2019. Ecological dimensions of population dynamics and subsistence in Neo-Eneolithic Eastern Europe. *Journal of Anthropological Archaeology* 53:92-101.

Harrison, Richard, and Volker Heyd. 2007. The Transformation of Europe in the Third Millennium BC: the example of 'Le Petit-Chasseur I + III' (Sion, Valais, Switzerland). *Praehistorische Zeitschrift* 82 (2).

Hassett, Brenna, and Haluk Sağlamtimur. 2018. Radical 'royals'? Burial practices at Başur Höyük and the emergence of early states in Mesopotamia. *Antiquity* 92 (363):640-654.

Hedman, Sven-Donald. 2003. *Boplatser och offerplatser. Ekonomisk strategi och boplatsmönster bland skoggsamer 700–1600 AD*, *Studia archaeologica Universitatis Umensis*. Umeå.

Heggarty, Paul. 2015. Ancient DNA and the Indo-European Question. In *Diversity Linguistics Comment. Language structures throughout the world*. Leipzig: Max Planck Institute for Evolutionary Anthropology.

Heise, Marc E. 2014. Heads North or East? A re-examination of Beaker Burials in Britain, School of History, Classics and Archaeology, University of Edinburgh, Edinburgh.

Helimski, Eugene. 2001. Уральцы и их предшественники: белые пятна на этноисторической карте Северной Евразии и уральские языки. Paper read at Congressus Nonus Internationalis Fenno-Ugristarum IV. Dissertationes sectionum: Linguistica I,, at Tartu.

Hellenthal, G., G. B. Busby, G. Band, J. F. Wilson, C. Capelli, D. Falush, and S. Myers. 2014. A genetic atlas of human admixture history. *Science* 343 (6172):747-51.

Heraclides, Alexandros, Evy Bashiardes, Eva Fernández-Domínguez, Stefania Bertoncini, Marios Chimonas, Vasilis Christofi, Jonathan King, Bruce Budowle, Panayiotis Manoli, and Marios A. Cariolou. 2017. Y-chromosomal analysis of Greek Cypriots reveals a primarily common pre-Ottoman paternal ancestry with Turkish Cypriots. *PLOS ONE* 12 (6):e0179474.

Herrera, K. J., R. K. Lowery, L. Hadden, S. Calderon, C. Chiou, L. Yepiskoposyan, M. Regueiro, P. A. Underhill, and R. J. Herrera. 2012. Neolithic patrilineal signals indicate that the Armenian plateau was repopulated by agriculturalists. *Eur J Hum Genet* 20 (3):313-20.

Heyd, Volker. 2004. Soziale Organisation im 3. Jahrtausend v. Chr. entlang der oberen Donau: Der Fall Schnurkeramik und Glockenbecher. *Das Altertum* 49 (3):183-214.

Repeated Author. 2007. Families, Prestige Goods, Warriors & Complex Societies: Beaker Groups of the 3rd Millennium cal BC Along the Upper & Middle Danube. *Proceedings of the Prehistoric Society* 73:327-379.

Repeated Author. 2011. Yamnaya Groups and Tumuli west of the Black Sea. In: Ancestral Landscapes. In *Ancestral Landscape. Burial mounds in the Copper and Bronze Ages. Proceedings of the International Conference held in Udine, May 15th-18th 2008*, edited by E. Borgna and S. Müllller Celka. Lyon: TMO.

Repeated Author. 2012. Yamnaya gropus and tumuli west of the Black Sea. *Travaux de la Maison de l'Orient et de la Méditerranée. Série recherches archéologiques* 58 (1):535-555.

Repeated Author. 2013. Europe 2500 to 2200 BC: Between Expiring Ideologies and Emerging Complexity. In *The Oxford Handbook of the European Bronze Age*, edited by H. Fokkens and A. Harding. Oxford: Oxford University Press.

Repeated Author. 2013. Europe at the Dawn of the Bronze Age. In *Transition to the Bronze Age*, edited by V. Heyd, G. Kulcsár and V. Szeverényi. Budapest: Archaeolingua.

Repeated Author. 2016. Das Zeitalter der Ideologien: Migration, Interaktion und Expansion im prähistorischen Europa des 4. und 3. Jahrtausends v. Chr. In *Transitional Landscapes? The 3rd Millennium BC in Europe. Proceedings of the International Workshop "Socio-Environmental Dynamics over the Last 12,000 Years: The Creation of Landscapes III (15th – 18th April 2013)" in Kiel*, edited by M. Furholt, R. Großmann and M. Szmyt. Bonn: Dr. Rudolf Habelt.

Repeated Author. 2017. Kossinna's smile. *Antiquity* 91 (356):348-359.

Heyd, Volker, and Katharine Walker. 2004. The First Metalwork and Expressions of Social Power. In *The Oxford Handbook of Neolithic Europe*, edited by C. Fowler, J. Harding and D. Hofmann. Oxford: Oxford University Press.

Heyd, Vollker. 2007. When the West meets the East: The Eastern Periphery of the Bell Beaker Phenomenon and its Relation with the Aegean Early Bronze Age. In *Between the Aegean and Baltic Seas*, edited by I. Galanaki. Liège: Aegaeum.

Hildebrand, Elisabeth A., Katherine M. Grillo, Elizabeth A. Sawchuk, Susan K. Pfeiffer, Lawrence B. Conyers, Steven T. Goldstein, Austin Chad Hill, Anneke Janzen, Carla E. Klehm, Mark Helper, Purity Kiura, Emmanuel Ndiema, Cecilia Ngugi, John J. Shea, and Hong Wang. 2018. A monumental cemetery built by eastern Africa's first herders near Lake Turkana, Kenya. *Proceedings of the National Academy of Sciences* 115 (36):8942-8947.

Hofmanova, Z., S. Kreutzer, G. Hellenthal, C. Sell, Y. Diekmann, D. Diez-Del-Molino, L. van Dorp, S. Lopez, A. Kousathanas, V. Link, K. Kirsanow, L. M. Cassidy, R. Martiniano, M. Strobel, A. Scheu, K. Kotsakis, P. Halstead, S. Triantaphyllou, N. Kyparissi-Apostolika, D. Urem-Kotsou, C. Ziota, F. Adaktylou, S. Gopalan, D. M. Bobo, L. Winkelbach, J. Blocher, M. Unterlander, C. Leuenberger, C. Cilingiroglu, B. Horejs, F. Gerritsen, S. J. Shennan, D. G. Bradley, M. Currat, K. R. Veeramah, D. Wegmann, M. G. Thomas, C. Papageorgopoulou, and J. Burger. 2016. Early farmers from across Europe directly descended from Neolithic Aegeans. *Proc Natl Acad Sci U S A* 113 (25):6886-91.

Hollard, C., C. Keyser, P. H. Giscard, T. Tsagaan, N. Bayarkhuu, J. Bemmann, E. Crubezy, and B. Ludes. 2014. Strong genetic admixture in the Altai at the Middle Bronze Age revealed by uniparental and ancestry informative markers. *Forensic Sci Int Genet* 12:199-207.

Hollard, Clémence, Vincent Zvénigorosky, Alexey Kovalev, Yurii Kiryushin, Alexey Tishkin, Igor Lazaretov, Eric Crubézy, Bertrand Ludes, and Christine Keyser. 2018. New genetic evidence of affinities and discontinuities between bronze age Siberian populations. *American Journal of Physical Anthropology* 167 (1):97-107.

Hollfelder, Nina, Carina M. Schlebusch, Torsten Günther, Hiba Babiker, Hisham Y. Hassan, and Mattias Jakobsson. 2017. Northeast African genomic variation shaped by the continuity of indigenous groups and Eurasian migrations. *PLOS Genetics* 13 (8):e1006976.

Holmqvist, Elisabeth, Åsa M. Larsson, Aivar Kriiska, Vesa Palonen, Petro Pesonen, Kenichiro Mizohata, Paula Kouki, and Jyrki Räisänen. 2018. Tracing grog and pots to reveal Neolithic Corded Ware Culture contacts in the Baltic Sea region (SEM-EDS, PIXE). *Journal of Archaeological Science* 91:77-91.

Hoole, M., A. Sheridan, A. Boyle, T. Booth, S. Brace, Y. Diekmann, I. Olalde, M. Thomas, I. Barnes, J. Evans, C. Chenery, H. Sloane, H. Morrison, S. Fraser, S. Timpany, and D. Hamilton. 2018. 'Ava': a Beaker-associated woman from a cist at Achavanich, Highland, and the story of her (re-)discovery and subsequent study. *Proceedings of the Society of Antiquaries of Scotland* 147:73-118.

Horváth, Csaba Barnabás. 2014. The story of two northward migrations - origins of Finno-Permic and Balto-Slavic languages in northeast Europe, based on Y-chromosome haplogroups. *European Scientific Journal* 2:531-538.

Horváth, Tünde. 2016. 4000-2000 BC in Hungary: The Age of Transformation. In *The Carpathian Basin and the Northern Balkans between 3500 and 2500 BC: Common Aspects and Regional Differences*, edited by C. I. Popa. Alba Iulia: Mega.

Horváth, Tünde, János Dani, Ákos Pető, Łukasz Pospieszny, and Éva Svingor. 2013. Multidisciplinary Contributions to the Study of Pit Grave Culture Kurgans of the Great Hungarian Plain. In *Transition to the Bronze Age: Interregional Interaction and Socio-Cultural Change at the Beginning of the Third Millennium BC in the Carpathian Basin and Surrounding Regions*, edited by V. M. Heyd, G. Kulcsár and V. Szeverényi. Budapest: Archaeolingua.

Hovhannisyan, A, Z Khachatryan, M Haber, P Hrechdakian, T Karafet, P Zalloua, and L Yepiskoposyan. 2014. Different waves and directions of Neolithic migrations in the Armenian Highland. *Investig Genet* 5 (1):15.

Huang, Yun-Zhi, Horolma Pamjav, Pavel Flegontov, Vlastimil Stenzl, Shao-Qing Wen, Xin-Zhu Tong, Chuan-Chao Wang, Ling-Xiang Wang, Lan-Hai Wei, Jing-Yi Gao, Li Jin, and Hui Li. 2017. Dispersals of the Siberian Y-chromosome haplogroup Q in Eurasia. *Molecular Genetics and Genomics*.

Hyllested, Adam. 2009. Internal reconstruction vs. external comparison: the case of the Indo-Uralic larnygeals. In *Internal reconstruction in Indo-European: Methods, results and problems. Section papers from the XVIth International Conference on Historical Linguistics held at the University of Copenhagen*, edited by J. E. Rasmussen and T. Olander. Copenhagen: Museum Tusculanum.

Ilumae, A. M., M. Reidla, M. Chukhryaeva, M. Jarve, H. Post, M. Karmin, L. Saag, A. Agdzhoyan, A. Kushniarevich, S. Litvinov, N. Ekomasova, K. Tambets, E. Metspalu, R. Khusainova, B. Yunusbayev, E. K. Khusnutdinova, L. P. Osipova, S. Fedorova, O. Utevska, S. Koshel, E. Balanovska, D. M. Behar, O. Balanovsky, T. Kivisild, P. A. Underhill, R. Villems, and S. Rootsi. 2016. Human Y Chromosome Haplogroup N: A Non-trivial Time-Resolved Phylogeography that Cuts across Language Families. *Am J Hum Genet* 99 (1):163-73.

Ilumäe, Anne-Mai, Maere Reidla, Marina Chukhryaeva, Mari Järve, Helen Post, Monika Karmin, Lauri Saag, Anastasiya Agdzhoyan, Alena Kushniarevich, Sergey Litvinov, Natalya Ekomasova, Kristiina Tambets, Ene Metspalu, Rita Khusainova, Bayazit Yunusbayev, Elza K Khusnutdinova, Ludmila P Osipova, Sardana Fedorova, Olga Utevska, Sergey Koshel, Elena Balanovska, Doron M Behar, Oleg Balanovsky, Toomas Kivisild, Peter A Underhill, Richard Villems, and Siiri Rootsi. 2016. Human Y Chromosome Haplogroup N: A Non-trivial Time-Resolved Phylogeography that Cuts across Language Families. *The American Journal of Human Genetics* 99 (1):163-173.

ISOGG. 2018. Y-DNA Haplogroup Tree. Version: 13.270 . Date: 13 November 2018. International Society of Genetic Genealogy.

Ivanova, M., B. De Cupere, J. Ethier, and E. Marinova. 2018. Pioneer farming in southeast Europe during the early sixth millennium BC: Climate-related adaptations in the exploitation of plants and animals. *PLoS ONE* 13 (5):e0197225.

Ivanova, Svetlana V., and Gennadiy N. Toschev. 2015. The Middle-Dniester Cultural Contact Area of Early Metal Age Societies. The Frontier of Pontic and Baltic Drainage Basins in the 4Th/3Rd-2Nd Millennium Bc. In *Baltic-Pontic Studies*.

Janhunen, Juha. 2009. Proto-Uralic: What, where, and when? – The quasquicentennial of the Finno-Ugrian society. *SUST* 258:57-78.

Jantzen, Detlef, Gundula Lidke, Jana Dräger, Joachim Krüger, Knut Rassmann, Sebastian Lorenz, and Thomas Terberger. 2017. An early Bronze Age causeway in the Tollense Valley, Mecklenburg-Western Pomerania – The starting point of a violent conflict 3300 years ago? In *Bericht der römisch-germanischen Komission*. Frankfurt a.M.: Römisch-Germanische Kommission des Deutschen Archäologischen Instituts.

Jarosz, P., M. Mazurek, J. Okoński, and A. Szczepanek. 2011. Bell Beaker influence in the Early Bronze Age on the basis of latest discoveries in Rozbórz, in south. Paper read at Current researches on Bell Beakers. Proceedings of the 15th International Bell Beaker Conference: From Atlantic to Ural. 5th-9th May 2011, at Poio (Pontevedra, Galicia, Spain).

Jaruf, Pablo. 2017. Santuarios subterráneos en el Calcolítico palestiniense (ca. 4500-3800/3600 a.C.). In *Si un Hombre desde el Sur... / Šumma Awīlum ina Šūtim...: Escritos de Alumnos, Colegas y Amigos en Homenaje a Bernardo Gandulla*, edited by I. Milevski, L. Monti and P. Jaruf. Buenos Aires: Universidad de Buenos Aires.

Järve, M., C. L. Scheib, L. Saag, A. Kriiska, I. Shramko, S. Zadnikov, N. Savelev, O. Utevska, L. Varul, A. K. Pathak, L. Pagani, J. R. Flores, F. Montinaro, L. Saag, K. Tambets, T. Kivisild, and R. Villems. 2018. Genetic continuity in the western Eurasian Steppe broken not due to Scythian dominance, but rather at the transition to the Chernyakhov culture (Ostrogoths). Paper read at 8th International Symposium on Biomolecular Archaeology ISBA 2018. 18th – 21st September, at Jena, Germany.

Järve, Mari, Lehti Saag, Christiana Lyn Scheib, Ajai K. Pathak, Francesco Montinaro, Luca Pagani, J. Rodrigo Flores, Meriam Guellil, Lauri Saag, Kristiina Tambets, Alena Kushniarevich, Anu Solnik, Liivi Varul, Stanislav Zadnikov, Oleg Petrauskas, Maryana Avramenko, Boris Magomedov, Serghii

Didenko, Gennadi Toshev, Igor Bruyako, Denys Grechko, Vitalii Okatenko, Kyrylo Gorbenko, Oleksandr Smyrnov, Anatolii Heiko, Roman Reida, Serheii Sapiehin, Sergey Sirotin, Aleksandr Tairov, Arman Beisenov, Maksim Starodubtsev, Vitali Vasilev, Alexei Nechvaloda, Biyaslan Atabiev, Sergey Litvinov, Natalia Ekomasova, Murat Dzhaubermezov, Sergey Voroniatov, Olga Utevska, Irina Shramko, Elza Khusnutdinova, Mait Metspalu, Nikita Savelev, Aivar Kriiska, Toomas Kivisild, and Richard Villems. 2019. Shifts in the Genetic Landscape of the Western Eurasian Steppe Associated with the Beginning and End of the Scythian Dominance. *Current Biology* In Review, Available at SSRN.

Jensen, J. 2003. *The prehistory of Denmark*. London and New York: Routledge.

Jensen, Theis Z. T., Jonas Niemann, Katrine Hoejholt Iversen, Anna K. Fotakis, Shyam Gopalakrishnan, Mikkel H. S. Sinding, Martin R. Ellegaard, Morten E. Allentoft, Liam T. Lanigan, Alberto J. Taurozzi, Sofie Holtsmark Nielsen, Michael W. Dee, Martin N. Mortensen, Mads C. Christensen, Soeren A. Soerensen, Matthew J. Collins, Tom Gilbert, Martin Sikora, Simon Rasmussen, and Hannes Schroeder. 2018. Stone Age "chewing gum" yields 5,700 year-old human genome and oral microbiome. *bioRxiv*:493882.

Jeong, Choongwon, Oleg Balanovsky, Elena Lukianova, Nurzhibek Kahbatkyzy, Pavel Flegontov, Valery Zaporozhchenko, Alexander Immel, Chuan-Chao Wang, Olzhas Ixan, Elmira Khussainova, Bakhytzhan Bekmanov, Victor Zaibert, Maria Lavryashina, Elvira Pocheshkhova, Yuldash Yusupov, Anastasiya Agdzhoyan, Sergey Koshel, Andrei Bukin, Pagbajabyn Nymadawa, Shahlo Turdikulova, Dilbar Dalimova, Mikhail Churnosov, Roza Skhalyakho, Denis Daragan, Yuri Bogunov, Anna Bogunova, Alexandr Shtrunov, Nadezhda Dubova, Maxat Zhabagin, Levon Yepiskoposyan, Vladimir Churakov, Nikolay Pislegin, Larissa Damba, Ludmila Saroyants, Khadizhat Dibirova, Lubov Atramentova, Olga Utevska, Eldar Idrisov, Evgeniya Kamenshchikova, Irina Evseeva, Mait Metspalu, Alan K. Outram, Martine Robbeets, Leyla Djansugurova, Elena Balanovska, Stephan Schiffels, Wolfgang Haak, David Reich, and Johannes Krause. 2019. The genetic history of admixture across inner Eurasia. *Nature Ecology & Evolution*.

Jeong, Choongwon, Oleg Balanovsky, Elena Lukianova, Nurzhibek Kahbatkyzy, Pavel Flegontov, Valery Zaporozhchenko, Alexander Immel, Chuan-Chao Wang, Olzhas Ixan, Elmira Khussainova, Bakhytzhan Bekmanov, Victor Zaibert, Maria Lavryashina, Elvira Pocheshkhova, Yuldash Yusupov, Anastasiya Agdzhoyan, Koshel Sergey, Andrei Bukin, Pagbajabyn Nymadawa, Michail Churnosov, Roza Skhalyakho, Denis Daragan, Yuri Bogunov, Anna Bogunova, Alexandr Shtrunov, Nadezda Dubova, Maxat Zhabagin, Levon Yepiskoposyan, Vladimir Churakov, Nikolay Pislegin, Larissa Damba, Ludmila Saroyants, Khadizhat Dibirova, Lubov Artamentova, Olga Utevska, Eldar Idrisov, Evgeniya Kamenshchikova, Irina Evseeva, Mait Metspalu, Martine Robbeets, Leyla Djansugurova, Elena Balanovska, Stephan Schiffels, Wolfgang Haak, David Reich, and Johannes Krause. 2018. Characterizing the genetic history of admixture across inner Eurasia. *bioRxiv*.

Jeong, Choongwon, Shevan Wilkin, Tsend Amgalantugs, Abigail S. Bouwman, William Timothy Treal Taylor, Richard W. Hagan, Sabri Bromage, Soninkhishig Tsolmon, Christian Trachsel, Jonas Grossmann, Judith Littleton, Cheryl A. Makarewicz, John Krigbaum, Marta Burri, Ashley Scott, Ganmaa Davaasambuu, Joshua Wright, Franziska Irmer, Erdene Myagmar, Nicole Boivin, Martine Robbeets, Frank J. Rühli, Johannes Krause, Bruno Frohlich, Jessica Hendy, and Christina Warinner. 2018. Bronze Age population dynamics and the rise of dairy pastoralism on the eastern Eurasian steppe. *Proceedings of the National Academy of Sciences*.

Jeunesse, Christian. 2015. Das Aufkommen der Ideologie des Kriegers im westlichen Mittelmeerraum in der zweiten Hälfte des vierten Jahrtausends v. Chr. *Das Altertum* 60:263-282.

Repeated Author. 2017. From Neolithic kings to the Staffordshire hoard. Hoards and aristocratic graves in the European Neolithic: the birth of a 'Barbarian' Europe? In *The Neolithic in Europe. Papers in Honour of Alasdair Whittle*, edited by P. Bickle, V. Cummings, D. Hofmann and J. Pollard. Oxford & Philadelphia: Oxbow.

Jia, Peter W., Alison Betts, Dexin Cong, Xiaobing Jia, and Paula Doumani Dupuy. 2017. Adunqiaolu: new evidence for the Andronovo in Xinjiang, China. *Antiquity* 91 (357):621-639.

Jia, Peter Wei Ming, and Alison V. G. Betts. 2010. A re-analysis of the Qiemu'erqieke (Shamirshak) cemeteries, Xinjiang, China. *JIES* 38 (3 & 4):275-317.

Jiráň, Luboš, Milan Salaš, and Alexandra Krenn-Leeb. 2013. The Czech Lands and Austria in the Bronze Age In *The Oxford Handbook of the European Bronze Age*, edited by H. Fokkens and A. Harding. Oxford: Oxford University Press.

Jockenhövel, Albrecht. 2013. Germany in the Bronze Age In *The Oxford Handbook of the European Bronze Age*, edited by H. Fokkens and A. Harding. Oxford: Oxford University Press.

Johansen, K. L., S. T. Laursen, and M. K. Holst. 2004. Spatial patterns of social organization in the Early Bronze Age of South Scandinavia. *Journal of Anthropological Archaeology* 23:33-55.

Jones, E. R., G. Gonzalez-Fortes, S. Connell, V. Siska, A. Eriksson, R. Martiniano, R. L. McLaughlin, M. Gallego Llorente, L. M. Cassidy, C. Gamba, T. Meshveliani, O. Bar-Yosef, W. Muller, A. Belfer-Cohen, Z. Matskevich, N. Jakeli, T. F. Higham, M. Currat, D. Lordkipanidze, M. Hofreiter, A. Manica, R. Pinhasi, and D. G. Bradley. 2015. Upper Palaeolithic genomes reveal deep roots of modern Eurasians. *Nat Commun* 6:8912.

Jones, Eppie R., Gunita Zarina, Vyacheslav Moiseyev, Emma Lightfoot, Philip R. Nigst, Andrea Manica, Ron Pinhasi, and Daniel G. Bradley. 2017. The Neolithic Transition in the Baltic Was Not Driven by Admixture with Early European Farmers. *Current Biology*.

Jones, Jennifer R., Cristina Vega Maeso, Eduardo Carmona Ballestero, Luis Villanueva Martín, Maria Eugenía Delgado Arceo, and Ana B. Marín-Arroyo. 2019. Investigating prehistoric diet and lifeways of early farmers in central northern Spain (3000–1500 CAL BC) using stable isotope techniques. *Archaeological and Anthropological Sciences*.

Judd, Margaret A., Jessica L. Walker, Alicia Ventresca Miller, Dmitry Razhev, Andrey V. Epimakhov, and Bryan K. Hanks. 2018. Life in the fast lane: Settled pastoralism in the Central Eurasian Steppe during the Middle Bronze Age. *American Journal of Human Biology* 30 (4):e23129.

Juras, Anna, Maciej Chyleński, Edvard Ehler, Helena Malmström, Danuta Żurkiewicz, Piotr Włodarczak, Stanisław Wilk, Jaroslav Peška, Pavel Fojtík, Miroslav Králík, Jerzy Libera, Jolanta Bagińska, Krzysztof Tunia, Viktor I. Klochko, Miroslawa Dabert, Mattias Jakobsson, and Aleksander Kośko. 2018. Mitochondrial genomes reveal an east to west cline of steppe ancestry in Corded Ware populations. *Scientific Reports* 8 (1):11603.

Kador, Thomas, Lara M. Cassidy, Jonny Geber, Robert Hensey, Pádraig Meehan, and Sam Moore. 2018. Rites of Passage: Mortuary Practice, Population Dynamics, and Chronology at the Carrowkeel Passage Tomb Complex, Co. Sligo, Ireland. *Proceedings of the Prehistoric Society*:1-31.

Kadrow, S. 2004. Problemy archeologicznej identyfikacji zjawisk nomadyzmu i pastoralizmu na przełomie epok kamienia i brązu w Europie. In *Nomadyzm a pastoralizm w międzyrzeczu Wisły i Dniepru (neolit, eneolit, epoka brązu)*, edited by A. Kośko and M. Szmyt. Poznań: Archaeologia Bimaris.

Kadrow, Sławomir. 1998. The Central European Dimension of the Decline of the Early Bronze Age Civilization. The Trzciniec Socio-cultural System at the Outset of ist Career. In *The Trzciniec area oft he Early Bronze Age Civilization: 1950-1200 BC*. Poznan.

Repeated Author. 2007. Soziale Strukturen und ethnische Identitäten der Bronzezeit Ostpolens, Auf der Suche nach Identitäten: Volk – Stamm – Kultur – Ethnos. Internationale Tagung der Universität Leipzig vom 8.- 9. Dezember 2000. In *Auf der Suche nach Identitäten: Volk – Stamm – Kultur – Ethnos. Internationale Tagung der Universität Leipzig vom 8.- 9. Dezember 2000*, edited by S. Rieckhoff and U. Sommer. Oxford.

Repeated Author. 2008. Settlements and subsistence strategies of the Corded Ware Culture at the beginning of the 3rd millenium BC in Southeastern Poland and in Western Ukraine. In *Umwelt - Wirtschaft - Siedlungen im dritten vorchristlichen Jahrtausend Mitteleuropas und Siidskandinaviens. Internationale Tagung Kiel 4.-6. November 2005*, edited by W. Dörfler and J. Müller. Neumünster: Wachholtz.

Repeated Author. 2016. Exchange of People, Ideas and Things between Cucuteni-Trypillian Complex and Areas of South-Eastern Poland. In *Cucuteni culture within the European Neo-Eneolithic context*, edited by C. P. Ciprian and D. Nicola. Romania: Complexul Muzeal Județean Neamț.

Repeated Author. 2017. What Happened in Iwanowice at the End of the 3rd Millennium BC? Did a Rebellion Break Out? In *Rebellion and Inequality in Archaeology. Proceedings of the Kiel Workshops "Archaeology of Rebellion" (2014) and "Social Inequality as aTopic in Archaeology" (2015)*, edited by S. Hansen and J. Müller. Bonn: Dr. Rudolf Habelt.

Repeated Author. 2018. South-Eastern Group of Funnel Beaker culture. *Prace i Materiały Muzeum Archeologicznego w Łodzi. Seria Archeologiczna* 47:255-266.

Kaiser, Elke, and Katja Winger. 2015. Pit graves in Bulgaria and the Yamnaya Culture. *Praehistorische Zeitschrift* 90 (1-2).

Kajtoch, Łukasz, Elżbieta Cieślak, Zoltán Varga, Wojciech Paul, Miłosz A. Mazur, Gábor Sramkó, and Daniel Kubisz. 2016. Phylogeographic patterns of steppe species in Eastern Central Europe: a review and the implications for conservation. *Biodiversity and Conservation* 25 (12):2309-2339.

Kallio, Petri. 2001. Phonetic Uralisms in Indo-European? In *Early Contacts between Uralic and Indo-European: Linguistic and Archaeological Considerations*, edited by C. Carpelan, A. Parpola and P. Koskikallio. Helsinki: Société Finno-Ougrienne.

Repeated Author. 2002. Prehistoric Contacts between Indo-European and Uralic. In *Proceedings of the Thirteenth Annual UCLA Indo-European Conference*, edited by K. Jones-Bley, M. E. Huld, A. D. Volpe and M. R. Dexter. Washington, DC: Institute for the Study of Man.

Repeated Author. 2008. On the 'Early Baltic' loanwords in Common Finnic. In *Evidence and Counter-Evidence, Festschrift Frederik Kortlandt*. Amsterdam - New York: Rodopi.

Repeated Author. 2009. Stratigraphy of Indo-European loanwords in Saami. In *Máttut - máddagat: The Roots of Saami Ethnicities, Societies and Spaces / Places*, edited by T. Äikäs. Oulu: Publications of the Giellagas Institute 12.

Repeated Author. 2012. The Prehistoric Germanic Loanword Strata in Finnic. In *A Linguistic Map of Prehistoric Northern Europe*. Helsinki: Suomalais-Ugrilainen Seura.

Repeated Author. 2014. The Diversification of Proto-Finnic. In *Fibula, Fabula, Fact: The Viking Age in Finland*, edited by J. A. Frog and C. Tolley Helsinki.

Repeated Author. 2015. The Language Contact Situation in Prehistoric Northeastern Europe. In *The Linguistic Roots of Europe: Origin and Development of European Languages*, edited by R. Mailhammer, T. Vennemann and B. A. Olsen. Copenhagen: Museum Tusculanum Press.

Repeated Author. 2015. Nugae Indo-Uralicae. *JIES* 43 (3 & 4):368-375.

Repeated Author. 2015. The Stratigraphy of the Germanic Loanwords in Finnic. In *Early Germanic Languages in Contact*, edited by J. O. Askedal and H. F. Nielsen. Amsterdam - Philadelphia: John Benjamins.

Repeated Author. 2017. The Indo-Europeans and the Non-Indo-Europeans in Prehistoric Northern Europe. In *Language and Prehistory of the Indo-European Peoples: A Cross-Disciplinary Perspective*, edited by A. Hyllested, B. N. Whitehead, T. Olander and B. A. Olsen. Copenhagen: University of Chicago Press.

Kaňáková, Ludmila, Jozef Bátora, and Vojtěch Nosek. 2019. Use-wear and ballistic analyses of arrowheads from the burial ground of the Nitra culture in Ludanice - Mýtna Nová Ves. *Journal of Archaeological Science: Reports* 23:25-35.

Karafet, Tatiana M., Ludmila P. Osipova, Olga V. Savina, Brian Hallmark, and Michael F. Hammer. 2018. Siberian genetic diversity reveals complex origins of the Samoyedic-speaking populations. *American Journal of Human Biology* 0 (0):e23194.

Karim, Alizadeh, Maziar Sepideh, and M. Rouhollah Mohammadi. 2018. The End of the Kura-Araxes Culture as Seen from Nadir Tepesi in Iranian Azerbaijan. *American Journal of Archaeology* 122 (3):463-477.

Kashuba, Natalija, Emrah Kırdök, Hege Damlien, Mikael A. Manninen, Bengt Nordqvist, Per Persson, and Anders Götherström. 2019. Ancient DNA from mastics solidifies connection between material culture and genetics of mesolithic hunter–gatherers in Scandinavia. *Communications Biology* 2 (1):185.

Kealhofer, Lisa, Peter Grave, and Mary M. Voigt. 2019. Dating Gordion: the timing and tempo of Late Bronze and Early Iron Age political transformation. *Radiocarbon*:1-20.

Kefi, Rym, Meriem Hechmi, Chokri Naouali, Haifa Jmel, Sana Hsouna, Eric Bouzaid, Sonia Abdelhak, Eliane Beraud-Colomb, and Alain Stevanovitch. 2018. On the origin of Iberomaurusians: new data based on ancient mitochondrial DNA and phylogenetic analysis of Afalou and Taforalt populations. *Mitochondrial DNA Part A* 29 (1):147-157.

Kelder, Jorrit M. 2010. *The Kingdom of Mycenae: A Great Kingdomin the Late Bronze Age Aegean*. Bethesda, Maryland: CDL Press.

Keyser, C., C. Bouakaze, E. Crubézy, V. G. Nikolaev, D. Montagnon, and T. Reis. 2009. Ancient DNA provides new insights into the history of south Siberian Kurgan people. *Hum Genet* 126.

Khokhlov, Aleksander. 2018. Предварительные результаты антропологo-генетических исследований материалов Волго-Уралья периода неолита-ранней бронзы международной группой ученых. Paper read at XIV Conference on Samaran Archaeology, 27-28th January, at Samara.

Khokhlov, Aleksandr A. 2016. Demographic and Cranial Characteristics of the Volga-Ural Population in the Eneolithic and Bronze Age. In *A Bronze Age Landscape in the Russian Steppes. The Samara Valley Project*, edited by D. W. Anthony, D. R. Brown, O. D. Mochalov, A. A. Khokhlov and P. F. Kuznetsov. Los Angeles: Cotsen Institute of Archaeology Press.

Khokhlova, Olga, Nina Morgunova, Alexander Khokhlov, and Alexandra Golyeva. 2018. Dynamics of paleoenvironments in the Cis-Ural steppes during the mid-to late Holocene. *Quaternary Research*:1-15.

Khomutova, Tatiana E., Natalia N. Kashirskaya, Tatiana S. Demkina, Tatiana V. Kuznetsova, Flavio Fornasier, Natalia I. Shishlina, and Alexander V. Borisov. 2019. Precipitation pattern during warm and cold periods in the Bronze Age (around 4.5-3.8 ka BP) in the desert steppes of Russia: Soil-microbiological approach for palaeoenvironmental reconstruction. *Quaternary International*.

Kiesslich, Jan, Franz Neuhuber, Harald J. Meyer, Max P. Baur, and Jutta Leskovar. 2004. KiDNA Analysis on Biological Remains from Archaeological Findings–Sex Identification and Kinship Analysis on Skeletons from Mitterkirchen, Upper Austria. *na*.

Kießling, Roland, Maarten Mous, and Derek Nurse. 2008. The Tanzanian Rift Valley area. In *A Linguistic Geography of Africa*

edited by B. Heine and D. Nurse. Cambridge: Cambridge University Press.

Kilinc, G. M., A. Omrak, F. Ozer, T. Gunther, A. M. Buyukkarakaya, E. Bicakci, D. Baird, H. M. Donertas, A. Ghalichi, R. Yaka, D. Koptekin, S. C. Acan, P. Parvizi, M. Krzewinska, E. A. Daskalaki, E. Yuncu, N. D. Dagtas, A. Fairbairn, J. Pearson, G. Mustafaoglu, Y. S. Erdal, Y. G. Cakan, I. Togan, M. Somel, J. Stora, M. Jakobsson, and A. Gotherstrom. 2016. The Demographic Development of the First Farmers in Anatolia. *Curr Biol* 26 (19):2659-2666.

Kılınç, Gülşah Merve, Natalija Kashuba, Reyhan Yaka, Arev Pelin Sümer, Eren Yüncü, Dmitrij Shergin, Grigorij Leonidovich Ivanov, Dmitrii Kichigin, Kjunnej Pestereva, Denis Volkov, Pavel Mandryka, Artur Kharinskii, Alexey Tishkin, Evgenij Ineshin, Evgeniy Kovychev, Aleksandr Stepanov, Aanatolij Alekseev, Svetlana Aleksandrovna Fedoseeva, Mehmet Somel, Mattias

Jakobsson, Maja Krzewińska, Jan Storå, and Anders Götherström. 2018. Investigating Holocene human population history in North Asia using ancient mitogenomes. *Scientific Reports* 8 (1):8969.

Kılınç, Gülşah Merve, Dilek Koptekin, Çiğdem Atakuman, Arev Pelin Sümer, Handan Melike Dönertaş, Reyhan Yaka, Cemal Can Bilgin, Ali Metin Büyükkarakaya, Douglas Baird, Ezgi Altınışık, Pavel Flegontov, Anders Götherström, İnci Togan, and Mehmet Somel. 2017. Archaeogenomic analysis of the first steps of Neolithization in Anatolia and the Aegean. *Proceedings of the Royal Society B: Biological Sciences* 284 (1867).

Kim, A., T. Savenkova, Y. Reis, S. Smushko, S. Mallick, N. Rohland, R. Bernardos, and D. Reich. 2018. Yeniseian hypotheses in light of genome-wide ancient DNA from historical Siberia. Paper read at 8th International Symposium on Biomolecular Archaeology ISBA 2018. 18th – 21st September, at Jena, Germany.

Kim, Kijeong, Charles H. Brenner, Victor H. Mair, Kwang-Ho Lee, Jae-Hyun Kim, Eregzen Gelegdorj, Natsag Batbold, Yi-Chung Song, Hyeung-Won Yun, Eun-Jeong Chang, Gavaachimed Lkhagvasuren, Munkhtsetseg Bazarragchaa, Ae-Ja Park, Inja Lim, Yun-Pyo Hong, Wonyong Kim, Sang-In Chung, Dae-Jin Kim, Yoon-Hee Chung, Sung-Su Kim, Won-Bok Lee, and Kyung-Yong Kim. 2010. A western Eurasian male is found in 2000-year-old elite Xiongnu cemetery in Northeast Mongolia. *American Journal of Physical Anthropology* 142 (3):429-440.

King, R. J., S. S. Ozcan, T. Carter, E. Kalfoglu, S. Atasoy, C. Triantaphyllidis, A. Kouvatsi, A. A. Lin, C. E. Chow, L. A. Zhivotovsky, M. Michalodimitrakis, and P. A. Underhill. 2008. Differential Y-chromosome Anatolian influences on the Greek and Cretan Neolithic. *Ann Hum Genet* 72 (Pt 2):205-14.

Kitov, E. P., A. A. Khokhlov, and P. S. Medvedeva. 2018. Paleoanthropological Data as a Source of Reconstruction of the Process of Social Formation and Social Stratifi cation (based on the Sintashta and Potapovo sites of the Bronze Age). *Stratum plus* 2:225-243.

Klejn, Leo S., Wolfgang Haak, Iosif Lazaridis, Nick Patterson, David Reich, Kristian Kristiansen, Karl-Göran Sjögren, Morten Allentoft, Martin Sikora, and Eske Willerslev. 2017. Discussion: Are the Origins of Indo-European Languages Explained by the Migration of the Yamnaya Culture to the West? *European Journal of Archaeology*:1-15.

Klimscha, Florian. 2017. Transforming Technical Know-how in Time and Space. Using the Digital Atlas of Innovations to Understand the Innovation Process of Animal Traction and the Wheel. *eTopoi* 6:16-63.

Klochko, V. I., and A Kośko. 2011. Społeczności kultur ceramiki sznurowej i stepu nadczarnomorskiego (jamowej oraz katakumbowej) w systemie organizacji szlaków bałtycko-pontyjskiego międzymorza. In *Między Bałtykiem a Morzem Czarnym. Szlaki międzymorza IV–I tys. przed Chr* . edited by M. Ignaczak, A. Kośko and M. Szmyt. Poznań.

Klochko, V. I., and A. Kośko. 2009. The societies of Corded Ware cultures and those of Black Sea steppes (Yamnaya and Catacomb Grave cultures) in the route network between the Baltic and Black Seas. *Baltic-Pontic-Studies* 14:269-301.

Klochko, Viktor. 2013. The Baltic drainage basin in the reconstruction of the Mental Map of Central Europe Held in common by Northern-Pontic Early-Bronze Civilization Communities: 3200-1600 BC. An outline of the research programme. In *The Ingul-Donets Early Bronze Civilization as Springboard for Transmission of Pontic Cultural Patterns to the Baltic Drainage Basin 3200-1750 BC*. Poznań.

Repeated Author. 2013. Complex of Metal Goods between the Vistula and Dnieper rivers at the turn of the 4th/3rd to the 3rd millennium BC. Concept of the Carpathian - Volhynia "Willow Leaf" metallurgy centre. In *The Ingul-Donets Early Bronze Civilization as Springboard for Transmission of Pontic Cultural Patterns to the Baltic Drainage Basin 3200-1750 BC*. Poznań.

Klochko, Viktor, and Aleksander Kośko. 1987. A Late Neolithic Composite Bow. *Journal of the Society of Archer Antiquaries. London* 30:15-23.

Repeated Author. 1998. "Trzciniec" – Borderland of Early Bronze Civilization of Eastern and Western Europe? In *The Trzciniec Area of the Early Bronze Age Civilization: 1950-1200 BC*. Poznan.

Repeated Author. 2009. Transit routes between the Baltic and Black seas: early development stages – from the 3rd to the middle of the 1st millennium BC. An outline of research project./Routes between the seas: Baltik-Boh-Bug-Pont from the 3rd to the middle of the 1st millennium BC. Poznan, 2009, (BPS 14), P. 7 – 16. In *Routes between the seas: Baltik-Boh-Bug-Pont from the 3rd to the middle of the 1st millennium BC*. Poznan.

Kloekhorst, Alwin. 2008. Some Indo-Uralic Aspects of Hittite. *JIES* 36 (1 & 2).

Knipper, Corina, Alissa Mittnik, Ken Massy, Catharina Kociumaka, Isil Kucukkalipci, Michael Maus, Fabian Wittenborn, Stephanie E. Metz, Anja Staskiewicz, Johannes Krause, and Philipp W. Stockhammer. 2017. Female exogamy and gene pool diversification at the transition from the Final Neolithic to the Early Bronze Age in central Europe. *Proceedings of the National Academy of Sciences*.

Ko, Seongyeon, Andrew Joseph, and John Whitman. 2014. Comparative consequences of the tongue root harmony analysis for proto-Tungusic, proto-Mongolic, and proto-Korean. In *Paradigm Change: In the Transeurasian languages and beyond*, edited by M. Robbeets and W. Bisang: John Benjamins.

Kobusiewicz, Michael. 2002. The problem of the Palaeolithic-Mesolithic transition on the Polish Plain: the state of research. In *Hunters in a changing world. Environment and Archaeology of the Pleistocene - Holocene Transition (ca. 11000 - 9000 B.C.) in Northern Central Europe*, edited by T. Terberger and B. V. Eriksen. Greifswald: Workshop of the U.I.S.P.P.-Commission XXXII.

Kobyliński, Zbigniew. 2005. The Slavs. In *The New Cambridge Medieval History, Vol. 1: c. 500-c. 700*, edited by P. Fouracre. Cambridge: Cambridge University Press.

Koch, John T. 2009. A case for tartessian as a celtic language. *Palaeohispanica* 9:339-351.

Repeated Author. 2013. Is Basque an Indo-European Language? *JIES* 41 (1 & 2).

Koivulehto, J. . 1991. *Uralische Evidenz für die Laryngaltheorie*. Vol. 566. Viena: Österreichische Akademie der Wissenschaften.

Koivulehto, Jorma. 2001. The Earliest Contacts between Indo-European and Uralic Speakers in the Light of Lexical Loans. Christian Carpelan,. In *Early Contacts*

between Uralic and Indo-European: Linguistic and Archaeological Considerations, edited by A. Parpola and P. Koskikallio. 2001: Societé Finno-Ougrienne.
Repeated Author. 2003. Frühe Kontakte zwischen Uralisch und Indogermanisch im nordwestindogermanischen Raum. In *Languages in Prehistoric Europe*, edited by A. Bammesberger and T. Vennemann. Heidelberg: Universitätsverlag Winter.
Repeated Author. 2006. Wie alt sind die Kontakte zwischen Finnisch-Ugrisch und Balto-Slavisch? In *The Slavicization of the Russian North. Mechanisms and Chronology*, edited by J. Nuorluoto. Helsinki.
Kolář, Jan, Petr Kuneš, Péter Szabó, Mária Hajnalová, Helena Svitavská Svobodová, Martin Macek, and Peter Tkáč. 2016. Population and forest dynamics during the Central European Eneolithic (4500–2000 BC). *Archaeological and Anthropological Sciences*.
Korenevskiy, S.N. 2012. *Rozhdenie kurgana: pogrebalnye pamjatniki eneoliticheskogo vremeni Predkavkaz'ja i Volgo-Donskogo mezhdurech'ja*. Moskva: TAUS.
Korolev, A., M. Kulkova M, V. Platonov, N. Roslyakova, A. Shalapinin, and Y. E. Yanish. 2018. Archaeological Materials of Eneolithic Settlements in Forest-Steppe Zone of the Volga Region: A Source for Diet and Chronology. *Radiocarbon* 60 (5):1587-1596.
Korolev, Arkadiy, Anna Kochkina, and Dmitry Stashenkov. 2019. КЕРАМИКА ГРУНТОВОГО МОГИЛЬНИКА ЕКАТЕРИНОВСКИЙ МЫС (ПО МАТЕРИАЛАМ РАСКОПОК 2013-2016 ГГ.). *ПОВОЛЖСКАЯ АРХЕОЛОГИЯ* 1 (27):18-32.
Korpela, Jukka. 2019. Eastern European Slave Trade. In *Slaves from the North. Finns and Karelians in the East European Slave Trade, 900-1600*. Leiden/Boston: Brill.
Kortlandt, Frederik. 1990. The spread of the Indo-Europeans. *Journal of Indo-European Studies* 18 (2):131-140.
Repeated Author. 2002. The Indo-Uralic verb. In *Finno-Ugrians and Indo-Europeans: Linguistic and literary contacts*. Maastricht: Shaker.
Repeated Author. 2010. Indo-Uralic and Altaic revisited. In *Transeurasian verbal morphology in a comparative perspective: genealogy, contact, chance*. Wiesbaden: Harrassowitz.
Repeated Author. 2016. Baltic, Slavic, Germanic. *Baltistica* 51 (1):81-86.
Repeated Author. 2019. On the reconstruction of Proto-Uralic. In *Petri Kallio Rocks. Liber Semisaecularis 7.2.2019*, edited by T. S. Junttila and J. Kuokkala. Helsinki: Printall.
Koryakova, Ludmila, and Andrej Epimakhov. 2007. *The Urals and Western Siberia in the Bronze and Iron Ages, Cambridge World Archaeology*. Cambridge: Cambridge University Press.
Kośko, Aleksander. 1979. *Rozwój kulturowy społeczeństw Kujaw w okresie schyłkowego neolitu i wczesnego brązu*. Poznań.
Kośko, Aleksander, and Marzena Szmyt. 2004. Hodowla w systemach gospodarki Niżu: IV-III tys. BC (kultury: pucharów lejkowatych i amfor kulistych). In *Nomadyzm a pastoralizm w międzyrzeczu Wisły i Dniepru (neolit, eneolit,*

epoka brązu) . edited by A. Kośko and M. Szmyt. Poznań: Archaeologia Bimaris.

Kosmenko, M. G. 1996. The culture of Bronze Age Net Ware in Karelia. *Fennoscandia Archaeologica* XIII:51-67.

Kotova, Nadezhda. 2016. The contacts of the Eastern European steppe people with the Balkan population during the transition period from Neolithic to Eneolithic. In *Der Schwarzmeerraum vom Neolithikum bis in die Früheisenzeit (6000-600 v. Chr.). Kulturelle Interferenzen in der Zirkumpontischen Zone und Kontakte mit ihren Nachbargebieten*, edited by V. Nikolov and W. Schier. Rahden/Westfalia: Marie Leidorf.

Kotova, Nadezhda S. 2008. *Early Eneolithic in the Pontic Steppes, British Archaeological Reports International Series 1735*. Oxford: John and Erica Hedges.

Kozłowski, Stefan Karol. 2009. *Thinking Mesolithic*. Oxford: Oxbow Books.

Krahe, H. 1949. Alteuropäische Flußnamen. *Beiträge zur Namenforschung* 1:24–51, 247–266 (and cont. in following volumes).

Repeated Author. 1964. *Unsere ältesten Flußnamen*. Wiesbaden: Harrassowitz.

Krause-Kyora, Ben, Julian Susat, Felix M. Key, Denise Kühnert, Esther Bosse, Alexander Immel, Christoph Rinne, Sabin-Christin Kornell, Diego Yepes, Sören Franzenburg, Henrike O. Heyne, Thomas Meier, Sandra Lösch, Harald Meller, Susanne Friederich, Nicole Nicklisch, Kurt W. Alt, Stefan Schreiber, Andreas Tholey, Alexander Herbig, Almut Nebel, and Johannes Krause. 2018. Neolithic and medieval virus genomes reveal complex evolution of hepatitis B. *eLife* 7:e36666.

Krauß, Raiko, Clemens Schmid, David Kirschenheuter, Jonas Abele, Vladimir Slavchev, and Bernhard Weninger. 2017. Chronology and development of the Chalcolithic necropolis of Varna I. *Documenta Praehistorica* XLIV:282-300.

Krenke, N., I. Erschov, E. Erschova, and A. Lazukin. 2013. Corded ware, Fatjanovo and Abashevo culture sites on the flood-plain of the Moskva River. *Sprawozdania Archeologiczne* 65:413-424.

Kristiansen, Kristian. 1987. From stone to bronze - the evolution of social complexity in Northern Europe, 2300-1200 BC. In *Specialization, exchange and complex societies*, edited by E. M. Brumfiel and T. K. Earle. Cambridge: Cambridge University Press.

Repeated Author. 1989. Prehistoric Migrations - the Case of the Single Grave and Corded Ware Cultures. *Journal of Danish Archaeology* 8 (1):211-225.

Repeated Author. 2000. *Europe Before History*. Cambridge: Cambridge University Press.

Repeated Author. 2009. Proto-Indo-European Languages and Institutions: An Archaeological Approach. In *Journal of Indo-European Studies Monograph Series, No. 56*, edited by M. V. Linden and K. Jones-Bley. Washinton: Institute for the Study of Man.

Repeated Author. 2016. Bronze Age Vikings? A Comparative Analysis of Deep Historical Structures and their Dynamics. In *Comparative Perspectives on Past Colonisation, Maritime Interaction and Cultural Integration. New Directions in Anthropological Archaeology*, edited by L. Melheim, Z. T. Glørstad and H. Glørstad. Sheffield: Equinox.

Kristiansen, Kristian, Morten E. Allentoft, Karin M. Frei, Rune Iversen, Niels N. Johannsen, Guus Kroonen, Łukasz Pospieszny, T. Douglas Price, Simon Rasmussen, Karl-Göran Sjögren, Martin Sikora, and Eske Willerslev. 2017. Re-theorising mobility and the formation of culture and language among the Corded Ware Culture in Europe. *Antiquity* 91 (356):334-347.

Kristiansen, Kristian, and Thomas B. Larsson. 2005. *The Rise of Bronze Age Society: Travels, Transmissions and Transformations*. Cambridge: Cambridge University Press.

Repeated Author. 2005. Rulership in the Near East and the eastern Mediterranean during the Bronze Age. In *The Rise of Bronze Age Society. Travels, Transmissions and Transformations*. Cambridge: Cambridge University Press.

Kristiansen, Kristian, and Paulina Suchowska-Ducke. 2015. Connected Histories: the Dynamics of Bronze Age Interaction and Trade 1500–1100 bc. *Proceedings of the Prehistoric Society* 81:361-392.

Kroonen, Guus. 2012. Non-Indo-European root nouns in Germanic: Evidence in support of the Agricultural Substrate Hypothesis. In *A Linguistic Map of Prehistoric Northern Europe*, edited by R. Grünthal and P. Kallio. Helsinki: Suomalais-Ugrilaisen Seura.

Krzewińska, Maja, Gülşah Merve Kılınç, Anna Juras, Dilek Koptekin, Maciej Chyleński, Alexey G. Nikitin, Nikolai Shcherbakov, Iia Shuteleva, Tatiana Leonova, Liudmila Kraeva, Flarit A. Sungatov, Alfija N. Sultanova, Inna Potekhina, Sylwia Łukasik, Marta Krenz-Niedbała, Love Dalén, Vitaly Sinika, Mattias Jakobsson, Jan Storå, and Anders Götherström. 2018. Ancient genomes suggest the eastern Pontic-Caspian steppe as the source of western Iron Age nomads. *Science Advances* 4 (10).

Krzewińska, Maja, Anna Kjellström, Torsten Günther, Charlotte Hedenstierna-Jonson, Torun Zachrisson, Ayça Omrak, Reyhan Yaka, Gülşah Merve Kılınç, Mehmet Somel, Veronica Sobrado, Jane Evans, Corina Knipper, Mattias Jakobsson, Jan Storå, and Anders Götherström. 2018. Genomic and Strontium Isotope Variation Reveal Immigration Patterns in a Viking Age Town. *Current Biology* 28 (17):2730-2738.e10.

Kuhn, Hans, Rolf Hachmann, and Georg Kossack. 1986. *Völker zwischen Germanen und Kelten. Schriftquellen, Bodenfunde und Namengute zur Geschichte des nördlichen Westdeutschlands um Christi Gebur*. Neumünster: Karl Wachholz.

Künnap, Ago. 1997. *Breakthrough in Present-Day Uralistics*. Tartu, Estonia: Tartu University Press.

Kushniarevich, A., O. Utevska, M. Chuhryaeva, A. Agdzhoyan, K. Dibirova, I. Uktveryte, M. Mols, L. Mulahasanovic, A. Pshenichnov, S. Frolova, A. Shanko, E. Metspalu, M. Reidla, K. Tambets, E. Tamm, S. Koshel, V. Zaporozhchenko, L. Atramentova, V. Kucinskas, O. Davydenko, O. Goncharova, I. Evseeva, M. Churnosov, E. Pocheshchova, B. Yunusbayev, E. Khusnutdinova, D. Marjanovic, P. Rudan, S. Rootsi, N. Yankovsky, P. Endicott, A. Kassian, A. Dybo, Consortium Genographic, C. Tyler-Smith, E. Balanovska, M. Metspalu, T. Kivisild, R. Villems, and O. Balanovsky. 2015. Genetic Heritage of the Balto-Slavic Speaking Populations: A Synthesis of Autosomal, Mitochondrial and Y-Chromosomal Data. *PLoS One* 10 (9):e0135820.

Kuzmina, E.E. 1994. *Otkuda prishli indoarii? [Whence the Indo-Aryans Came From?]*. Moscow: Vostochnaya Literatura.

Kuzmina, Elena E. 2007. *The Origin of the Indo-Iranians*. Leiden: Brill.

Repeated Author. 2008. *The Prehistory of the Silk Road*. Edited by V. H. Mair. Philadelphia: University of Pennsylvania Press.

Kuzminykh, S. V. , and A. A. Chizhevskij. 2009. Anan'inskij mir: Vzglyad na sovremennoe sostoyanie problemi. In *U istokov arkheologii Volgo-Kam'ya: K 150-letiyu otkrytiya Anan'inskogo mogil'nika. Arkheologiya Evrazijskikh stepej, vypusk 8*, edited by S. V. Kuz'minykh, A. A. Chizhevskij and G. R. Rudenko. Elabuga: Institut Arkheologii AN RT.

Kuznetsov, Pavel F., and Oleg D. Mochalov. 2016. The Samara Valley in the Bronze Age: A Review of Archaeological Discoveries. In *A Bronze Age Landscape in the Russian Steppes. The Samara Valley Project*, edited by D. W. Anthony, D. R. Brown, O. D. Mochalov, A. A. Khokhlov and P. F. Kuznetsov. Los Angeles: The Cotsen Institute of Archaeology Press at UCLA.

Laakso, Ville. 2017. Continuity or Change? Selecting the Sites for Early Medieval Churches in Finland. In *Sacred Monuments and Practices in the Baltic Sea Region. New Visits to Old Churches*, edited by J. Harjula, S. Hukantaival, V. Immonen, A. Randla and T. Ratilainen. Cambridge: Cambridge Scholars.

Lamnidis, Thiseas C., Kerttu Majander, Choongwon Jeong, Elina Salmela, Anna Wessman, Vyacheslav Moiseyev, Valery Khartanovich, Oleg Balanovsky, Matthias Ongyerth, Antje Weihmann, Antti Sajantila, Janet Kelso, Svante Pääbo, Päivi Onkamo, Wolfgang Haak, Johannes Krause, and Stephan Schiffels. 2018. Ancient Fennoscandian genomes reveal origin and spread of Siberian ancestry in Europe. *Nature Communications* 9 (1):5018.

Laneman, Margot, and Valter Lang. 2013. New radiocarbon dates for two stone-cist graves at Muuksi, Northern Estonia. *Estonian Journal of Archaeology* 17 (2):89-122.

Lang, Valter. 2016. Early Finni-Baltic contacts as evidenced by archaeological and linguistic data. *ESUKA - JEFUL* 7 (1):11-38.

Lavento, Mika. 2001. *Textile Ceramics in Finland and on the Karelian Isthmus. Nine variations and Fugue on a Theme of C. F.Meinander*, *Suomen Muinaismuisto yhdistuksen Aikakauskirja / Finska Fornminnseföreningens Tidsskrift*. Helsinki.

Lazaridis, I., D. Nadel, G. Rollefson, D. C. Merrett, N. Rohland, S. Mallick, D. Fernandes, M. Novak, B. Gamarra, K. Sirak, S. Connell, K. Stewardson, E. Harney, Q. Fu, G. Gonzalez-Fortes, E. R. Jones, S. A. Roodenberg, G. Lengyel, F. Bocquentin, B. Gasparian, J. M. Monge, M. Gregg, V. Eshed, A. S. Mizrahi, C. Meiklejohn, F. Gerritsen, L. Bejenaru, M. Bluher, A. Campbell, G. Cavalleri, D. Comas, P. Froguel, E. Gilbert, S. M. Kerr, P. Kovacs, J. Krause, D. McGettigan, M. Merrigan, D. A. Merriwether, S. O'Reilly, M. B. Richards, O. Semino, M. Shamoon-Pour, G. Stefanescu, M. Stumvoll, A. Tonjes, A. Torroni, J. F. Wilson, L. Yengo, N. A. Hovhannisyan, N. Patterson, R. Pinhasi, and D. Reich. 2016. Genomic insights into the origin of farming in the ancient Near East. *Nature* 536 (7617):419-24.

Lazaridis, I., N. Patterson, A. Mittnik, G. Renaud, S. Mallick, K. Kirsanow, P. H. Sudmant, J. G. Schraiber, S. Castellano, M. Lipson, B. Berger, C. Economou, R. Bollongino, Q. Fu, K. I. Bos, S. Nordenfelt, H. Li, C. de Filippo, K. Prufer,

S. Sawyer, C. Posth, W. Haak, F. Hallgren, E. Fornander, N. Rohland, D. Delsate, M. Francken, J. M. Guinet, J. Wahl, G. Ayodo, H. A. Babiker, G. Bailliet, E. Balanovska, O. Balanovsky, R. Barrantes, G. Bedoya, H. Ben-Ami, J. Bene, F. Berrada, C. M. Bravi, F. Brisighelli, G. B. Busby, F. Cali, M. Churnosov, D. E. Cole, D. Corach, L. Damba, G. van Driem, S. Dryomov, J. M. Dugoujon, S. A. Fedorova, I. Gallego Romero, M. Gubina, M. Hammer, B. M. Henn, T. Hervig, U. Hodoglugil, A. R. Jha, S. Karachanak-Yankova, R. Khusainova, E. Khusnutdinova, R. Kittles, T. Kivisild, W. Klitz, V. Kucinskas, A. Kushniarevich, L. Laredj, S. Litvinov, T. Loukidis, R. W. Mahley, B. Melegh, E. Metspalu, J. Molina, J. Mountain, K. Nakkalajarvi, D. Nesheva, T. Nyambo, L. Osipova, J. Parik, F. Platonov, O. Posukh, V. Romano, F. Rothhammer, I. Rudan, R. Ruizbakiev, H. Sahakyan, A. Sajantila, A. Salas, E. B. Starikovskaya, A. Tarekegn, D. Toncheva, S. Turdikulova, I. Uktveryte, O. Utevska, R. Vasquez, M. Villena, M. Voevoda, C. A. Winkler, L. Yepiskoposyan, P. Zalloua, T. Zemunik, A. Cooper, C. Capelli, M. G. Thomas, A. Ruiz-Linares, S. A. Tishkoff, L. Singh, K. Thangaraj, R. Villems, D. Comas, R. Sukernik, M. Metspalu, M. Meyer, E. E. Eichler, J. Burger, M. Slatkin, S. Paabo, J. Kelso, D. Reich, and J. Krause. 2014. Ancient human genomes suggest three ancestral populations for present-day Europeans. *Nature* 513 (7518):409-13.

Lazaridis, Iosif. 2018. The evolutionary history of human populations in Europe. *Current Opinion in Genetics & Development* 53:21-27.

Lazaridis, Iosif, Anna Belfer-Cohen, Swapan Mallick, Nick Patterson, Olivia Cheronet, Nadin Rohland, Guy Bar-Oz, Ofer Bar-Yosef, Nino Jakeli, Eliso Kvavadze, David Lordkipanidze, Zinovi Matzkevich, Tengiz Meshveliani, Brendan J. Culleton, Douglas J. Kennett, Ron Pinhasi, and David Reich. 2018. Paleolithic DNA from the Caucasus reveals core of West Eurasian ancestry. *bioRxiv*.

Lazaridis, Iosif, Alissa Mittnik, Nick Patterson, Swapan Mallick, Nadin Rohland, Saskia Pfrengle, Anja Furtwängler, Alexander Peltzer, Cosimo Posth, Andonis Vasilakis, P. J. P. McGeorge, Eleni Konsolaki-Yannopoulou, George Korres, Holley Martlew, Manolis Michalodimitrakis, Mehmet Özsait, Nesrin Özsait, Anastasia Papathanasiou, Michael Richards, Songül Alpaslan Roodenberg, Yannis Tzedakis, Robert Arnott, Daniel M. Fernandes, Jeffery R. Hughey, Dimitra M. Lotakis, Patrick A. Navas, Yannis Maniatis, John A. Stamatoyannopoulos, Kristin Stewardson, Philipp Stockhammer, Ron Pinhasi, David Reich, Johannes Krause, and George Stamatoyannopoulos. 2017. Genetic origins of the Minoans and Mycenaeans. *Nature* 548 (7666):214-218.

Lehmann, W.P. 1992. *Historical Linguistics: An Introduction*. London: Routledge.

Leonardi, Michela, Francesco Boschin, Konstantinos Giampoudakis, Robert M. Beyer, Mario Krapp, Robin Bendrey, Robert Sommer, Paolo Boscato, Andrea Manica, David Nogues-Bravo, and Ludovic Orlando. 2018. Late Quaternary horses in Eurasia in the face of climate and vegetation change. *Science Advances* 4 (7).

Leonardi, Michela, Anna Sandionigi, Annalisa Conzato, Stefania Vai, Martina Lari, Francesca Tassi, Silvia Ghirotto, David Caramelli, and Guido Barbujani. 2018. The female ancestor's tale: Long-term matrilineal continuity in a nonisolated region of Tuscany. *American Journal of Physical Anthropology* 167 (3):497-506.

Li, C., H. Li, Y. Cui, C. Xie, D. Cai, W. Li, V. H. Mair, Z. Xu, Q. Zhang, I. Abuduresule, L. Jin, H. Zhu, and H. Zhou. 2010. Evidence that a West-East admixed population lived in the Tarim Basin as early as the early Bronze Age. *BMC Biol* 8:15.

Li, Jiawei, Ye Zhang, Yongbin Zhao, Yongzhi Chen, A. Ochir, Sarenbilige, Hong Zhu, and Hui Zhou. 2018. The genome of an ancient Rouran individual reveals an important paternal lineage in the Donghu population. *American Journal of Physical Anthropology* 166 (4):895-905.

Li, X., M. Ma, and S. Wen. 2018. Archaeological and ancient DNA evidence reveals the early population admixture between Han farmers and steppes nomads in northwest China. Paper read at American Geophysical Union, Fall Meeting 2018, at Washington, D.C.

Linden, Marc Vander. 2015. What linked the Bell Beakers in third millennium BC Europe? *Antiquity* 81 (312):343-352.

Lindstedt, Jouko Sakari, and Elina Salmela. 2019. Migrations and language shifts as components of the Slavic spread. In *Language contact and the early Slavs*, edited by T. Klír and V. Boček. Heidelberg: Universitätsverlag Winter.

Ling, J., Per Cornell, and K. Kristiansen. 2017. Bronze Economy and Mode of Production: The Role of Comparative Advantages in Temperate Europe during the Bronze Age.

Lipiński, Edward. 2001. *Semitic Languages Outline of a Comparative Grammar*. 2nd ed, *Orientalia Lovaniensia Analecta*. Leuven - Paris - Sterling: Peeters.

Lipson, Mark, Anna Szécsényi-Nagy, Swapan Mallick, Annamária Pósa, Balázs Stégmár, Victoria Keerl, Nadin Rohland, Kristin Stewardson, Matthew Ferry, Megan Michel, Jonas Oppenheimer, Nasreen Broomandkhoshbacht, Eadaoin Harney, Susanne Nordenfelt, Bastien Llamas, Balázs Gusztáv Mende, Kitti Köhler, Krisztián Oross, Mária Bondár, Tibor Marton, Anett Osztás, János Jakucs, Tibor Paluch, Ferenc Horváth, Piroska Csengeri, Judit Koós, Katalin Sebők, Alexandra Anders, Pál Raczky, Judit Regenye, Judit P. Barna, Szilvia Fábián, Gábor Serlegi, Zoltán Toldi, Emese Gyöngyvér Nagy, János Dani, Erika Molnár, György Pálfi, László Márk, Béla Melegh, Zsolt Bánfai, László Domboróczki, Javier Fernández-Eraso, José Antonio Mujika-Alustiza, Carmen Alonso Fernández, Javier Jiménez Echevarría, Ruth Bollongino, Jörg Orschiedt, Kerstin Schierhold, Harald Meller, Alan Cooper, Joachim Burger, Eszter Bánffy, Kurt W. Alt, Carles Lalueza-Fox, Wolfgang Haak, and David Reich. 2017. Parallel palaeogenomic transects reveal complex genetic history of early European farmers. *Nature* 551:368.

Liu, Shuhu, Yilihamu Nizam, Bake Rabiyamu, Bupatima Abdukeram, and Matyusup Dolkun. 2018. A study of genetic diversity of three isolated populations in Xinjiang using Y-SNP. *Acta Anthropologica Sinica* 37 (1):146-156.

Lo Schiavo, Fulvia. 2013. The Bronze Age in Sardinia In *The Oxford Handbook of the European Bronze Age*, edited by H. Fokkens and A. Harding. Oxford: Oxford University Press.

Luca, F., F. Di Giacomo, T. Benincasa, L. O. Popa, J. Banyko, A. Kracmarova, P. Malaspina, A. Novelletto, and R. Brdicka. 2007. Y-chromosomal variation in the Czech Republic. *American Journal of Physical Anthropology* 132 (1):132-139.

Lull, V., R. Micó, C. Rihuete Herrada, and R. Risch. 2013. The Bronze Age in the Balearic Islands Oxford Handbooks. In *The Oxford Handbook of the European Bronze Age*, edited by H. Fokkens and A. Harding. Oxford.

Lull, Vicente, Rafael Micó, Cristina Rihuete Herrada, and Roberto Risch. 2013. Bronze Age Iberia. In *The Oxford Handbook of the European Bronze Age*, edited by H. Fokkens and A. Harding. Oxford: Oxford University Press.

Luneau, Élise. 2019. Climate Change and the Rise and Fall of the Oxus Civilization in Southern Central Asia. In *Socio-Environmental Dynamics along the Historical Silk Road*, edited by L. E. Yang, H.-R. Bork, X. Fang and S. Mischke. Cham: Springer International Publishing.

Maeir, Aren M., Brent Davis, and Louise A. Hitchcock. 2016. Philistine Names and Terms Once Again: A Recent Perspective. *Journal of Eastern Mediterranean Archaeology & Heritage Studies* 4 (4):321-340.

Magness, Jodi. 2001. A Near Eastern Ethnic Element Among the Etruscan Elite? *Etruscan Studies* 8 (4):79-117.

Maisano Delser, Pierpaolo, Metka Ravnik-Glavač, Paolo Gasparini, Damjan Glavač, and Massimo Mezzavilla. 2018. Genetic Landscape of Slovenians: Past Admixture and Natural Selection Pattern. *Frontiers in Genetics* 9 (551).

Major, Candace O., Steven L. Goldstein, William B. F. Ryan, Gilles Lericolais, Alexander M. Piotrowski, and Irka Hajdas. 2006. The co-evolution of Black Sea level and composition through the last deglaciation and its paleoclimatic significance. *Quaternary Science Reviews* 25 (17–18):2031-2047.

Makarowicz, Przemysław. 2010. The Creation of New Social Space. Barrows of the Corded Ware Culture and Trzciniec Circle as markers of a mental map in the upland parts of Poland and western Ukraine. In *Landscapes and Human Development: The Contribution of European Archaeology. Proceedings of the International Workshop "Socio-Environmental Dynamics over the Last 12,000 Years: The Creation of Landscapes (1st-4th April 2009)"*, edited by K. G. School. Bonn: Dr. Rudolf Habelt.

Malin-Boyce, Susan. 2004. Hallstatt and La Tène. In *Ancient Europe, 8000 B.C. to A.D. 1000: An Encyclopedia of the Barbarian World*, edited by P. Bogucki and P. J. Crabtree. New York: Charles Scribner.

Mallick, S., H. Li, M. Lipson, I. Mathieson, M. Gymrek, and F. Racimo. 2016. The Simons Genome Diversity Project: 300 genomes from 142 diverse populations. *Nature* 538.

Mallory, J., and D.Q. Adams. 2007. Reconstructing the Proto-Indo-Europeans. In *The Oxford Introduction to Proto-Indo-European and the Proto-Indo-European World*. Oxford: Oxford University Press.

Mallory, J.P. 2013. The Indo-Europeanization of Atlantic Europe. In *Celtic From the West 2: Rethinking the Bronze Age and the Arrival of Indo-European in Atlantic Europe*, edited by J. T. Koch and B. Cunliffe. Oxford: Oxbow Books.

Repeated Author. 2014. Indo-European dispersals and the Eurasian Steppe. In *Reconfiguring the Silk Road: New Research on East-West Exchange in Antiquity*, edited by V. H. Mair and J. Hickman. Philadelphia: University of Pennsylvania Museum of Archaeology and Anthropology.

Mallory, J.P., and D. Q. Adams. 2007. A Place in Time. In *The Oxford Introduction to Proto-Indo-European and the Proto-Indo-European World*, edited by J. Mallory and R. B. Adams. Oxford: Oxford University Press.

Mallory, J.P., and Douglas Q. Adams. 1997. *Encyclopedia of Indo-European Culture*. London: Fitzroy Dearborn Publishers.

Mallory, James P. 2015. The problem of Tocharian origins: An archaeological perspective. In *Sino-Platonic Papers*. Philadelphia: University of Pennsylvania.

Malmström, H., M.T.P. Gilbert, M.G. Thomas, M. Brandström, J. Storå, P. Molnar, P.K. Andersen, C. Bendixen, G. Holmlund, A. Götherström, and E. Willerslev. 2009. Ancient DNA reveals lack of continuity between neolithic hunter-gatherers and contemporary Scandinavians. *Curr Biol* 19:1758–1762.

Manzura, Igor. 2005. Steps to the Steppe: Or, how the North Pontic region was colonised. *Oxford Journal of Archaeology* 24 (4):313-338.

Repeated Author. 2016. North Pontic Steppes at the End of the 4th Millennium BC: the Epoch of Broken Borders. In *Man, culture, and society from the Copper Age until the Early Iron Age in Northern Eurasia (Contributions in honour of the 60th anniversary of Eugen Sava)*. Chișinău: Bons Offices.

Marchenko, Z. V., S. V. Svyatko, V. I. Molodin, A. E. Grishin, and M. P. Rykun. 2017. Radiocarbon Chronology of Complexes With Seima-Turbino Type Objects (Bronze Age) in Southwestern Siberia. *Radiocarbon* 59 (5):1381-1397.

Marchesini, Simona. 2012. The Elymian language. In *Language and Linguistic Contact in Ancient Sicily*, edited by O. Tribulato. Cambridge: Cambridge University Press.

Marcus, Joseph H., Cosimo Posth, Harald Ringbauer, Luca Lai, Robin Skeates, Carlo Sidore, Jessica Beckett, Anja Furtwängler, Anna Olivieri, Charleston Chiang, Hussein Al-Asadi, Kushal Dey, Tyler A. Joseph, Clio Der Sarkissian, Rita Radzevičiūtė, Maria Giuseppina Gradoli, Wolfgang Haak, David Reich, David Schlessinger, Francesco Cucca, Johannes Krause, and John Novembre. 2019. Population history from the Neolithic to present on the Mediterranean island of Sardinia: An ancient DNA perspective. *bioRxiv*:583104.

Margaryan, Ashot, Miroslava Derenko, Hrant Hovhannisyan, Boris Malyarchuk, Rasmus Heller, Zaruhi Khachatryan, Pavel Avetisyan, Ruben Badalyan, Arsen Bobokhyan, Varduhi Melikyan, Gagik Sargsyan, Ashot Piliposyan, Hakob Simonyan, Ruzan Mkrtchyan, Galina Denisova, Levon Yepiskoposyan, Eske Willerslev, and Morten E. Allentoft. 2017. Eight Millennia of Matrilineal Genetic Continuity in the South Caucasus. *Current Biology*.

Marin Aguilera, Beatriz, Esther Rodriguez-Gonzalez, Sebastian Celestino, and Margarita Gleba. 2019. Dressing the sacrifice: textiles, textile production and the sacrificial economy at Casas del Turuñuelo, in the fifth century BC Iberia. *Antiquity* (Accepted manuscript).

Marková, Klára, and Gábor Ilon. 2013. Slovakia and Hungary. In *The Oxford Handbook of the European Bronze Age*, edited by H. Fokkens and A. Harding. Oxford: Oxford University Press.

Martin, Alicia R., Konrad J. Karczewski, Sini Kerminen, Mitja I. Kurki, Antti-Pekka Sarin, Mykyta Artomov, Johan G. Eriksson, Tõnu Esko, Giulio Genovese, Aki S. Havulinna, Jaakko Kaprio, Alexandra Konradi, László Korányi, Anna Kostareva, Minna Männikkö, Andres Metspalu, Markus Perola, Rashmi B. Prasad, Olli Raitakari, Oxana Rotar, Veikko Salomaa, Leif Groop, Aarno

Palotie, Benjamin M. Neale, Samuli Ripatti, Matti Pirinen, and Mark J. Daly. 2018. Haplotype Sharing Provides Insights into Fine-Scale Population History and Disease in Finland. *The American Journal of Human Genetics* 102 (5):760-775.

Martínez, Maria Pilar Prieto, and Laure Salanova. 2015. Concluding remarks. The Bell Beaker Transition: The end of the neolithisation of Europe; the starting point of a new order. In *The Bell BeakerTransition in Europe. Mobility and local evolution during the 3rd millenium BC*, edited by M. P. P. Martínez and L. Salanova. Oxford & Philadelphia: Oxbow Books.

Martínez Sánchez, Rafael M., Juan Carlos Vera Rodríguez, Leonor Peña-Chocarro, Youssef Bokbot, Guillem Pérez Jordà, and Salvador Pardo-Gordó. 2018. The Middle Neolithic of Morocco's North-Western Atlantic Strip: New Evidence from the El-Khil Caves (Tangier). *African Archaeological Review* 35 (3):417-442.

Martiniano, Rui, Anwen Caffell, Malin Holst, Kurt Hunter-Mann, Janet Montgomery, Gundula Müldner, Russell L. McLaughlin, Matthew D. Teasdale, Wouter van Rheenen, Jan H. Veldink, Leonard H. van den Berg, Orla Hardiman, Maureen Carroll, Steve Roskams, John Oxley, Colleen Morgan, Mark G. Thomas, Ian Barnes, Christine McDonnell, Matthew J. Collins, and Daniel G. Bradley. 2016. Genomic signals of migration and continuity in Britain before the Anglo-Saxons. *Nature Communications* 7:10326.

Martiniano, Rui, Lara M. Cassidy, Ros Ó'Maoldúin, Russell McLaughlin, Nuno M. Silva, Licinio Manco, Daniel Fidalgo, Tania Pereira, Maria J. Coelho, Miguel Serra, Joachim Burger, Rui Parreira, Elena Moran, Antonio C. Valera, Eduardo Porfirio, Rui Boaventura, Ana M. Silva, and Daniel G. Bradley. 2017. The population genomics of archaeological transition in west Iberia: Investigation of ancient substructure using imputation and haplotype-based methods. *PLOS Genetics* 13 (7):e1006852.

Matasović, Ranko 2009. *Etymological Dictionary of Proto-Celtic*. Vol. 9, *Leiden Indo-European Etymological Dictionary Series*. Leiden/Boston: Brill.

Mathieson, I., I. Lazaridis, N. Rohland, S. Mallick, N. Patterson, S. A. Roodenberg, E. Harney, K. Stewardson, D. Fernandes, M. Novak, K. Sirak, C. Gamba, E. R. Jones, B. Llamas, S. Dryomov, J. Pickrell, J. L. Arsuaga, J. M. de Castro, E. Carbonell, F. Gerritsen, A. Khokhlov, P. Kuznetsov, M. Lozano, H. Meller, O. Mochalov, V. Moiseyev, M. A. Guerra, J. Roodenberg, J. M. Verges, J. Krause, A. Cooper, K. W. Alt, D. Brown, D. Anthony, C. Lalueza-Fox, W. Haak, R. Pinhasi, and D. Reich. 2015. Genome-wide patterns of selection in 230 ancient Eurasians. *Nature* 528 (7583):499-503.

Mathieson, Iain, Songül Alpaslan-Roodenberg, Cosimo Posth, Anna Szécsényi-Nagy, Nadin Rohland, Swapan Mallick, Iñigo Olalde, Nasreen Broomandkhoshbacht, Francesca Candilio, Olivia Cheronet, Daniel Fernandes, Matthew Ferry, Beatriz Gamarra, Gloria González Fortes, Wolfgang Haak, Eadaoin Harney, Eppie Jones, Denise Keating, Ben Krause-Kyora, Isil Kucukkalipci, Megan Michel, Alissa Mittnik, Kathrin Nägele, Mario Novak, Jonas Oppenheimer, Nick Patterson, Saskia Pfrengle, Kendra Sirak, Kristin Stewardson, Stefania Vai, Stefan Alexandrov, Kurt W. Alt, Radian Andreescu, Dragana Antonović, Abigail Ash, Nadezhda Atanassova, Krum Bacvarov, Mende Balázs Gusztáv, Hervé Bocherens, Michael Bolus, Adina Boroneanţ, Yavor Boyadzhiev, Alicja Budnik, Josip Burmaz, Stefan Chohadzhiev, Nicholas J. Conard, Richard Cottiaux, Maja Čuka, Christophe Cupillard, Dorothée G. Drucker, Nedko Elenski, Michael Francken, Borislava Galabova, Georgi Ganetsovski, Bernard Gély, Tamás Hajdu, Veneta Handzhyiska, Katerina Harvati, Thomas Higham, Stanislav Iliev, Ivor Janković, Ivor Karavanić, Douglas J. Kennett, Darko Komšo, Alexandra Kozak, Damian Labuda, Martina Lari, Catalin Lazar, Maleen Leppek, Krassimir Leshtakov, Domenico Lo Vetro, Dženi Los, Ivaylo Lozanov, Maria Malina, Fabio Martini, Kath McSweeney, Harald Meller, Marko Menđušić, Pavel Mirea, Vyacheslav Moiseyev, Vanya Petrova, T. Douglas Price, Angela Simalcsik, Luca Sineo, Mario Šlaus, Vladimir Slavchev, Petar Stanev, Andrej Starović, Tamás Szeniczey, Sahra Talamo, Maria Teschler-Nicola, Corinne Thevenet, Ivan Valchev, Frédérique Valentin, Sergey Vasilyev, Fanica Veljanovska, Svetlana Venelinova, Elizaveta Veselovskaya, Bence Viola, Cristian Virag, Joško Zaninović, Steve Zäuner, Philipp W. Stockhammer, Giulio Catalano, Raiko Krauß, David Caramelli, Gunita Zariņa, Bisserka Gaydarska, Malcolm Lillie, Alexey G. Nikitin, Inna Potekhina, Anastasia Papathanasiou, Dušan Borić, Clive Bonsall, Johannes Krause, Ron Pinhasi, and David Reich. 2018. The genomic history of southeastern Europe. *Nature* 555:197.

Mathieson, Iain, Songül Alpaslan Roodenberg, Cosimo Posth, Anna Szécsényi-Nagy, Nadin Rohland, Swapan Mallick, Iñigo Olade, Nasreen Broomandkhoshbacht, Olivia Cheronet, Daniel Fernandes, Matthew Ferry, Beatriz Gamarra, Gloria González Fortes, Wolfgang Haak, Eadaoin Harney, Ben Krause-Kyora, Isil Kucukkalipci, Megan Michel, Alissa Mittnik, Kathrin Nägele, Mario Novak, Jonas Oppenheimer, Nick Patterson, Saskia Pfrengle, Kendra Sirak, Kristin Stewardson, Stefania Vai, Stefan Alexandrov, Kurt W. Alt, Radian Andreescu, Dragana Antonović, Abigail Ash, Nadezhda Atanassova, Krum Bacvarov, Mende Balázs Gusztáv, Hervé Bocherens, Michael Bolus, Adina Boroneanţ, Yavor Boyadzhiev, Alicja Budnik, Josip Burmaz, Stefan Chohadzhiev, Nicholas J. Conard, Richard Cottiaux, Maja Čuka, Christophe Cupillard, Dorothée G. Drucker, Nedko Elenski, Michael Francken, Borislava Galabova, Georgi Ganetovski, Bernard Gely, Tamás Hajdu, Veneta Handzhyiska, Katerina Harvati, Thomas Higham, Stanislav Iliev, Ivor Janković, Ivor Karavanić, Douglas J. Kennett, Darko Komšo, Alexandra Kozak, Damian Labuda, Martina Lari, Catalin Lazar, Maleen Leppek, Krassimir Leshtakov, Domenico Lo Vetro, Dženi Los, Ivaylo Lozanov, Maria Malina, Fabio Martini, Kath McSweeney, Harald Meller, Marko Menđušić, Pavel Mirea, Vyacheslav Moiseyev, Vanya Petrova, T. Douglas Price, Angela Simalcsik, Luca Sineo, Mario Šlaus, Vladimir Slavchev, Petar Stanev, Andrej Starović, Tamás Szeniczey, Sahra Talamo, Maria Teschler-Nicola, Corinne Thevenet, Ivan Valchev, Frédérique Valentin, Sergey Vasilyev, Fanica Veljanovska, Svetlana Venelinova, Elizaveta Veselovskaya, Bence Viola, Cristian Virag, Joško Zaninović, Steve Zäuner, Philipp W. Stockhammer, Giulio Catalano, Raiko Krauß, David Caramelli, Gunita Zariņa, Bisserka Gaydarska, Malcolm Lillie, Alexey G. Nikitin, Inna Potekhina, Anastasia Papathanasiou, Dušan Borić, Clive Bonsall, Johannes Krause, Ron Pinhasi, and David Reich. 2017. The Genomic History Of Southeastern Europe. *bioRxiv*.

Matisoo-Smith, E., A. L. Gosling, D. Platt, O. Kardailsky, S. Prost, S. Cameron-Christie, C. J. Collins, J. Boocock, Y. Kurumilian, M. Guirguis, R. Pla Orquín, W. Khalil, H. Genz, G. Abou Diwan, J. Nassar, and P. Zalloua. 2018. Ancient mitogenomes of Phoenicians from Sardinia and Lebanon: A story of settlement, integration, and female mobility. *PLOS ONE* 13 (1):e0190169.

Mazurkevich, A. N., B. N. Korotkevich, P. M. Dolukhanov, A. M. Shukurov, Kh A. Arslanov, L. A. Savel'eva, E. N. Dzinoridze, M. A. Kulkova, and G. I. Zaitseva. 2009. Climate, subsistence and human movements in the Western Dvina – Lovat River Basins. *Quaternary International* 203 (1-2):52-66.

Mazurkevich, Andrey, and Ekaterina Dolbunova. 2015. The oldest pottery in hunter-gatherer communities and models of Neolithisation of Eastern Europe. *Documenta Praehistorica* XLII:13-66.

McEvoy, Brian P., and Daniel G. Bradley. 2010. Irish Genetics and Celts. In *Celtic from the West: Alternative Perspectives from Archaeology, Genetics, Language and Literature*, edited by B. Cunliffe and J. T. Koch. Oxford: Oxbow Books.

Meid, W. 1975. Probleme der räumlichen und zeitlichen Gliederung der Indogermanischen. In *Flexion und Wortbildung*, edited by H. Rix. Wiesbaden: Reichert.

Meier-Brügger, Michael. 2003. *Indo-European Linguistics*. Berlin, New York: Walter de Gruyter.

Meiri, Meirav, Philipp W. Stockhammer, Peggy Morgenstern, and Joseph Maran. 2019. Mobility and trade in Mediterranean antiquity: Evidence for an 'Italian connection' in Mycenaean Greece revealed by ancient DNA of livestock. *Journal of Archaeological Science: Reports* 23:98-103.

Melchert, Craig. 2011. Indo-Europeans. In *The Oxford Handbook of Ancient Anatolia 10,000-323 B.C.E.*, edited by S. R. Steadman and G. McMahon. Oxford: Oxford University Press.

Melchert, H. Craig. 1998. The dialectal position of Anatolian within Indo-European. In *Annual Meeting of the Berkeley Linguistics Society*.

Melheim, Lene, Johan Ling, Zofia A. Stos-Gale, Eva Hjärthner-Holdar, and Lena Grandin. 2018. The role of pre-Norsemen in trade and exchange of commodities in Bronze Age Europe. In *Metal, Minds and Mobility. Integrating scientific data with archaeological theory*, edited by X.-L. Armada, M. Murillo-Barroso and M. Charlton. Oxford & Philadelphia: Oxbow books.

Meller, Harald. 2017. Armies in the Early Bronze Age? An alternative interpretation of Únětice Culture axe hoards. *Antiquity* 91 (360):1529-1545.

Meyer, Christian, Corina Knipper, Nicole Nicklisch, Angelina Münster, Olaf Kürbis, Veit Dresely, Harald Meller, and Kurt W. Alt. 2018. Early Neolithic executions indicated by clustered cranial trauma in the mass grave of Halberstadt. *Nature Communications* 9 (1):2472.

Michel, Cécile. 2011. The Kārum Period on the Plateau. In *The Oxford Handbook of Ancient Antolia 10,000-323 B.C.E.*, edited by S. R. Steadman and G. McMahon. Oxford: Oxford University Press.

Middleton, Guy D. 2015. Telling Stories: The Mycenaean Origins of the Philistines. *Oxford Journal of Archaeology* 34 (1):45-65.

Midgley, Magdalena S. 2004. Consequences of Farming in Southern Scandinavia. In *Ancient Europe, 8000 B.C. to A.D. 1000: An Encyclopedia of the Barbarian*

World, edited by P. I. Bogucki and P. J. Crabtree. New York: Charles Scribner & Sons.

Mihovilić, Kristina. 2013. Castellieri-Gradine of the Northern Adriatic. In *The Oxford Handbook of the European Bronze Age*, edited by H. Fokkens and A. Harding. Oxford: Oxford University Press.

Mikhailova, Tatyana A. 2015. Celtic origin: location in time and space? Reconsidering the “East-West Celtic” debate. *Journal of Language Relationship* 13 (3):257-279.

Mileto, Simona. 2018. Diet and subsistence practices in the Dnieper area of the North-Pontic region (4th - 3rd millennium BC). An integrated archaeological, molecular and isotopic approach. Dissertation, History and Cultural Studies, Freie Universität Berlin.

Mileto, Simona, Elke Kaiser, Yuri Rassamakin, and Richard P. Evershed. 2017. New insights into the subsistence economy of the Eneolithic Dereivka culture of the Ukrainian North-Pontic region through lipid residues analysis of pottery vessels. *Journal of Archaeological Science: Reports* 13:67-74.

Mittnik, A., K. Massy, C. Knipper, R. Friedrich, W. Haak, S. Schiffels, P. W. Stockhammer, and J. Krause. 2018. Ancient genomes from the Lech Valley, Bavaria, suggest socially stratified households in the European Bronze Age. Paper read at 8th International Symposium on Biomolecular Archaeology ISBA 2018. 18th – 21st September, at Jena, Germany.

Mittnik, Alissa, Chuan-Chao Wang, Saskia Pfrengle, Mantas Daubaras, Gunita Zariņa, Fredrik Hallgren, Raili Allmäe, Valery Khartanovich, Vyacheslav Moiseyev, Mari Tõrv, Anja Furtwängler, Aida Andrades Valtueña, Michal Feldman, Christos Economou, Markku Oinonen, Andrejs Vasks, Elena Balanovska, David Reich, Rimantas Jankauskas, Wolfgang Haak, Stephan Schiffels, and Johannes Krause. 2018. The genetic prehistory of the Baltic Sea region. *Nature Communications* 9 (1):442.

Mochalov, Oleg D. 2008. *Keramika Pogrebal’nykh Pamiatnikov Epokhi Bronzy Lesostepi Volgo-Ural’skogo Mezhdurech’ya.* Samara: Samarskii Gosudarstvennyi Pedagogicheskii Universitet.

Molodin, V. I., L. N. Mylnikova, and L. S. Kobeleva. 2008. Stages in the settlement history of Chicha-1: The results of ceramic analysis. *Archaeology, Ethnology and Anthropology of Eurasia* 35 (3):54-67.

Monroy Kuhn, Jose Manuel, Mattias Jakobsson, and Torsten Günther. 2017. Estimating genetic kin relationships in prehistoric populations. *bioRxiv*.

Mooder, K. P., T. G. Schurr, F. J. Bamforth, V. I. Bazaliiski, and N. A. Savel'ev. 2005. Population affinities of Neolithic Siberians: A snapshot from prehistoric Lake Baikal. *American Journal of Physical Anthropology* 129 (3):349-361.

Moorjani, P., K. Thangaraj, N. Patterson, M. Lipson, P. R. Loh, and P. Govindaraj. 2013. Genetic evidence for recent population mixture in India. *Am J Hum Genet* 93.

Mordant, Claude. 2013. The Bronze Age in France In *The Oxford Handbook of the European Bronze Age*, edited by H. Fokkens and A. Harding. Oxford: Oxford University Press.

Morgunova, N. L. 2002. Yamnaya (Pit-Grave) Culture in the Southern Urals Area. In *Complex Societies of Central Eurasia from the 3rd to the 1st Millennium BC:*

Regional Specifics in Light of Global Models, edited by K. Jones-Bley and D. Zdanovich. Washington, D.C.: Institute for Study of Man.

Morgunova, Nina. 2014. О ХАРАКТЕРЕ КУЛЬТУРНОГО ВЗАИМОДЕЙСТВИЯ НАСЕЛЕНИЯ ЯМНОЙ КУЛЬТУРЫ СТЕПНОГО ВОЛГО-УРАЛЬЯ И АФАНАСЬЕВСКОЙ КУЛЬТУРЫ АЛТАЕ-САЯНСКОГО РЕГИОНА. *АРХЕОЛОГИЯ* 3 (26):4-13.

Morgunova, Nina L. 2015. Pottery from the Volga area in the Samara and South Urals region from Eneolithic to Early Bronze Age. *Documenta Prehistorica* XLII:311-320.

Morgunova, Nina L., and A. A. Fayzullin. 2018. The Social Structure of the Yamnaya (Pit-Grave) Culture of the Volga-Ural Interfluve. *Stratum plus* (2):35-60.

Morgunova, Nina L., and Mikhail A. Turetskij. 2016. Archaeological and natural scientific studies of Pit-Grave culture barrows in the Volga-Ural interfluve. *Estonian Journal of Archaeology* 20 (2):128-149.

Moroni, Adriana, Vincenzo Spagnolo, Jacopo Crezzini, Francesco Boschin, Marco Benvenuti, Samuele Gardin, Silvia Cipriani, and Simona Arrighi. 2019. Settlement, space organization and land-use of a small Middle Bronze Age community of central Italy. The case study of Gorgo del Ciliegio (Arezzo-Tuscany). *Quaternary International*.

Moussa, N. M., V. I. Bazaliiskii, O. I. Goriunova, F. Bamforth, and A. W. Weber. 2016. Y-chromosomal DNA analyzed for four prehistoric cemeteries from Cis-Baikal, Siberia. *Journal of Archaeological Science: Reports*.

Müller, J. 2014. 4100–2700 B.C.: Monuments and Ideologies in the Neolithic Landscape. In *Approaching Monumentality in Archaeology*, edited by J. F. Osborne. New York: Suny.

Müller, J., V. P. J. Arponen, R. Hofmann, and R. Ohlrau. 2015. The Appearance of Social Inequalities: Cases of Neolithic and Chalcolithic Societies. *Origini* 38 (2):65-86.

Müller, J., and S. VanVilligen. 2001. New radiocarbon evidence for European Bell Beakers and the consequences for the diffusion of the Bell Beaker Phenomenon. *Nicolis (ed.)*:59-80.

Müller, Johannes, and Aleksandr Diachenko. 2019. Tracing long-term demographic changes: The issue of spatial scales. *PLOS ONE* 14 (1):e0208739.

Müller, Johannes, Timo Seregély, Anne-Mette Christensen, Ullrich Schüssler, Cornelia Becker, Helmut Kroll, and Markus Fuchs. 2009. A Revision of Corded Ware Settlement Pattern–New Results from the Central European Low Mountain Range. *Proceedings of the Prehistoric Society* 75:125-142.

Murillo-Barroso, Mercedes, and Ignacio Montero-Ruiz. 2017. The Social Value of Things. In *Key Resources and Socio-Cultural Developments in the Iberian Chalcolithic*, edited by M. Bartelheim, P. B. Ramírez and M. Kunst. Tübingen: Tübingen Library Publishing.

Murphy, Eileen M., and Aleksandr A. Khokhlov. 2016. A Bioarchaeological Study of Prehistoric Populations from the Volga Region. In *A Bronze Age Landscape in the Russian Steppes. The Samara Valley Project*, edited by D. W. Anthony, D. R. Brown, O. D. Mochalov, A. A. Khokhlov and P. F. Kuznetsov. Los Angeles: Cotsen Institute of Archaeology Press.

Myres, N. M., S. Rootsi, A. A. Lin, M. Jarve, R. J. King, I. Kutuev, V. M. Cabrera, E. K. Khusnutdinova, A. Pshenichnov, B. Yunusbayev, O. Balanovsky, E. Balanovska, P. Rudan, M. Baldovic, R. J. Herrera, J. Chiaroni, J. Di Cristofaro, R. Villems, T. Kivisild, and P. A. Underhill. 2011. A major Y-chromosome haplogroup R1b Holocene era founder effect in Central and Western Europe. *Eur J Hum Genet* 19 (1):95-101.

Narasimhan, Vagheesh M, Nick J Patterson, Priya Moorjani, Iosif Lazaridis, Lipson Mark, Swapan Mallick, Nadin Rohland, Rebecca Bernardos, Alexander M. Kim, Nathan Nakatsuka, Inigo Olalde, Alfredo Coppa, James Mallory, Vyacheslav Moiseyev, Janet Monge, Luca M. Olivieri, Nicole Adamski, Nasreen Broomandkhoshbacht, Francesca Candilio, Olivia Cheronet, Brendan J. Culleton, Matthew Ferry, Daniel Fernandes, Beatriz Gamarra, Daniel Gaudio, Mateja Hajdinjak, Eadaoin Harney, Thomas K. Harper, Denise Keating, Ann-Marie Lawson, Megan Michel, Mario Novak, Jonas Oppenheimer, Niraj Rai, Kendra Sirak, Viviane Slon, Kristin Stewardson, Zhao Zhang, Gaziz Akhatov, Anatoly N. Bagashev, Baurzhan Baitanayev, Gian Luca Bonora, Tatiana Chikisheva, Anatoly Derevianko, Enshin Dmitry, Katerina Douka, Nadezhda Dubova, Andrey Epimakhov, Suzanne Freilich, Dorian Fuller, Alexander Goryachev, Andrey Gromov, Bryan Hanks, Margaret Judd, Erlan Kazizov, Aleksander Khokhlov, Egor Kitov, Elena Kupriyanova, Pavel Kuznetsov, Donata Luiselli, Farhad Maksudov, Chris Meiklejohn, Deborah C. Merrett, Roberto Micheli, Oleg Mochalov, Zahir Muhammed, Samridin Mustafakulov, Ayushi Nayak, Rykun M. Petrovna, Davide Pettner, Richard Potts, Dmitry Razhev, Stefania Sarno, Kulyan Sikhymbaevae, Sergey M. Slepchenko, Nadezhda Stepanova, Svetlana Svyatko, Sergey Vasilyev, Massimo Vidale, Dima Voyakin, Antonina Yermolayeva, Alisa Zubova, Vasant S. Shinde, Carles Lalueza-Fox, Matthias Meyer, David Anthony, Nicole Boivin, Kumarasmy Thangaraj, Douglas Kennett, Michael Frachetti, Ron Pinhasi, and David Reich. 2018. The Genomic Formation of South and Central Asia. *bioRxiv*.

Neparáczki, Endre, Zoltán Juhász, Horolma Pamjav, Tibor Fehér, Bernadett Csányi, Albert Zink, Frank Maixner, György Pálfi, Erika Molnár, Ildikó Pap, Ágnes Kustár, László Révész, István Raskó, and Tibor Török. 2017. Genetic structure of the early Hungarian conquerors inferred from mtDNA haplotypes and Y-chromosome haplogroups in a small cemetery. *Molecular Genetics and Genomics* 292 (1):201-214.

Neparáczki, Endre, Zoltán Maróti, Tibor Kalmár, Kitti Maár, István Nagy, Dóra Latinovics, Ágnes Kustár, György Pálfi, Erika Molnár, Antónia Marcsik, Csilla Balogh, Gábor Lőrinczy, Szilárd Sándor Gál, Péter Tomka, Bernadett Kovacsóczy, László Kovács, István Raskó, and Tibor Török. 2019. Y-chromosome haplogroups from Hun, Avar and conquering Hungarian period nomadic people of the Carpathian Basin. *bioRxiv*:597997.

Nicolaisen, W. 1957. Die alteuropäischen Gewässernamen der britischen Hauptinsel. *Beiträge zur Namenforschung*:211-268.

Nicolis, Franco. 2013. Northern Italy In *The Oxford Handbook of the European Bronze Age*, edited by H. Fokkens and A. Harding. Oxford: Oxford University Press.

Nikitin, Alexey G., Inna Potekhina, Nadin Rohland, Swapan Mallick, David Reich, and Malcolm Lillie. 2017. Mitochondrial DNA analysis of eneolithic trypillians from Ukraine reveals neolithic farming genetic roots. *PLOS ONE* 12 (2):e0172952.

Ning, C. 2018. Genomic insight into the Neolithic transition peopling of Northeast Asia. Paper read at 8th International Symposium on Biomolecular Archaeology ISBA 2018. 18th – 21st September, at Jena, Germany.

Noble, Gordon, Martin Goldberg, and Derek Hamilton. 2018. The development of the Pictish symbol system: inscribing identity beyond the edges of Empire. *Antiquity* 92 (365):1329-1348.

Norberg, Erik. 2019. The Meaning of Words and the Power of Silence. In *The Indigenous Identity of the South Saami : Historical and Political Perspectives on a Minority within a Minority*, edited by H. Hermanstrand, A. Kolberg, T. R. Nilssen and L. Sem. Cham: Springer International Publishing.

Nordqvist, Kerkko. 2018. The Stone Age of north-eastern Europe 5500–1800 calBC : bridging the gap between the East and the West, Human Sciences, University of Oulu, Oulu.

Nordqvist, Kerkko, and Piritta Häkälä. 2014. Distribution of Corded Ware in the Areas North of the Gulf of Finland – An Update. *Estonian Journal of Archaeology* 18 (1):3-29.

Nordqvist, Kerkko, Vesa-Pekka Herva, Janne Ikäheimo, and Antti Lahelma. 2012. Early Copper Use in Neolithic North-Eastern Europe: An Overview. *Estonian Journal of Archaeology* 16 (1):3-25.

Nordqvist, Kerkko, and Teemu Mökkönen. 2016. New Radiocarbon Dates for Early Pottery in North-Eastern Europe. In *Традиции и инновации в изучении древнейшей керамики*, edited by Л. Б. Вишняцкий and Е. Л. Костылёва. Санкт-Петербург, Россия: ИИМК РАН.

Novak, Marek. 2017. Do 14C dates always turn into an absolute chronology? The case of the Middle Neolithic in western Lesser Poland. *Documenta Praehistorica* 44:240-271.

Novozhenov, Victor A. 2012. *Communications and the Earliest Wheeled Transport of Eurasia*. Edited by E. E. Kuzmina. Moscow: Taus Publishing.

Nowak, M. 2014. Późny etap rozwoju cyklu lendzielskopolgarskiego w Zachodniej Małopolsce,. In *Szkice neolityczne. Księga poświęcona pamięci Profesor Anny Kulczyckiej-Leciejewiczowej*, edited by K. Czarniak, J. Kolenda and M. Markiewicz. Wrocław.

Oettinger, Norbert. 1997. Grundsätzliche Überlegungen zum Nordwest-Indogermanischen. *Incontri Linguistici* 20 (93-111).

Repeated Author. 2003. Neuerungen in Lexikon und Wortbildung des Nordwest-Indogermanischen. In *Languages in prehistoric Europe*, edited by A. Bammesberger, M. Bieswanger, J. Grzega and T. Venneman. Heidelberg: Winter.

Oinonen, Markku, Petro Pesonen, Teija Alenius, Volker Heyd, Elisabeth Holmqvist-Saukkonen, Sanna Kivimäki, Tuire Nygrén, Tarja Sundell, and Päivi Onkamo. 2014. Event reconstruction through Bayesian chronology: Massive mid-Holocene lake-burst triggered large-scale ecological and cultural change. *The Holocene* 24 (11):1419-1427.

Ojārs, Bušs. 2014. The Finno-Ugric influence on the Latvian place names: the history of the research and current challenges. In *Международной научной конференции «Uralo-indogermanica», посвященной лингвисту Р.-П. Риттеру (1938–2011). (16–17 октября 2014 г., Нарвский колледж, филиал Тартуского ун-та.)*.

Ökse, A. Tuba. 2017. Salat Tepe: Overview of the Stratigraphic Sequence and the Early EBA Levels Excavated in the Last Two Seasons. In *The Archaeology of Anatolia Volume II: Recent Discoveries (2015-2016)*, edited by S. R. Steadman and G. McMahon. Newcastle: Cambridge Scholars Publishing.

Olalde, I., H. Schroeder, M. Sandoval-Velasco, L. Vinner, I. Lobon, O. Ramirez, S. Civit, P. Garcia Borja, D. C. Salazar-Garcia, S. Talamo, J. Maria Fullola, F. Xavier Oms, M. Pedro, P. Martinez, M. Sanz, J. Daura, J. Zilhao, T. Marques-Bonet, M. T. Gilbert, and C. Lalueza-Fox. 2015. A Common Genetic Origin for Early Farmers from Mediterranean Cardial and Central European LBK Cultures. *Mol Biol Evol* 32 (12):3132-42.

Olalde, Iñigo, Selina Brace, Morten E. Allentoft, Ian Armit, Kristian Kristiansen, Thomas Booth, Nadin Rohland, Swapan Mallick, Anna Szécsényi-Nagy, Alissa Mittnik, Eveline Altena, Mark Lipson, Iosif Lazaridis, Thomas K. Harper, Nick Patterson, Nasreen Broomandkhoshbacht, Yoan Diekmann, Zuzana Faltyskova, Daniel Fernandes, Matthew Ferry, Eadaoin Harney, Peter de Knijff, Megan Michel, Jonas Oppenheimer, Kristin Stewardson, Alistair Barclay, Kurt Werner Alt, Corina Liesau, Patricia Ríos, Concepción Blasco, Jorge Vega Miguel, Roberto Menduiña García, Azucena Avilés Fernández, Eszter Bánffy, Maria Bernabò-Brea, David Billoin, Clive Bonsall, Laura Bonsall, Tim Allen, Lindsey Büster, Sophie Carver, Laura Castells Navarro, Oliver E. Craig, Gordon T. Cook, Barry Cunliffe, Anthony Denaire, Kirsten Egging Dinwiddy, Natasha Dodwell, Michal Ernée, Christopher Evans, Milan Kuchařík, Joan Francès Farré, Chris Fowler, Michiel Gazenbeek, Rafael Garrido Pena, María Haber-Uriarte, Elżbieta Haduch, Gill Hey, Nick Jowett, Timothy Knowles, Ken Massy, Saskia Pfrengle, Philippe Lefranc, Olivier Lemercier, Arnaud Lefebvre, César Heras Martínez, Virginia Galera Olmo, Ana Bastida Ramírez, Joaquín Lomba Maurandi, Tona Majó, Jacqueline I. McKinley, Kathleen McSweeney, Balázs Gusztáv Mende, Alessandra Modi, Gabriella Kulcsár, Viktória Kiss, András Czene, Róbert Patay, Anna Endrődi, Kitti Köhler, Tamás Hajdu, Tamás Szeniczey, János Dani, Zsolt Bernert, Maya Hoole, Olivia Cheronet, Denise Keating, Petr Velemínský, Miroslav Dobeš, Francesca Candilio, Fraser Brown, Raúl Flores Fernández, Ana-Mercedes Herrero-Corral, Sebastiano Tusa, Emiliano Carnieri, Luigi Lentini, Antonella Valenti, Alessandro Zanini, Clive Waddington, Germán Delibes, Elisa Guerra-Doce, Benjamin Neil, Marcus Brittain, Mike Luke, Richard Mortimer, Jocelyne Desideri, Marie Besse, Günter Brücken, Mirosław Furmanek, Agata Hałuszko, Maksym Mackiewicz, Artur Rapiński, Stephany Leach, Ignacio Soriano, Katina T. Lillios, João Luís Cardoso, Michael Parker Pearson, Piotr Włodarczak, T. Douglas Price, Pilar Prieto, Pierre-Jérôme Rey, Roberto Risch, Manuel A. Rojo Guerra, Aurore Schmitt, Joël Serralongue, Ana Maria Silva, Václav Smrčka, Luc Vergnaud, João Zilhão, David Caramelli, Thomas Higham, Mark G. Thomas, Douglas J. Kennett, Harry Fokkens, Volker Heyd, Alison Sheridan, Karl-Göran Sjögren, Philipp W. Stockhammer, Johannes Krause, Ron Pinhasi, Wolfgang Haak, Ian Barnes, Carles Lalueza-Fox, and David Reich. 2018. The Beaker phenomenon and the genomic transformation of northwest Europe. *Nature* 555:190.

Olalde, Iñigo, Swapan Mallick, Nick Patterson, Nadin Rohland, Vanessa Villalba-Mouco, Marina Silva, Katharina Dulias, Ceiridwen J. Edwards, Francesca Gandini, Maria Pala, Pedro Soares, Manuel Ferrando-Bernal, Nicole Adamski, Nasreen Broomandkhoshbacht, Olivia Cheronet, Brendan J. Culleton, Daniel Fernandes, Ann Marie Lawson, Matthew Mah, Jonas Oppenheimer, Kristin Stewardson, Zhao Zhang, Juan Manuel Jiménez Arenas, Isidro Jorge Toro Moyano, Domingo C. Salazar-García, Pere Castanyer, Marta Santos, Joaquim Tremoleda, Marina Lozano, Pablo García Borja, Javier Fernández-Eraso, José Antonio Mujika-Alustiza, Cecilio Barroso, Francisco J. Bermúdez, Enrique Viguera Mínguez, Josep Burch, Neus Coromina, David Vivó, Artur Cebrià, Josep Maria Fullola, Oreto García-Puchol, Juan Ignacio Morales, F. Xavier Oms, Tona Majó, Josep Maria Vergès, Antònia Díaz-Carvajal, Imma Ollich-Castanyer, F. Javier López-Cachero, Ana Maria Silva, Carmen Alonso-Fernández, Germán Delibes de Castro, Javier Jiménez Echevarría, Adolfo Moreno-Márquez, Guillermo Pascual Berlanga, Pablo Ramos-García, José Ramos-Muñoz, Eduardo Vijande Vila, Gustau Aguilella Arzo, Ángel Esparza Arroyo, Katina T. Lillios, Jennifer Mack, Javier Velasco-Vázquez, Anna Waterman, Luis Benítez de Lugo Enrich, María Benito Sánchez, Bibiana Agustí, Ferran Codina, Gabriel de Prado, Almudena Estalrrich, Álvaro Fernández Flores, Clive Finlayson, Geraldine Finlayson, Stewart Finlayson, Francisco Giles-Guzmán, Antonio Rosas, Virginia Barciela González, Gabriel García Atiénzar, Mauro S. Hernández Pérez, Armando Llanos, Yolanda Carrión Marco, Isabel Collado Beneyto, David López-Serrano, Mario Sanz Tormo, António C. Valera, Concepción Blasco, Corina Liesau, Patricia Ríos, Joan Daura, María Jesús de Pedro Michó, Agustín A. Diez-Castillo, Raúl Flores Fernández, Joan Francès Farré, Rafael Garrido-Pena, Victor S. Gonçalves, Elisa Guerra-Doce, Ana Mercedes Herrero-Corral, Joaquim Juan-Cabanilles, Daniel López-Reyes, Sarah B. McClure, Marta Merino Pérez, Arturo Oliver Foix, Montserrat Sanz Borràs, Ana Catarina Sousa, Julio Manuel Vidal Encinas, Douglas J. Kennett, Martin B. Richards, Kurt Werner Alt, Wolfgang Haak, Ron Pinhasi, Carles Lalueza-Fox, and David Reich. 2019. The genomic history of the Iberian Peninsula over the past 8000 years. *Science* 363 (6432):1230-1234.

Olasz, Judit, Verena Seidenberg, Susanne Hummel, Zoltán Szentirmay, György Szabados, Béla Melegh, and Miklós Kásler. 2018. DNA profiling of Hungarian King Béla III and other skeletal remains originating from the Royal Basilica of Székesfehérvár. *Archaeological and Anthropological Sciences*.

Olivieri, Anna, Carlo Sidore, Alessandro Achilli, Andrea Angius, Cosimo Posth, Anja Furtwängler, Stefania Brandini, Marco Rosario Capodiferro, Francesca Gandini, Magdalena Zoledziewska, Maristella Pitzalis, Andrea Maschio, Fabio Busonero, Luca Lai, Robin Skeates, Maria Giuseppina Gradoli, Jessica Beckett, Michele Marongiu, Vittorio Mazzarello, Patrizia Marongiu, Salvatore Rubino, Teresa Rito, Vincent Macaulay, Ornella Semino, Maria Pala, Gonçalo R. Abecasis, David Schlessinger, Eduardo Conde-Sousa, Pedro Soares, Martin B. Richards, Francesco Cucca, and Antonio Torroni. 2017. Mitogenome Diversity in Sardinians: A Genetic Window onto an Island's Past. *Molecular Biology and Evolution* 34 (5):1230-1239.

Orel, Vladimir. 1998. *Albanian Etymological Dictionary*. Leiden / Boston / Köln: Brill.

Översti, Sanni, Päivi Onkamo, Monika Stoljarova, Bruce Budowle, Antti Sajantila, and Jukka U. Palo. 2017. Identification and analysis of mtDNA genomes attributed to Finns reveal long-stagnant demographic trends obscured in the total diversity. *Scientific Reports* 7 (1):6193.

Özbal, Rana. 2011. The Chalcolithic of Southeast Anatolia. In *The Oxford Handbook of Ancient Anatolia (10,000-323 BCE)*, edited by S. R. Steadman and G. McMahon. Oxford: Oxford University Press.

Özbaşaran, Mihriban. 2011. The Neolithic in the Plateau. In *The Oxford Handbook of Ancient Anatolia (10,000-323 BCE)*, edited by S. R. Steadman and G. McMahon. Oxford: Oxford University Press.

Özdoğan, M. 2008. An alternative approach in tracing changes in demographic composition. In *The Neolithic Demographic Transition and Its Consequences*, edited by Bar-Yosef O. and B.-A. J.P.: Springer.

Özdoğan, Mehmet. 2011. Eastern Thrace: The Contact Zone between Anatolia and the Balkans. In *The Oxford Handbook of Ancient Anatolia 10,000-323 B.C.E.*, edited by S. R. Steadman and G. McMahon. Oxford: Oxford University Press.

Paavel, Kristiina, Aivar Kriiska, Valter Lang, and Alexander Kulkov. 2019. Three bronze axes with wooden haft remains from Estonia. *Estonian Journal of Archaeology* 23 (1):3-19.

Pacciarelli, Marco, Teodoro Scarano, and Anita Crispino. 2015. The transition between the Copper and Bronze Ages in southern Italy and Sicily. Paper read at 2200 BC – A climatic breakdown as a cause for the collapse of the old world? 7. Mitteldeutscher Archäologentag

vom 23. bis 26. Oktober 2014, at Halle (Saale).

Pagani, Luca, Toomas Kivisild, Ayele Tarekegn, Rosemary Ekong, Chris Plaster, Irene Gallego Romero, Qasim Ayub, S. Qasim Mehdi, Mark G Thomas, Donata Luiselli, Endashaw Bekele, Neil Bradman, David J Balding, and Chris Tyler-Smith. 2012. Ethiopian Genetic Diversity Reveals Linguistic Stratification and Complex Influences on the Ethiopian Gene Pool. *The American Journal of Human Genetics* 91 (1):83-96.

Pagel, Mark, Quentin D. Atkinson, Andreea S. Calude, and Andrew Meade. 2013. Ultraconserved words point to deep language ancestry across Eurasia. *Proceedings of the National Academy of Sciences* 110 (21):8471.

Palumbi, Giulio. 2011. The Chalcolithic of Eastern Anatolia. In *The Oxford Handbook of Ancient Anatolia (10,000-323 BCE)*, edited by S. R. Steadman and G. McMahon. Oxford: Oxford University Press.

Pamjav, Horolma, Á Fóthi, T. Fehér, and Erzsébet Fóthi. 2017. A study of the Bodrogköz population in north-eastern Hungary by Y chromosomal haplotypes and haplogroups. *Molecular Genetics and Genomics* 292 (4):883-894.

Pamjav, Horolma, Andrea Zalán, Judit Béres, Melinda Nagy, and Yuet Meng Chang. 2011. Genetic structure of the paternal lineage of the Roma People. *American Journal of Physical Anthropology* 145 (1):21-29.

Parker Pearson, Mike, Andrew Chamberlain, Mandy Jay, Mike Richards, Alison Sheridan, Neil Curtis, Jane Evans, Alex Gibson, Margaret Hutchison, Patrick

Mahoney, Peter Marshall, Janet Montgomery, Stuart Needham, Sandra O'Mahoney, Maura Pellegrini, and Neil Wilkin. 2016. Beaker people in Britain: migration, mobility and diet. *Antiquity* 90 (351):620-637.

Parpola, A. 2015. *The Roots of Hinduism: The Early Aryans and the Indus Civilization*. New York: Oxford University Press.

Parpola, Asko. 2013. Formation of the Indo-European and Uralic (Finno-Ugric) language families in the light of archaeology: Revised and integrated ‘total’ correlations. In *A Linguistic Map of Prehistoric Northern Europe*. Helsinki: Société Finno-Ougrienne.

Repeated Author. 2018. Finnish vatsa ~ Sanskrit vatsá and the formation of Indo-Iranian and Uralic languages. *Suomalais-Ugrilaisen Seuran Aikakauskirja* 96:245-286.

Parpola, Asko, and Christian Carpelan. 2005. The cultural counterparts to Proto-Indo-European, Proto-Uralic and Proto-Aryan: matching the dispersal and contact patterns in the linguistic and archaeological record. In *The Indo-Aryan controversy. Evidence and inference in Indian history.*, edited by E. F. Bryant and L. L. Patton. London and New York: Routledge.

Parzinger, Hermann. 2006. *Die frühen Völker Eurasiens: Vom Neolithikum bis zum Mittelalter*. München: Verlag C. H. Beck.

Repeated Author. 2013. Ukraine and South Russia in the Bronze Age. In *The Oxford Handbook of the European Bronze Age*, edited by H. Fokkens and A. Harding. Oxford: Oxford University Press.

Pathak, Ajai K., Anurag Kadian, Alena Kushniarevich, Francesco Montinaro, Mayukh Mondal, Linda Ongaro, Manvendra Singh, Pramod Kumar, Niraj Rai, Jüri Parik, Ene Metspalu, Siiri Rootsi, Luca Pagani, Toomas Kivisild, Mait Metspalu, Gyaneshwer Chaubey, and Richard Villems. 2018. The Genetic Ancestry of Modern Indus Valley Populations from Northwest India. *The American Journal of Human Genetics* 103 (6):918-929.

Patton, Henry, Alun Hubbard, Karin Andreassen, Amandine Auriac, Pippa L. Whitehouse, Arjen P. Stroeven, Calvin Shackleton, Monica Winsborrow, Jakob Heyman, and Adrian M. Hall. 2017. Deglaciation of the Eurasian ice sheet complex. *Quaternary Science Reviews* 169:148-172.

Perdikaris, Sophia. 2004. Pre-Roman Iron Age Scandinavia. In *Ancient Europe, 8000 B.C. to A.D. 1000: An Encyclopedia of the Barbarian World*, edited by P. Bogucki and P. J. Crabtree. New York: Charles Scribner.

Pereltsvaig, Asya, and Martin W. Lewis. 2015. *The Indo-European Controversy. Facts and Fallacies in Historical Linguistics*. Cambridge: Cambridge University Press.

Peričić, Marijana, Lovorka Barać Lauc, Irena Martinović Klarić, Siiri Rootsi, Branka Janićijević, Igor Rudan, Rifet Terzić, Ivanka Čolak, Ante Kvesić, Dan Popović, Ana Šijački, Ibrahim Behluli, Dobrivoje Đorđević, Ljudmila Efremovska, Đorđe D. Bajec, Branislav D. Stefanović, Richard Villems, and Pavao Rudan. 2005. High-Resolution Phylogenetic Analysis of Southeastern Europe Traces Major Episodes of Paternal Gene Flow Among Slavic Populations. *Molecular Biology and Evolution* 22 (10):1964-1975.

Perra, M. 2009. Osservazioni sull’evoluzione sociale e politica in età nuragica. *Rivista di Scienze Preistoriche* LIX:355-368.

Petkovski, Elizabet. 2006. Polymorphismes ponctuels de séquence et identification génétique: étude par spectrométrie de masse MALDI-TOF, Université Louis Pasteur, Strasbourg.

Petrova, VIktoria. 2016. Varna culture: an autonomous phenomenon or a local version of the Kodzhadermen-Gumelnitsa-Karanovo VI cultural complex. In *Der Schwarzmeerraum vom Neolithikum bis in die Früheisenzeit (6000-600 v. Chr.). Kulturelle Interferenzen in der zirkumpontischen Zone und Kontakte mit ihren Nachbargebieten*, edited by B. Hänsel and W. Schier. Rahden/Westfalen: Verlag Marie Leidorf.

Pickrell, Joseph K., Nick Patterson, Po-Ru Loh, Mark Lipson, Bonnie Berger, Mark Stoneking, Brigitte Pakendorf, and David Reich. 2014. Ancient west Eurasian ancestry in southern and eastern Africa. *Proceedings of the National Academy of Sciences of the United States of America* 111 (7):2632-2637.

Piezonka, Henny. 2015. Older than the farmers' pots? Hunter-gatherer ceramics east of the Baltic Sea. In *The Dąbki Site in Pomerania and the Neolithisation of the North European Lowlands (c. 5000-3000 calBC)*, edited by J. Kabaciński, S. Hatz, R. D. C. M. and T. Terberger. Rahden/Westf.: Marie Leidorf.

Repeated Author. 2016. Die frühe Keramik Eurasiens: Aktuelle Forschungsfragen und methodische Ansätze, in Multidisciplinary approach to archaeology: Recent achievements and prospects. Proceedings of the International Symposium “Multidisciplinary approach to archaeology: Recent achievements and prospects”, June 22-26, 2015, Novosibirsk, Eds. V. I. Molodin, S. Hansen. In *Multidisciplinary approach to archaeology: Recent achievements and prospects. Proceedings of the International Symposium “Multidisciplinary approach to archaeology: Recent achievements and prospects”, June 22-26, 2015, Novosibirsk*, edited by V. I. Molodin and S. Hansen.

Piličiauskas, Gytis, Vitali Asheichyk, Grzegorz Osipowicz, Raminta Skipitytė, Liivi Varul, Justina Kozakaitė, Mikola Kryvaltsevich, Aliaksandra Vaitovich, Vadzim Lakiza, Justina Šapolaitė, Žilvinas Ežerinskis, Mikalai Pamazanau, Alexandre Lucquin, Oliver E. Craig, and Harry K. Robson. 2018. The Corded Ware culture in the Eastern Baltic: New evidence on chronology, diet, beaker, bone and flint tool function. *Journal of Archaeological Science: Reports* 21:538-552.

Pilipenko, A.S., R.O Trapezov, and N.V. Polosmak. 2015. Paleogenetic study of Pazyryk people buried at Ak-Alakha-1, the Altai mountains. *Archaeol Ethnol Anthrop Eurasia* 43:144-150.

Pimenta, João, Alexandra M. Lopes, Angel Carracedo, Miguel Arenas, António Amorim, and David Comas. 2019. Spatially explicit analysis reveals complex human genetic gradients in the Iberian Peninsula. *Scientific Reports* 9 (1):7825.

Pinheiro, Elias. 2011. The Sintashta cultural particulars and the origin of the war chariot. *Res Antiquitatis : journal of ancient history Vol. 2 (2011) p. 149-168* 2:149-168.

Pleinerová, I. . 1992. Les Habitats et les maisons du Bronze Ancien en Bohême du Nordouest. In *L' Habitat et l' occupation du sol a l âge du Bronze en Europe*, edited by C. Mordant and A. Richard. Paris: éditions du Comité des Travaux Historiques et Scientifiques.

Poccetti, Paolo. 2012. Language relations in Sicily - Evidence for the speech of the Σικανοί, the Σικελοί, and others. In *Language and Linguistic Contact in Ancient Sicily*, edited by O. Tribulato. Cambridge: Cambridge University Press.

Pokutta, Anna. 2013. Population Dynamics, Diet and Migrations of the Únětice culture in Poland, Gothernburg, Department of Archaeology, University of Gothenburg, Gothenburg.

Poljakov, A. V. , S. V. Svjatko, and N. F. Stepanova. 2018. Поляков А.В., Святко С.В., Степанова Н.Ф. Современное состояние радиоуглеродного датирования афанасьевской и окуневской культур. *Научное обозрение Саяно-Алтая* 21 (5):14-22.

Popova, Laura M., Eileen M. Murphy, and Aleksandr A. Khokhlov. 2011. Standardization and Resistance: Changing Funerary Rites at Spiridonovka (Russia) during the Beginning of the Late Bronze Age. In *The Archaeology of Politics: The Materiality of Political Practice and Action in the Past*, edited by P. G. Johansen and A. M. Bauer: Cambridge Scholars Publishing.

Poska, A., and L. Saarse. 2002. Vegetation development and introduction of agriculture to Saaremaa Island, Estonia: the human response to shore displacement. *The Holocene* 12 (5):555-568.

Pospieszny, Ł. 2015. Freshwater reservoir effect and the radiocarbon chronology of the cemetery in Ząbie. *Journal of Archaeological Science* 53:264-276.

Post, Helen, Endre Németh, László Klima, Rodrigo Flores, Tibor Fehér, Attila Türk, Gábor Székely, Hovhannes Sahakyan, Mayukh Mondal, Francesco Montinaro, Monika Karmin, Lauri Saag, Bayazit Yunusbayev, Elza K. Khusnutdinova, Ene Metspalu, Richard Villems, Kristiina Tambets, and Siiri Rootsi. 2019. Y-chromosomal connection between Hungarians and geographically distant populations of the Ural Mountain region and West Siberia. *Scientific Reports* 9 (1):7786.

Prendergast, Mary E., Mark Lipson, Elizabeth A. Sawchuk, Iñigo Olalde, Christine A. Ogola, Nadin Rohland, Kendra A. Sirak, Nicole Adamski, Rebecca Bernardos, Nasreen Broomandkhoshbacht, Kimberly Callan, Brendan J. Culleton, Laurie Eccles, Thomas K. Harper, Ann Marie Lawson, Matthew Mah, Jonas Oppenheimer, Kristin Stewardson, Fatma Zalzala, Stanley H. Ambrose, George Ayodo, Henry Louis Gates, Agness O. Gidna, Maggie Katongo, Amandus Kwekason, Audax Z. P. Mabulla, George S. Mudenda, Emmanuel K. Ndiema, Charles Nelson, Peter Robertshaw, Douglas J. Kennett, Fredrick K. Manthi, and David Reich. 2019. Ancient DNA reveals a multistep spread of the first herders into sub-Saharan Africa. *Science*:eaaw6275.

Prescott, C., and E. Walderhaug. 1995. The Last Frontier? Processes of Indo-Europeanization in Northern Europe. The Norwegian Case. *JIES* 23 (2):257-278.

Prescott, Christopher. 2009. History in prehistory - the later Neolithic / Early Metal Age, Norway. In *Neolithisation as if History mattered. Process of Neolithisation in North-Western Europe*, edited by H. Glørstad and C. Prescott. Lindome: Bricoleur.

Repeated Author. 2012. No longer north of the Beakers. Modeling an interpretative platform for third millennium transformations in Norway. In *Background to Beakers: Inquiries in Regional Cultural Backgrounds of the Bell Beaker Complex* edited by H. Fokkens and F. Nicolis. Leiden: Sidestone Press.

Prescott, Christopher, Anette Sand-Eriksen, and Knut Ivar Austvoll. 2018. The Sea and Bronze Age Transformations Water and Power in Past Societies. In *Water and Power in Past Societies*, edited by E. Holt. Albany: State University of New York Press.

Prøsch-Danielsen, Lisbeth, Christopher Prescott , and Mads Kähler Holst. 2018. Economic and social zones during the Late Neolithic/Early Bronze Age in Jaeren, Southwest Norway. Reconstructing large-scale land-use patterns. *Praehistorische Zeitschrift* 93 (1).

Prósper, Blanca María. 2013. Is Basque an Indo-European language? Possibilities and limits of the comparative method when applied to isolates. *JIES* 41 (1 & 2):239-245.

Repeated Author. 2017. Proto-Italic laryngeals in the context CLHC- and new Italic and Celtic etymological connections. *Rivista Italiana di Linguistica e Dialettologia, Roma*.

Pustovalov, S. Z. 2000. The «Tyagunova Mogila» Burial Mound and the Problem of Wheeled Transport of the Pit Grave and Catacomb Cultures in Eastern Europe. *Stratum plus* 2:296-321.

Qiu, Zhenwei, Yimin Yang, Xue Shang, Wenying Li, Yidilisi Abuduresule, Xingjun Hu, Yan Pan, David K. Ferguson, Yaowu Hu, Changsui Wang, and Hongen Jiang. 2014. Paleo-environment and paleo-diet inferred from Early Bronze Age cow dung at Xiaohe Cemetery, Xinjiang, NW China. *Quaternary International* 349:167-177.

Quade, Jay, Elad Dente, Moshe Armon, Yoav Ben Dor, Efrat Morin, Ori Adam, and Yehouda Enzel. 2018. Megalakes in the Sahara? A Review – ADDENDUM. *Quaternary Research* 90 (2):435-435.

Quiles, Carlos. 2012. Part I: Language and culture. In *A Grammar of Modern Indo-European*. Badajoz: The Indo-European Language Association.

Repeated Author. 2017. *Indo-European demic diffusion model*. 3rd ed. Badajoz: Universidad de Extremadura.

Radivojević, Miljana, Benjamin W. Roberts, Ernst Pernicka, Zofia Stos-Gale, Marcos Martinón-Torres, Thilo Rehren, Peter Bray, Dirk Brandherm, Johan Ling, Jianjun Mei, Helle Vandkilde, Kristian Kristiansen, Stephen J. Shennan, and Cyprian Broodbank. 2018. The Provenance, Use, and Circulation of Metals in the European Bronze Age: The State of Debate. *Journal of Archaeological Research*.

Raghavan, M., P. Skoglund, K. E. Graf, M. Metspalu, A. Albrechtsen, I. Moltke, S. Rasmussen, T. W. Stafford, Jr., L. Orlando, E. Metspalu, M. Karmin, K. Tambets, S. Rootsi, R. Magi, P. F. Campos, E. Balanovska, O. Balanovsky, E. Khusnutdinova, S. Litvinov, L. P. Osipova, S. A. Fedorova, M. I. Voevoda, M. DeGiorgio, T. Sicheritz-Ponten, S. Brunak, S. Demeshchenko, T. Kivisild, R. Villems, R. Nielsen, M. Jakobsson, and E. Willerslev. 2014. Upper Palaeolithic Siberian genome reveals dual ancestry of Native Americans. *Nature* 505 (7481):87-91.

Rahkonen, Pauli. 2011. Finno-Ugrian hydronyms of the River Volkhov and Luga catchment areas. *SUSA/JSFOu* 93:205-266.

Rahmani, Noura, and David Lubell. 2012. Early Holocene Climat Change and the Adoption of Pressure Technique in the Maghreb: The Capsian Sequence at Kef

Zoura D. In *The Emergence of Pressure Blade Making: From Origin to Modern Experimentation*, edited by P. M. Desrosiers. New York: Springer.

Rascovan, Nicolás, Karl-Göran Sjögren, Kristian Kristiansen, Rasmus Nielsen, Eske Willerslev, Christelle Desnues, and Simon Rasmussen. 2018. Emergence and Spread of Basal Lineages of Yersinia pestis during the Neolithic Decline. *Cell*.

Rasmussen, Simon, Morten Erik Allentoft, Kasper Nielsen, Ludovic Orlando, Martin Sikora, Karl-Göran Sjögren, Anders Gorm Pedersen, Mikkel Schubert, Alex Van Dam, Christian Moliin Outzen Kapel, Henrik Bjørn Nielsen, Søren Brunak, Pavel Avetisyan, Andrey Epimakhov, Mikhail Viktorovich Khalyapin, Artak Gnuni, Aivar Kriiska, Irena Lasak, Mait Metspalu, Vyacheslav Moiseyev, Andrei Gromov, Dalia Pokutta, Lehti Saag, Liivi Varul, Levon Yepiskoposyan, Thomas Sicheritz-Pontén, Robert A Foley, Marta Mirazón Lahr, Rasmus Nielsen, Kristian Kristiansen, and Eske Willerslev. 2015. Early Divergent Strains of *Yersinia pestis* in Eurasia 5,000 Years Ago. *Cell* 163 (3):571-582.

Rassamakin, Yuri. 1999. The Eneolithic of the Black Sea Steppe: Dynamics of Cultural and Economic Development 4500-2300 BC. In *Late prehistoric exploitation of the Eurasian steppe*, edited by M. Levine, Y. Rassamakin, A. Kislenko and N. Tatarintseva. Cambridge: McDonald Inst. Monogr.

Rassamakin, Yuri Ya., and Alla V. Nikolova. 2008. *Carpathian Imports in the Graves of the Yamnaya Culture on the Lower Dnieper*. *Some Problems of Chronology and Connections in the Black Sea Steppes During the Early Bronze Age*. Edited by F. Bertemes and A. Furtwängler, *Import and Imitation in Archaeology*. Langenweissbach: Beier & Beran.

Raveane, Alessandro, Serena Aneli, Francesco Montinaro, Georgios Athanasiadis, Simona Barlera, Giovanni Birolo, Giorgio Boncoraglio, Anna Maria Di Blasio, Cornelia Di Gaetano, Luca Pagani, Silvia Parolo, Peristera Paschou, Alberto Piazza, George Stamatoyannopoulos, Andrea Angius, Nicolas Brucato, Francesco Cucca, Garrett Hellenthal, Antonella Mulas, Marine Peyret-Guzzon, Madzia Zoledziewska, Abdellatif Baali, Clare Bycroft, Mohammed Cherkaoui, Christian Dina, Jean-Michel Dugoujon, Pilar Galan, Joanna Giemza, Toomas Kivisild, Mohammed Melhaoui, Mait Metspalu, Simon Myers, Luisa Mesquita Pereira, Francois-Xavier Ricaut, Francesca Brisighelli, Irene Cardinali, Viola Grugni, Hovirag Lancioni, Vincenzo Lorenzo Pascali, Antonio Torroni, Ornella Semino, Giuseppe Matullo, Alessandro Achilli, Anna Olivieri, and Cristian Capelli. 2018. Population structure of modern-day Italians reveals patterns of ancient and archaic ancestries in Southern Europe. *bioRxiv*:494898.

Rębała, Krzysztof, Begoña Martínez-Cruz, Anke Tönjes, Peter Kovacs, Michael Stumvoll, Iris Lindner, Andreas Büttner, H. Erich Wichmann, Daniela Siváková, Miroslav Soták, Lluís Quintana-Murci, Zofia Szczerkowska, David Comas, and Consortium the Genographic. 2012. Contemporary paternal genetic landscape of Polish and German populations: from early medieval Slavic expansion to post-World War II resettlements. *European Journal Of Human Genetics* 21:415.

Rebay-Salisbury, Katharina. 2019. Personal relationships between co-buried individuals in the central European early Bronze Age. In *Giving New meaning to Cultural Heritage - The Old and the Young in Past Societies.*, edited by E.

Murphy and G. Lillehammer. Stavanger: Museum of Archaeology, University of Stavanger/Society for the Study of Childhood in the Past.

Reguera-Galan, A., T. Barreiro-Grille, M. Moldovan, L. Lobo, M. Á de Blas Cortina, and J. I. García Alonso. 2018. A Provenance Study of Early Bronze Age Artefacts Found in Asturias (Spain) by Means of Metal Impurities and Lead, Copper and Antimony Isotopic Compositions. *Archaeometry* 0 (0).

Reich, David. 2018. *Who We Are and How We Got Here: Ancient DNA and the New Science of the Human Past* New York: Pantheon.

Reich, David, Kumarasamy Thangaraj, Nick Patterson, Alkes L. Price, and Lalji Singh. 2009. Reconstructing Indian Population History. *Nature* 461 (7263):489-494.

Reingruber, Agathe, and Yuri Rassamakin. 2016. Zwischen Donau und Kuban: Das nordpontische Steppengebiet im 5. Jt. v. Chr. In *Der Schwarzmeerraum vom Neolithikum bis in die Früheisenzeit (6000-600 v. Chr.). Kulturelle Interferenzen in der zirkumpontischen Zone und kontakte mit ihren Nachbargebieten.*, edited by V. Nikolov and W. Schier. Rahden/Westf.: Verlag Marie Leidorf.

Reinhold, Sabine, Julia Gresky, Natalia Berezina, Anatoly R. Kantorovich, Corina Knipper, Vladimir E. Maslov, Vladimira G. Petrenko, Kurt W. Alt, and Andrey B. Belinsky. 2017. Contextualising Innovation: Cattle Owners and Wagon Drivers in the North Caucasus and Beyond. In *Appropriating Innovations: Entangled Knowledge in Eurasia, 5000-150 BCE*, edited by J. Maran and P. Stockhammer. Oxford: Oxbow Books.

Renfrew, Colin. 1987. *Archaeology and Language: The Puzzle of Indo-European Origins*. London: Jonathan Cape.

Rhys, Guto. 2015. Approaching the Pictish language: historiography, early evidence and the question of Pritenic, School of Humanities. College of Arts., University of Glasgow, Glasgow.

Rigaud, Solange, Claire Manen, and Iñigo García-Martínez de Lagrán. 2018. Symbols in motion: Flexible cultural boundaries and the fast spread of the Neolithic in the western Mediterranean. *PLOS ONE* 13 (5):e0196488.

Ringe, D. 2006. *A Linguistic History of English: Volume I, From Proto-Indo-European to Proto-Germanic. Oxford Scholarship Online, 2006.* Edited by D. Ringe. 2 vols. Vol. 1, *A Linguistic History of English*. Oxford: Oxford University Press.

Ringe, D., T. Warnow, and A. Taylor. 2002. Indo-European and computational cladistics. *Trans. Philol. Soc.* 100 (1):59-129.

Risch, Roberto, Vicente Lull, Rafael Micó, and Cristina Rihuete. 2015. Transitions and conflict at the end of the 3rd millennium BC in south Iberia. In *2200 BC – A climatic breakdown as a cause for the collapse of the old world?*, edited by H. Meller, H. Arz, R. Jung and R. Risch. Halle: Landesmuseum für Vorgeschichte Halle.

Rivollat, Maïté, Fanny Mendisco, Marie-Hélène Pemonge, Audrey Safi, Didier Saint-Marc, Antoine Brémond, Christine Couture-Veschambre, Stéphane Rottier, and Marie-France Deguilloux. 2015. When the Waves of European Neolithization Met: First Paleogenetic Evidence from Early Farmers in the Southern Paris Basin. *PLOS ONE* 10 (4):e0125521.

Robb, John. 2009. People of Stone: Stelae, Personhood, and Society in Prehistoric Europe. *Journal of Archaeological Method and Theory* 16 (3):162-183.

Roberts, Benjamin W. 2013. Britain and Ireland in the Bronze Age: Farmers in the Landscape or Heroes on the High Seas? In *The Oxford Handbook of the European Bronze Age*, edited by H. Fokkens and A. Harding. Oxford: Oxford University Press.

Rodríguez-Corral, Javier. 2018. Arming landscapes: Connectivity and resistance in northwestern Iberia in Late Prehistory. *Journal of Anthropological Archaeology*.

Rodríguez-Varela, Ricardo, Torsten Günther, Maja Krzewińska, Jan Storå, Thomas H. Gillingwater, Malcolm MacCallum, Juan Luis Arsuaga, Keith Dobney, Cristina Valdiosera, Mattias Jakobsson, Anders Götherström, and Linus Girdland-Flink. 2017. Genomic Analyses of Pre-European Conquest Human Remains from the Canary Islands Reveal Close Affinity to Modern North Africans. *Current Biology*.

Rosenberg, Michael, and Asli Erim-Özdoğan. 2011. The Neolithic in Southeastern Anatolia. In *The Oxford Handbook of Ancient Anatolia (10,000-323 BCE)*, edited by S. R. Steadman and G. McMahon. Oxford: Oxford University Press.

Rouse, Lynne M., and Barbara Cerasetti. 2016. Micro-dynamics and macro-patterns: Exploring new archaeological data for the late Holocene human-water relationship in the Murghab alluvial fan, Turkmenistan. *Quaternary International*.

Repeated Author. 2018. Mixing metaphors: sedentary-mobile interactions and local-global connections in prehistoric Turkmenistan. *Antiquity* 92 (363):674-689.

Ryan, J., J. Desideri, and M. Besse. 2018. Bell Beaker Archers: Warriors or an Ideology? . *Journal of Neolithic Archaeology* 4:95-120.

Ryan, William B. F. 2007. Status of the Black Sea flood hypothesis. In *The Black Sea Flood Question: Changes in Coastline, Climate, and Human Settlement*, edited by V. Yanko-Hombach, A. S. Gilbert, N. Panin and P. M. Dolukhanov. Dordrecht: Springer Netherlands.

Saag, Lehti, Margot Laneman, Liivi Varul, Martin Malve, Heiki Valk, Maria A. Razzak, Ivan G. Shirobokov, Valeri I. Khartanovich, Elena R. Mikhaylova, Alena Kushniarevich, Christiana Lyn Scheib, Anu Solnik, Tuuli Reisberg, Jüri Parik, Lauri Saag, Ene Metspalu, Siiri Rootsi, Francesco Montinaro, Maido Remm, Reedik Mägi, Eugenia D'Atanasio, Enrico Ryunosuke Crema, David Díez-del-Molino, Mark G. Thomas, Aivar Kriiska, Toomas Kivisild, Richard Villems, Valter Lang, Mait Metspalu, and Kristiina Tambets. 2019. The Arrival of Siberian Ancestry Connecting the Eastern Baltic to Uralic Speakers further East. *Current Biology* 29 (10):1701-1711.e16.

Saag, Lehti, Liivi Varul, Christiana Lyn Scheib, Jesper Stenderup, Morten E Allentoft, Lauri Saag, Luca Pagani, Maere Reidla, Kristiina Tambets, Ene Metspalu, Aivar Kriiska, Eske Willerslev, Toomas Kivisild, and Mait Metspalu. 2017. Extensive farming in Estonia started through a sex-biased migration from the Steppe. *bioRxiv*.

Sagona, Antonio. 2011. Anatolia and the Transcaucasus: Themes and Variations ca. 6400-1500 B.C.E. In *The Oxford Handbook of Ancient Anatolia 10,000-323 B.C.E.*, edited by S. R. Steadman and G. McMahon. Oxford: Oxford University Press.

Repeated Author. 2017. Dolmens for the Dead: The Western Caucasus in the Bronze Age (3250–1250 BC). In *The Archaeology of the Caucasus: From Earliest Settlements to the Iron Age*. Cambridge: Cambridge University Press.

Repeated Author. 2017. The Emergence of Elites and a New Social Order (2500–1500 BC). In *The Archaeology of the Caucasus: From Earliest Settlements to the Iron Age*. Cambridge: Cambridge University Press.

Repeated Author. 2017. Far-Flung Networks: The Chalcolithic (5000/4800–3500 BC). In *The Archaeology of the Caucasus: From Earliest Settlements to the Iron Age*. Cambridge: Cambridge University Press.

Repeated Author. 2017. Trailblazers: The Palaeolithic and Mesolithic Foundations. In *The Archaeology of the Caucasus: From Earliest Settlements to the Iron Age*. Cambridge: Cambridge University Press.

Repeated Author. 2017. Transition to Settled Life: The Neolithic (6000–5000 BC). In *The Archaeology of the Caucasus: From Earliest Settlements to the Iron Age*. Cambridge: Cambridge University Press.

Sahala, Aleksi. 2009-2013. Sumero-Indo-European language contacts. *University of Helsinki*.

Salugina, N. P. 2005. Ceramic technology of the Repin type burials within the Pit-Grave culture of the Volga-Ural. *Российская археология* 3:85-92.

Sánchez-Quinto, Federico, Helena Malmström, Magdalena Fraser, Linus Girdland-Flink, Emma M. Svensson, Luciana G. Simões, Robert George, Nina Hollfelder, Göran Burenhult, Gordon Noble, Kate Britton, Sahra Talamo, Neil Curtis, Hana Brzobohata, Radka Sumberova, Anders Götherström, Jan Storå, and Mattias Jakobsson. 2019. Megalithic tombs in western and northern Neolithic Europe were linked to a kindred society. *Proceedings of the National Academy of Sciences* 116 (19):9469-9474.

Sand-Eriksen, Anette. 2017. Mjeltehaugen: Europe's northernmost Bell Beaker expression? In *New Perspectives on the Bronze Age: Proceedings of the 13th Nordic Bronze Age Symposium Held in Gothenburg 9th to 13th June 2015*, edited by S. Bergerbrant and A. Wessman. Oxford: Archaeopress.

Scerri, Eleanor M. L., Maria Guagnin, Huw S. Groucutt, Simon J. Armitage, Luke E. Parker, Nick Drake, Julien Louys, Paul S. Breeze, Muhammad Zahir, Abdullah Alsharekh, and Michael D. Petraglia. 2018. Neolithic pastoralism in marginal environments during the Holocene Humid Period, northern Saudi Arabia. *Antiquity* 92 (365):1180-1194.

Scheeres, Mirjam. 2014. High mobility rates during the period of the "Celtic migrations"? $^{87}Sr/^{86}Sr$ and $\delta^{18}O$ evidence from Early La Tène Europe, Fachbereich Biologie, Johannes Gutenberg–Universität Mainz, Mainz.

Schilz, Felix. 2006. Molekulargenetische Verwandtschaftsanalysen am prähistorischen Skelettkollektiv der Lichtensteinhöhle, Johann Friedrich Blumenbach Institut für Zoologie und Anthropologie, Abteilung Historische Anthropologie und Humanökologie, Georg-August-Universität Göttingen, Göttingen.

Schlebusch, Carina M, Helena Malmström, Torsten Günther, Per Sjödin, Alexandra Coutinho, Hanna Edlund, Arielle R Munters, Maryna Steyn, Himla Soodyall, Marlize Lombard, and Mattias Jakobsson. 2017. Ancient genomes from southern Africa pushes modern human divergence beyond 260,000 years ago. *bioRxiv*.

Schmidt, Isabell, and Andreas Zimmermann. 2019. Population dynamics and socio-spatial organization of the Aurignacian: Scalable quantitative demographic data for western and central Europe. *PLOS ONE* 14 (2):e0211562.

Schoep, Ilse. 2010. Middle Bronze Age: Crete. In *The Oxford Handbook of the Bronze Age Aegean*, edited by E. H. Cline. Oxford: Oxford University Press.

Schoop, Ulf-Dietrich. 2011. The Chalcolithic on the Plateau. In *The Oxford Handbook of Ancient Anatolia (10,000-323 BCE)*, edited by S. R. Steadman and G. McMahon. Oxford: Oxford University Press.

Schrijver, Peter. 2000. Varia V. Non-Indo-European Surviving in Ireland in the First Millennium AD. *Ériu* 51:195-199.

Repeated Author. 2005. Varia I. More on Non-Indo-European Surviving in Ireland in the First Millennium AD. *Ériu* 55:137-144.

Repeated Author. 2014. *Language Contact and the Origins of the Germanic Languages*, *Routledge Studies in Linguistics*. New York and London: Routledge.

Repeated Author. 2015. Talking Neolithic: the case for Hatto-Minoan and its relationship to Sumerian. *Article accepted, still awaiting publication*.

Schroeder, Hannes, Ashot Margaryan, Marzena Szmyt, Bertrand Theulot, Piotr Włodarczak, Simon Rasmussen, Shyam Gopalakrishnan, Anita Szczepanek, Tomasz Konopka, Theis Z. T. Jensen, Barbara Witkowska, Stanisław Wilk, Marcin M. Przybyła, Łukasz Pospieszny, Karl-Göran Sjögren, Zdzislaw Belka, Jesper Olsen, Kristian Kristiansen, Eske Willerslev, Karin M. Frei, Martin Sikora, Niels N. Johannsen, and Morten E. Allentoft. 2019. Unraveling ancestry, kinship, and violence in a Late Neolithic mass grave. *Proceedings of the National Academy of Sciences*:201820210.

Schuenemann, Verena J., Alexander Peltzer, Beatrix Welte, W. Paul van Pelt, Martyna Molak, Chuan-Chao Wang, Anja Furtwängler, Christian Urban, Ella Reiter, Kay Nieselt, Barbara Teßmann, Michael Francken, Katerina Harvati, Wolfgang Haak, Stephan Schiffels, and Johannes Krause. 2017. Ancient Egyptian mummy genomes suggest an increase of Sub-Saharan African ancestry in post-Roman periods. 8:15694.

Schulting, Rick J., and Michael P. Richards. 2016. Stable Isotope Analysis of Neolithic to Late Bronze Age Populations in the Samara Valley. In *A Bronze Age Landscape in the Russian Steppes. The Samara Valley Project*, edited by D. W. Anthony, D. R. Brown, O. D. Mochalov, A. A. Khokhlov and P. F. Kuznetsov. Los Angeles: The Cotsen Institute of Archaeology at UCLA.

Schulz Paulsson, B. 2019. Radiocarbon dates and Bayesian modeling support maritime diffusion model for megaliths in Europe. *Proceedings of the National Academy of Sciences* 116 (9):3460-3465.

Šebest, Lukáš, Marian Baldovič, Adam Frtús, Csaba Bognár, Klaudia Kyselicová, Ľudevít Kádasi, and Radoslav Beňuš. 2018. Detection of mitochondrial haplogroups in a small avar-slavic population from the eigth–ninth century AD. *American Journal of Physical Anthropology* 165 (3):536-553.

Seeher, Jürgen. 2011. The Plateau: The Hittites. In *The Oxford Handbook of Ancient Antolia 10,000-323 B.C.E.*, edited by S. R. Steadman and G. McMahon. Oxford: Oxford University Press.

Sell, Christian. 2017. Addressing Challenges of Ancient DNA Sequence Data Obtained with Next Generation Methods, Faculty of Biology, Johannes Gutenberg University Mainz, Mainz.

Semino, O. 2000. The Genetic Legacy of Paleolithic Homo sapiens sapiens in Extant Europeans: A Y Chromosome Perspective. *Science* 290 (5494):1155-1159.

Shelton, Kim. 2010. Late Bronze Age: Mainland Greece. In *The Oxford Handbook of the Bronze Age Aegean*, edited by E. H. Cline. Oxford: Oxford University Press.

Sherratt, A. 2004. Material resources, capital, and power: the coevolution of society and culture. Archaeological Perspectives on

Political Economies. University of Utah Press, Salt Lake City, pp. 79e103. In *Archaeological Perspectives on Political Economies*, edited by G. Feinman and L. Nicholas. Salt Lake City: University of Utah Press.

Sherratt, Andrew. 1981. Plough and pastoralism: aspects of teh secondary products revolution. In *Pattern of the Past: studies in honour of David Clarke*, edited by N. Hammond, I. Hodder and G. Isaac. Cambridge: Cambridge University Press.

Shishlina, N. I. 2008. *Reconstruction of the Bronze Age of the Caspian Steppes: Life Styles and Life Ways of Pastoral Nomads.* Oxford: British Archaeological Reports International Series 1876.

Shishlina, Natalia I., Johannes van der Plicht, and Elya P. Zazovskaya. 2011. Radiocarbon dating of the bronze age bone pins from Eurasian steppe. *Geochronometria* 38 (2):107-115.

Sikora, Martin, Meredith L. Carpenter, Andres Moreno-Estrada, Brenna M. Henn, Peter A. Underhill, Federico Sánchez-Quinto, Ilenia Zara, Maristella Pitzalis, Carlo Sidore, Fabio Busonero, Andrea Maschio, Andrea Angius, Chris Jones, Javier Mendoza-Revilla, Georgi Nekhrizov, Diana Dimitrova, Nikola Theodossiev, Timothy T. Harkins, Andreas Keller, Frank Maixner, Albert Zink, Goncalo Abecasis, Serena Sanna, Francesco Cucca, and Carlos D. Bustamante. 2014. Population Genomic Analysis of Ancient and Modern Genomes Yields New Insights into the Genetic Ancestry of the Tyrolean Iceman and the Genetic Structure of Europe. *PLOS Genetics* 10 (5):e1004353.

Sikora, Martin, Vladimir Pitulko, Vitor Sousa, Morten E Allentoft, Lasse Vinner, Simon Rasmussen, Ashot Margaryan, Peter de Barros Damgaard, Constanza de la Fuente Castro, Gabriel Renaud, Melinda Yang, Qiaomei Fu, Isabelle Dupanloup, Konstantinos Giampoudakis, David Bravo Nogues, Carsten Rahbek, Guus Kroonen, Michael Peyrot, Hugh McColl, Sergey Vasilyev, Elizaveta Veselovskaya, Margarita Gerasimova, Elena Pavlova, Vyacheslav Chasnyk, Pavel Nikolskiy, Pavel Grebenyuk, Alexander Fedorchenko, Alexander Lebedintsev, Boris Malyarchuk, Morten Meldgaard, Rui Martiniano, Laura Arppe, Jukka Palo, Tarja Sundell, Kristiina Mannermaa, Mikko Putkonen, Verner Alexandersen, Charlotte Primeau, Ripan Mahli, Karl-Göran Sjögren, Kristian Kristiansen, Anna Wessman, Antti Sajantila, Marta Mirazohn Lahr, Richard Durbin, Rasmus Nielsen, David Meltzer, Laurent Excoffier, and Eske Willerslev. 2018. The population history of northeastern Siberia since the Pleistocene. *bioRxiv*.

Sikora, Martin, Andaine Seguin-Orlando, Vitor C. Sousa, Anders Albrechtsen, Thorfinn Korneliussen, Amy Ko, Simon Rasmussen, Isabelle Dupanloup, Philip R. Nigst, Marjolein D. Bosch, Gabriel Renaud, Morten E. Allentoft, Ashot Margaryan, Sergey V. Vasilyev, Elizaveta V. Veselovskaya, Svetlana B. Borutskaya, Thibaut Deviese, Dan Comeskey, Tom Higham, Andrea Manica, Robert Foley, David J. Meltzer, Rasmus Nielsen, Laurent Excoffier, Marta Mirazon Lahr, Ludovic Orlando, and Eske Willerslev. 2017. Ancient genomes show social and reproductive behavior of early Upper Paleolithic foragers. *Science*.

Silva, Fabio, and Marc Vander Linden. 2018. Author Correction: Amplitude of travelling front as inferred from 14C predicts levels of genetic admixture among European early farmers. *Scientific Reports* 8 (1):12809.

Silva, Fabio, Alison Weisskopf, Cristina Castillo, Charlene Murphy, Eleanor Kingwell-Banham, Ling Qin, and Dorian Q. Fuller. 2018. A tale of two rice varieties: Modelling the prehistoric dispersals of japonica and proto-indica rices. *The Holocene* 28 (11):1745-1758.

Simkin, Oliver. 2012. Coins and Language in Ancient Sicily. In *Language and Linguistic Contact in Ancient Sicily*, edited by O. Tribulato. Cambridge: Cambridge University Press.

Sjogren, K. G., T. D. Price, and K. Kristiansen. 2016. Diet and Mobility in the Corded Ware of Central Europe. *PLoS One* 11 (5):e0155083.

Skoglund, P., H. Malmstrom, M. Raghavan, J. Stora, P. Hall, E. Willerslev, M. T. Gilbert, A. Gotherstrom, and M. Jakobsson. 2012. Origins and genetic legacy of Neolithic farmers and hunter-gatherers in Europe. *Science* 336 (6080):466-9.

Skoglund, Pontus, Helena Malmström, Ayça Omrak, Maanasa Raghavan, Cristina Valdiosera, Torsten Günther, Per Hall, Kristiina Tambets, Jüri Parik, Karl-Göran Sjögren, Jan Apel, Eske Willerslev, Jan Storå, Anders Götherström, and Mattias Jakobsson. 2014. Genomic Diversity and Admixture Differs for Stone-Age Scandinavian Foragers and Farmers. *Science* 344 (6185):747.

Skoglund, Pontus, Jessica C. Thompson, Mary E. Prendergast, Alissa Mittnik, Kendra Sirak, Mateja Hajdinjak, Tasneem Salie, Nadin Rohland, Swapan Mallick, Alexander Peltzer, Anja Heinze, Iñigo Olalde, Matthew Ferry, Eadaoin Harney, Megan Michel, Kristin Stewardson, Jessica I. Cerezo-Román, Chrissy Chiumia, Alison Crowther, Elizabeth Gomani-Chindebvu, Agness O. Gidna, Katherine M. Grillo, I. Taneli Helenius, Garrett Hellenthal, Richard Helm, Mark Horton, Saioa López, Audax Z. P. Mabulla, John Parkington, Ceri Shipton, Mark G. Thomas, Ruth Tibesasa, Menno Welling, Vanessa M. Hayes, Douglas J. Kennett, Raj Ramesar, Matthias Meyer, Svante Pääbo, Nick Patterson, Alan G. Morris, Nicole Boivin, Ron Pinhasi, Johannes Krause, and David Reich. 2017. Reconstructing Prehistoric African Population Structure. *Cell* 171 (1):59-71.e21.

Skourtanioti, E., J. Choongwon, Y. S. Erdal, M. Frangipane, P. W. Stockhammer, M. Burri, J. Krause, and W. Haak. 2018. Population dynamics at Late Chalcolithic and Early Bronze Age Arslantepe, Anatolia. Paper read at 8th International Symposium on Biomolecular Archaeology ISBA 2018. 18th – 21st September, at Jena, Germany.

Slatkin, M., and F. Racimo. 2016. Ancient DNA and human history. *Proc Natl Acad Sci U S A* 113 (23):6380-7.

Smolyaninov, Roman, Andrey Skorobogatov, and Aleksey Surkov. 2017. Chronology of Neolithic sites in the forest-steppe area of the Don River. *Documenta Praehistorica* XLIV:192-202.

Smyntina, Olena. 2016. Cultural Resilience Theory as an instrument of modeling of Human response to the global climate change. A case study in the North-Western Black Sea region on the Pleistocene-Holocene boundary. *RIPARIA* 2:1-20.

Solé-Morata, Neus, Patricia Villaescusa, Carla García-Fernández, Neus Font-Porterias, María José Illescas, Laura Valverde, Francesca Tassi, Silvia Ghirotto, Claude Férec, Karen Rouault, Susana Jiménez-Moreno, Begoña Martínez-Jarreta, Maria Fátima Pinheiro, María T. Zarrabeitia, Ángel Carracedo, Marian M. de Pancorbo, and Francesc Calafell. 2017. Analysis of the R1b-DF27 haplogroup shows that a large fraction of Iberian Y-chromosome lineages originated recently in situ. *Scientific Reports* 7 (1):7341.

Sørensen, Marie Louise Stig, and Katharina Rebay-Salisbury. 2008. Landscapes of the body: burials of the Middle Bronze Age in Hungary. *European Journal of Archaeology* 11 (1):49-74.

Sørensen, Tim Flohr. 2017. The Two Cultures and a World Apart: Archaeology and Science at a New Crossroads. *Norwegian Archaeological Review* 50 (2):101-115.

Spatzier, André, and François Bertemes. 2018. The ring sanctuary of Pömmelte, Germany: a monumental, multi-layered metaphor of the late third millennium BC. *Antiquity* 92 (363):655-673.

Spyrou, Maria A., Rezeda I. Tukhbatova, Chuan-Chao Wang, Aida Andrades Valtueña, Aditya K. Lankapalli, Vitaly V. Kondrashin, Victor A. Tsybin, Aleksandr Khokhlov, Denise Kühnert, Alexander Herbig, Kirsten I. Bos, and Johannes Krause. 2018. Analysis of 3800-year-old Yersinia pestis genomes suggests Bronze Age origin for bubonic plague. *Nature Communications* 9 (1):2234.

Stolarek, I., L. Handschuh, A. Juras, W. Nowaczewska, H. Kóčka-Krenz, A. Michalowski, J. Piontek, P. Kozlowski, and M. Figlerowicz. 2019. Goth migration induced changes in the matrilineal genetic structure of the central-east European population. *Scientific Reports* 9 (1):6737.

Stolarek, Ireneusz, Anna Juras, Luiza Handschuh, Malgorzata Marcinkowska-Swojak, Anna Philips, Michal Zenczak, Artur Dębski, Hanna Kóčka-Krenz, Janusz Piontek, Piotr Kozlowski, and Marek Figlerowicz. 2018. A mosaic genetic structure of the human population living in the South Baltic region during the Iron Age. *Scientific Reports* 8 (1):2455.

Strahm, C. 2002. Tradition und Wandel der sozialen Strukturen vom 3. zum 2. vorchristlichen Jahrtausend. In *Vom Endneolithikum zur Fruhbronzezeit: Muster sozialen Wandels? Tagung Bamberg 14.-16. Juni 2001*, edited by J. Müller. Bonn: Habelt.

Sureda, Pau. 2018. The first metallurgy in the Pityusic Islands (Balearic archipelago, Mediterranean Sea). *Archaeological and Anthropological Sciences*.

Szécsényi-Nagy, A., M. Lipson, I. Olalde, K. Oross, M. Bondár, G. Kulcsár, V. Kiss, B. Mende, K. Alt, E. Bánffy, and D. Reich. 2018. Population transformations in the 6000-2000 BC period of the Carpathian Basin. Paper read at 8th

International Symposium on Biomolecular Archaeology ISBA 2018. 18th – 21st September, at Jena, Germany.

Szecsenyi-Nagy, Anna, Christina Roth, Brandt Guido, Cristina Rihuete-Herrada, Cristina Tejedor-Rodriguez, Petra Held, Inigo Garcia-Martinez-de-Lagran, Hector Arcusa Magallon, Stephanie Zesch, Corina Knipper, Eszter Banffy, Susanne Friedrich, Harald Meller, Primitiva Bueno-Ramirez, Rosa Barroso Bermejo, Rodrigo de Balbin Behrmann, Ana M. Herrero-Coral, Raul Flores Fernandez, Carmen Alonso Fernandez, Javier Jimenez Echevarria, Laura Rindlisbacher, Camila Oliart, Maria-Ines Fregeiro, Ignacio Soriano, Oriol Vincente, Rafael Mico, Vincente Lull, Jorge Soler Diaz, Juan Antonio Lopez Padilla, Consuelo Roca de Togores Munoz, Mauro S. Hernandez Perez, Francisco Javier Jover Maestre, Joaquin Lomba Maurandi, Azucena Aviles Fernandez, Katina T. Lillios, Ana Maria Silva, Miguel Magalhaes Ramalho, Luiz Miguel Oosterbeek, Claudia Cunha, Anna J Waterman, Jordi Roig Buxo, Andres Martinez, Juana Ponce Martinez, Mark Hunt Ortiz, Juan Carlos Mejias-Gracia, Juan Carlos Pecero Espin, Rosario Cruz-Aunon Briones, Tiago Tome, Eduardo Carmona Ballestero, Joao Luis Cardoso, Ana Cristina Araujo, Corina Liesau von Lettow-Vorbeck, Conception Blasco Bosqued, Patricia Rios Mendoza, Ana Pujante, Jose I. Royo-Guillen, Marco Aurelio Esquembre Bevia, Victor Manuel Dos Santos Goncalves, Rui Parreira, Elena Moran Hernandez, Elena Mendez Izquierdo, Jorge Vega de Miguel, Roberto Menduina Garcia, Victoria Martinez Calvo, Oscar Lopez Jimenez, Johannes Krause, Sandra L. Pichler, Rafael Garrido-Pena, Michael Kunst, Roberto Risch, Manuel A. Rojo-Guerra, Wolfgang Haak, and Kurt W. Alt. 2017. The maternal genetic make-up of the Iberian Peninsula between the Neolithic and the Early Bronze Age. *bioRxiv*.

Szeifert, Bea, Veronika Csakyova, Balazs Stegmar, Daniel Gerber, Balazs Egyed, S. G. Botalov, R. D Goldina., A. V. Danich, Attila Tiirk, Balazs G. Mende, and Anna Szecsenyi-Nagy. 2018. Maternal genetic. *Archeologiya evraziiskikh stepei* 6:202-222.

Szmyt, Marzena. 2008. Baden Patterns in the Milieu of Globular Amphorae: Transformation, Incorporation and Long Continuity. A case study from the Kujavia region, Polish Lowland. In *The Baden Complex and the Outside World*, edited by M. Furholt, M. Szmyt and A. Zastawny. Bonn: Dr. Rudolf Habelt.

Repeated Author. 2010. *Between West and East. People of the Globular Amphora Culture in Eastern Europe: 2950-2350 BC*. Edited by A. Kosko, *Baltic-Pontic Studies*. Poznań: Uniwersytet im. Adama Mickiewicza.

Repeated Author. 2013. The circulation of People and Ideas in the Baltic and Pontic Areas during 3rd millennium BC.

Tambets, Kristiina, Bayazit Yunusbayev, Georgi Hudjashov, Anne-Mai Ilumäe, Siiri Rootsi, Terhi Honkola, Outi Vesakoski, Quentin Atkinson, Pontus Skoglund, Alena Kushniarevich, Sergey Litvinov, Maere Reidla, Ene Metspalu, Lehti Saag, Timo Rantanen, Monika Karmin, Jüri Parik, Sergey I. Zhadanov, Marina Gubina, Larisa D. Damba, Marina Bermisheva, Tuuli Reisberg, Khadizhat Dibirova, Irina Evseeva, Mari Nelis, Janis Klovins, Andres Metspalu, Tõnu Esko, Oleg Balanovsky, Elena Balanovska, Elza K. Khusnutdinova, Ludmila P. Osipova, Mikhail Voevoda, Richard Villems, Toomas Kivisild, and Mait Metspalu. 2018. Genes reveal traces of common recent demographic history for most of the Uralic-speaking populations. *Genome Biology* 19 (1):139.

Tassi, Francesca, Stefania Vai, Silvia Ghirotto, Martina Lari, Alessandra Modi, Elena Pilli, Andrea Brunelli, Roberta Rosa Susca, Alicja Budnik, Damian Labuda, Federica Alberti, Carles Lalueza-Fox, David Reich, David Caramelli, and Guido Barbujani. 2017. Genome diversity in the Neolithic Globular Amphorae culture and the spread of Indo-European languages. *Proceedings of the Royal Society B: Biological Sciences* 284 (1867).

Tätte, Kai, Luca Pagani, Ajai Kumar Pathak, Sulev Kõks, Binh Ho Duy, Xuan Dung Ho, Gazi Nurun Nahar Sultana, Mohd Istiaq Sharif, Md Asaduzzaman, Doron M. Behar, Yarin Hadid, Richard Villems, Gyaneshwer Chaubey, Toomas Kivisild, and Mait Metspalu. 2018. The genetic legacy of continental scale admixture in Indian Austroasiatic speakers. *bioRxiv*.

Taylor, William, Svetlana Shnaider, Aida Abdykanova, Antoine Fages, Frido Welker, Franziska Irmer, Andaine Seguin-Orlando, Naveed Khan, Katerina Douka, Ksenia Kolobova, Ludovic Orlando, Andrei Krivoshapkin, and Nicole Boivin. 2018. Early pastoral economies along the Ancient Silk Road: Biomolecular evidence from the Alay Valley, Kyrgyzstan. *PLOS ONE* 13 (10):e0205646.

Taylor, William Timothy Treal, Jamsranjav Bayarsaikhan, Tumurbaatar Tuvshinjargal, Scott Bender, Monica Tromp, Julia Clark, K. Bryce Lowry, Jean-Luc Houle, Dimitri Staszewski, Jocelyn Whitworth, William Fitzhugh, and Nicole Boivin. 2018. Origins of equine dentistry. *Proceedings of the National Academy of Sciences* 115 (29):E6707-E6715.

Telegin, D. Ya., M. Lillie, Inna Potekhina, and M. M. Kovaliukh. 2015. Settlement and economy in Neolithic Ukraine: A new chronology. *Antiquity* 77 (297):456-470.

Terberger, Thomas, Joachim Burger, Friedrich Lüth, Johannes Müller, and Henny Piezonka. 2018. Step by step – The neolithisation of Northern Central Europe in the light of stable isotope analyses. *Journal of Archaeological Science* 99:66-86.

Terradas, Xavier, Bernard Gratuze, Josep Bosch, Roser Enrich, Xavier Esteve, F. Xavier Oms, and Genís Ribé. 2014. Neolithic diffusion of obsidian in the western Mediterranean: new data from Iberia. *Journal of Archaeological Science* 41:69-78.

Teržan, Biba, and Snježana Karavanić. 2013. The Western Balkans in the Bronze Age. In *The Oxford Handbook of the European Bronze Age*, edited by H. Fokkens and A. Harding. Oxford: Oxford University Press.

Thangaraj, Kumarasamy, B. Prathap Naidu, Federica Crivellaro, Rakesh Tamang, Shashank Upadhyay, Varun Kumar Sharma, Alla G. Reddy, S. R. Walimbe, Gyaneshwer Chaubey, Toomas Kivisild, and Lalji Singh. 2010. The Influence of Natural Barriers in Shaping the Genetic Structure of Maharashtra Populations. *PLOS ONE* 5 (12):e15283.

Thangaraj, Kumarasamy, Lalji Singh, Alla G. Reddy, V. Raghavendra Rao, Subhash C. Sehgal, Peter A. Underhill, Melanie Pierson, Ian G. Frame, and Erika Hagelberg. 2003. Genetic Affinities of the Andaman Islanders, a Vanishing Human Population. *Current Biology* 13 (2):86-93.

Thrane, Henrik. 2013. Scandinavia In *The Oxford Handbook of the European Bronze Age*, edited by H. Fokkens and A. Harding. Oxford: Oxford University Press.

Tikhonov, Dmitrii G., Cemal Gurkan, Gokce Y. A. Peler, and Victor M. Dyakonov. 2019. Matrilineal Patrilineal Genetic Continuity of Two Iron Age Individuals from a Pazyryk Culture Burial. *International Journal of Human Genetics* 19 (1):29-47.

Tolochko, P. P. 1997. *Davnya istoriya Ukraynu 1*. Kiyv: Naukova dumka.

Torelli, M. 2000. *Gli Etruschi*. Venezia.

Tóth, Csaba, Katalin Joó, and Attila Barczi. 2015. Lyukas Mound: One of the Many Prehistoric Tumuli in the Great Plain. In *Landscapes and Landforms of Hungary*, edited by D. n. Lóczy. Pécs: Springer.

Trager, George L., and Henry Lee Smith. 1950. A chronology of Indo-Hittite. *Studies in linguistics* 8 (3):61-70.

Trifonov, V. A., N. I. Shishlina, A. Yu. Loboda, N. N. Kolobylina, E. Yu. Tereschenko, and E. B. Yatsishina. 2018. The Production of Thin-Walled Jointless Gold Beads from the Maykop Culture Megalithic Tomb of the Early Bronze Age at Tsarskaya in the North Caucasus: Results of Analytical and Experimental Research. *Archaeometry* 0 (0).

Trump, D. H. 2014. The Apennine Culture of Italy. *Proceedings of the Prehistoric Society* 24:165-200.

Tvauri, Andres. 2007. Migrants or Natives? The Research History of Long Barrows in Russia and Estonia in the 5th– 10th Centuries. *Slavica Helsingiensia* 32:247-285.

Udolph, Jürgen. 1994. *Namenkundliche Studien zum Germanenproblem*. Edited by H. Beck, H. Steueer and D. Timpe, *Ergänzungsbände zum Reallexikon der Germanischen Altertumskunde*. Berlin/New York: Walter de Gruyter.

Repeated Author. 1997. Alteuropäische Hydronymie und urslavische Gewässernamen. *Onomastica* XLII:21-70.

Repeated Author. 2016. Expansion slavischer Stämme aus namenkundlicher und bodenkundlicher Sicht. *Onomastica* 60:215-231.

Ugas, Giovanni. 2005. *L'Alba dei Nuraghi*. Cagliari: Fabula.

Ullah, Inam, Jill K. Olofsson, Ashot Margaryan, Melissa Ilardo, Habib Ahmad, Martin Sikora, Anders J. Hansen, Muhammad Shahid Nadeem, Numan Fazal, Murad Ali, Anders Buchard, Brian E. Hemphill, Eske Willerslev, and Morten E. Allentoft. 2017. High Y-chromosomal Differentiation Among Ethnic Groups of Dir and Swat Districts, Pakistan. *Annals of Human Genetics* 81 (6):234-248.

Underhill, P. A., G. D. Poznik, S. Rootsi, M. Jarve, A. A. Lin, J. Wang, B. Passarelli, J. Kanbar, N. M. Myres, R. J. King, J. Di Cristofaro, H. Sahakyan, D. M. Behar, A. Kushniarevich, J. Sarac, T. Saric, P. Rudan, A. K. Pathak, G. Chaubey, V. Grugni, O. Semino, L. Yepiskoposyan, A. Bahmanimehr, S. Farjadian, O. Balanovsky, E. K. Khusnutdinova, R. J. Herrera, J. Chiaroni, C. D. Bustamante, S. R. Quake, T. Kivisild, and R. Villems. 2015. The phylogenetic and geographic structure of Y-chromosome haplogroup R1a. *Eur J Hum Genet* 23 (1):124-31.

Unterländer, Martina, Friso Palstra, Iosif Lazaridis, Aleksandr Pilipenko, Zuzana Hofmanová, Melanie Groß, Christian Sell, Jens Blöcher, Karola Kirsanow, Nadin Rohland, Benjamin Rieger, Elke Kaiser, Wolfram Schier, Dimitri Pozdniakov, Aleksandr Khokhlov, Myriam Georges, Sandra Wilde, Adam Powell, Evelyne Heyer, Mathias Currat, David Reich, Zainolla Samashev, Hermann Parzinger, Vyacheslav I. Molodin, and Joachim Burger. 2017. Ancestry and demography and descendants of Iron Age nomads of the Eurasian Steppe. 8:14615.

Váczi, Gábor. 2013. Cultural connections and interactions of Eastern Transdanubia during the Urnfield period. *DissArch* 3 (1):205-230.

Vai, Stefania, Stefania Sarno, Martina Lari, Donata Luiselli, Giorgio Manzi, Marina Gallinaro, Safaa Mataich, Alexander Hübner, Alessandra Modi, Elena Pilli, Mary Anne Tafuri, David Caramelli, and Savino di Lernia. 2019. Ancestral mitochondrial N lineage from the Neolithic 'green' Sahara. *Scientific Reports* 9 (1):3530.

Valamoti, Soultana Maria. 2016. Millet, the late comer: on the tracks of Panicum miliaceum in prehistoric Greece. *Archaeological and Anthropological Sciences* 8 (1):51-63.

Valdiosera, Cristina, Torsten Günther, Juan Carlos Vera-Rodríguez, Irene Ureña, Eneko Iriarte, Ricardo Rodríguez-Varela, Luciana G. Simões, Rafael M. Martínez-Sánchez, Emma M. Svensson, Helena Malmström, Laura Rodríguez, José-María Bermúdez de Castro, Eudald Carbonell, Alfonso Alday, José Antonio Hernández Vera, Anders Götherström, José-Miguel Carretero, Juan Luis Arsuaga, Colin I. Smith, and Mattias Jakobsson. 2018. Four millennia of Iberian biomolecular prehistory illustrate the impact of prehistoric migrations at the far end of Eurasia. *Proceedings of the National Academy of Sciences* 115 (13):3428-3433.

Vallejo, José M. 2013. Hacia una definición del lusitano. *Acta Palaeohispanica* 13:273-291.

van den Brink, Edwin C. M., Ron Beeri, Dan Kirzner, Enno Bron, Anat Cohen-Weinberger, Elisheva Kamaisky, Tamar Gonen, Lilly Gershuny, Yossi Nagar, Daphna Ben-Tor, Naama Sukenik, Orit Shamir, Edward F. Maher, and David Reich. 2017. A Late Bronze Age II clay coffin from Tel Shaddud in the Central Jezreel Valley, Israel: context and historical implications AU - van den Brink, Edwin C. M. *Levant* 49 (2):105-135.

van Dorp, Lucy, David Balding, Simon Myers, Luca Pagani, Chris Tyler-Smith, Endashaw Bekele, Ayele Tarekegn, Mark G. Thomas, Neil Bradman, and Garrett Hellenthal. 2015. Evidence for a Common Origin of Blacksmiths and Cultivators in the Ethiopian Ari within the Last 4500 Years: Lessons for Clustering-Based Inference. *PLOS Genetics* 11 (8):e1005397.

Vander Linden, Marc. 2007. For equalities are plural: reassessing the social in Europe during the third millenniumbc. *World Archaeology* 39 (2):177-193.

Repeated Author. 2015. An impossible dialogue? On the interface between archaeology, historical linguistics and comparative philology. In *The Linguistic Roots of Europe. Origin and development of European languages*, edited by R. Mailhammer, T. Vennemann and B. A. Olsen. Copenhagen: Museum Tusculanum Press.

Vandkilde, Helle. 2005. A Review of the Early Late Neolithic Period in Denmark: Practice, Identity and Connectivity. *Journal of Neolithic Archaeology* 7.

Vanek, Daniel, Hana Brzobohata, Marcela Silerova, Zdenek Horak, Miriam Nyvltova Fisakova, Michaela Vasinova Galiova, Pavla Zednikova Mala, Vladislava Urbanova, Miluse Dobisikova, Michal Beran, and Petr Brestovansky. 2015. Complex Analysis of 700-Year-Old Skeletal Remains found in an Unusual Grave-Case Report. *Anthropology* 2 (5).

Vanhanen, Santeri, Stefan Gustafsson, Håkan Ranheden, Niclas Björck, Marianna Kemell, and Volker Heyd. 2019. Maritime Hunter-Gatherers Adopt Cultivation at the Farming Extreme of Northern Europe 5000 Years Ago. *Scientific Reports* 9 (1):4756.

Varul, Liivi, Ravil M. Galeev, Anna A. Malytina, Mari Tõrv, Sergey V. Vasilyev, Lembi Lõugas, and Aivar Kriiska. 2019. Complex mortuary treatment of a Corded Ware Culture individual from the Eastern Baltic: A case study of a secondary deposit in Sope, Estonia. *Journal of Archaeological Science: Reports* 24:463-472.

Vasilyev, Stanislav Aleksandrovich. 2002. Iskusstvo drevnego naselenija Volgo-Kam'ja v Anan'inskuju epokhu (istoki i formirovanie), Sankt Peterburg.

Vasilyeva, I. N. 2002. About technology of ceramics of the I Hvalynsk Eneolithic burial ground. *Вопросы археологии Поволжья. Самара* 2:15-49.

Veeramah, Krishna R. 2018. The importance of fine-scale studies for integrating paleogenomics and archaeology. *Current Opinion in Genetics & Development* 53:83-89.

Veeramah, Krishna R., Andreas Rott, Melanie Groß, Lucy van Dorp, Saioa López, Karola Kirsanow, Christian Sell, Jens Blöcher, Daniel Wegmann, Vivian Link, Zuzana Hofmanová, Joris Peters, Bernd Trautmann, Anja Gairhos, Jochen Haberstroh, Bernd Päffgen, Garrett Hellenthal, Brigitte Haas-Gebhard, Michaela Harbeck, and Joachim Burger. 2018. Population genomic analysis of elongated skulls reveals extensive female-biased immigration in Early Medieval Bavaria. *Proceedings of the National Academy of Sciences* 115 (13):3494-3499.

Villalba-Mouco, Vanessa, Marieke S. van de Loosdrecht, Cosimo Posth, Rafael Mora, Jorge Martínez-Moreno, Manuel Rojo-Guerra, Domingo C. Salazar-García, José I. Royo-Guillén, Michael Kunst, Hélène Rougier, Isabelle Crevecoeur, Héctor Arcusa-Magallón, Cristina Tejedor-Rodríguez, Iñigo García-Martínez de Lagrán, Rafael Garrido-Pena, Kurt W. Alt, Choongwon Jeong, Stephan Schiffels, Pilar Utrilla, Johannes Krause, and Wolfgang Haak. 2019. Survival of Late Pleistocene Hunter-Gatherer Ancestry in the Iberian Peninsula. *Current Biology* 29 (7):1169-1177.e7.

Villar Liébana, Francisco. 2014. *Indoeuropeos, iberos, vascos y sus parientes. Estratigrafía y cronología de las poblaciones prehistóricas*. Salamanca: Ediciones Universidad de Salamanca.

Vinogradov, N. B. 2018. Синташта как транскультурный феномен. *Поволжская археология* 23 (1):74-90.

Volkov, V.G., and A.N. Seslavin. 2019. Genetic study of the Rurik Dynasty. In *Centenary of Human Population Genetics*. Moscow.

Voskarides, K., S. Mazieres, D. Hadjipanagi, J. Di Cristofaro, A. Ignatiou, C. Stefanou, R. J. King, P. A. Underhill, J. Chiaroni, and C. Deltas. 2016. Y-chromosome phylogeographic analysis of the Greek-Cypriot population reveals elements consistent with Neolithic and Bronze Age settlements. *Investig Genet* 7:1.

Voutsaki, Sofia. 2010. Middle Bronze Age: Mainland Greece. In *The Oxford Handbook of the Bronze Age Aegean,* edited by E. H. Cline. Oxford: Oxford University Press.

Vybornov, Aleksandr. 2016. Initial stages of two Neolithisation models in the Lower Volga basin. *Documenta Prehistorica* 43:161-166.

Vybornov, Aleksandr A., Markku Oinonen, Natalia S. Doga, Marianna A. Kulkova, and Aleksandr S. Popov. 2016. On the chronological aspect of productive economy origin in the Lower Volga region. *Science Journal of Volgograd State University* 21 (3):6-13.

Vybornov, Alexander, Pavel Kosintsev, and Marianna Kulkova. 2015. The origin of farming in the Lower Volga Region. *Documenta Praehistorica* XLII:67-76.

Vybornov, A.A., A.I. Yudin, I.N. Vasilyeva, P.A. Kosintsev, N.S. Doga, A.S. Popov, V.I. Platonov, and N.V. Roslyakova. 2018. New results of studies on the Oroshaemoe site in the Lower Volga regionn. *Археология и этнография* 20 (3):215-222.

Wakabayashi, Ken, Ryan Schmidt, Takashi Gakuhari, Kae Koganebuchi, Motoyuki Ogawa, Jordan Karsten, Mykhailo Sokhatsky, and Hiroki Oota. 2017. Analysis of ancient human mitochondrial DNA from Verteba Cave, Ukraine: insights into the origins and expansions of the Late Neolithic-Chalcolithic Cututeni-Tripolye Culture. *bioRxiv*.

Wang, Chuan-Chao, Sabine Reinhold, Alexey Kalmykov, Antje Wissgott, Guido Brandt, Choongwon Jeong, Olivia Cheronet, Matthew Ferry, Eadaoin Harney, Denise Keating, Swapan Mallick, Nadin Rohland, Kristin Stewardson, Anatoly R. Kantorovich, Vladimir E. Maslov, Vladimira G. Petrenko, Vladimir R. Erlikh, Biaslan Ch Atabiev, Rabadan G. Magomedov, Philipp L. Kohl, Kurt W. Alt, Sandra L. Pichler, Claudia Gerling, Harald Meller, Benik Vardanyan, Larisa Yeganyan, Alexey D. Rezepkin, Dirk Mariaschk, Natalia Berezina, Julia Gresky, Katharina Fuchs, Corina Knipper, Stephan Schiffels, Elena Balanovska, Oleg Balanovsky, Iain Mathieson, Thomas Higham, Yakov B. Berezin, Alexandra Buzhilova, Viktor Trifonov, Ron Pinhasi, Andrej B. Belinskij, David Reich, Svend Hansen, Johannes Krause, and Wolfgang Haak. 2019. Ancient human genome-wide data from a 3000-year interval in the Caucasus corresponds with eco-geographic regions. *Nature Communications* 10 (1):590.

Wang, Chuan-Chao, Sabine Reinhold Reinhold, Alexey Kalmykov, Antje Wissgott, Guido Brandt, Choongwon Jeong, Olivia Cheronet, Matthew Ferry, Eadaoin Harney, Denise Keating, Swapan Mallick, Nadin Rohland, Kristin Stewardson, Anatoly R. Kantorovich, Vladimir E. Maslov, Vladimira G. Petrenko, Vladimir R. Erlikh, Biaslan C. Atabiev, Rabadan G. Magomedov, Philipp L. Kohl, Kurt W. Alt, Sandra L. Pichler, Claudia Gerling, Harald Meller, Benik Vardanyan, Larisa Yeganyan, Alexey D. Rezepkin, Dirk Mariaschk, Natalia Y. Berezina, Julia Gresky, Katharina Fuchs, Corina Knipper, Stephan Schiffels, Elena Balanovska, Oleg Balanovsky, Iain Mathieson, Thomas Higham, Yakov B. Berezin, Alexandra P. Buzhilova, Viktor Trifonov, Ron Pinhasi, Andrej B. Belinskiy, David Reich, Svend Hansen, Johannes Krause, and Wolfgang Haak. 2018. The genetic prehistory of the Greater Caucasus. *bioRxiv*.

Wei, Lan-Hai, Shi Yan, Yan Lu, Shao-Qing Wen, Yun-Zhi Huang, Ling-Xiang Wang, Shi-Lin Li, Ya-Jun Yang, Xiao-Feng Wang, Chao Zhang, Shu-Hua Xu, Da-Li Yao, Li Jin, and Hui Li. 2018. Whole-sequence analysis indicates that the Y chromosome C2*-Star Cluster traces back to ordinary Mongols, rather than Genghis Khan. *European Journal of Human Genetics* 26 (2):230-237.

Welton, Megan Lynn. 2010. Mobility and Social Organization on the Ancient Anatolian Black Sea Coast: An Archaeological, Spatial and Isotopic Investigation of the Cemetery at İkiztepe, Turkey, Near & Middle Eastern Civilizations, University of Toronto, Toronto.

West, M.L. 2007. *Indo-European Poetry and Myth*. Oxford: Oxford University Press.

Whittaker, Gordon. 2008. The Case for Euphratic. *Bull. Georg. Natl. Acad. Sci.* 2 (3):156-168.

Repeated Author. 2012. Euphratic: A phonological sketch. In *The Sound of Indo-European: Phonetics, Phonemics, and Morphophonemics*, edited by B. N. Whitehead, T. Olander, B. A. Olsen and J. E. Rasmussen. Copenhagen: Museum Tusculanum Press.

Whittle, Alasdair. 1996. *Europe in the Neolithic. The Creation of New Worlds*. Edited by N. Yoffee, *Cambridge World Archaeology*. Cambridge: Cambridge University Press.

Wiik, Kalevi. 1997. The Uralic and Finno-Ugric phonetic substratum in Proto-Germanic. *Linguistica Uralica* 33 (4):258-280.

Wilk, Stanisław. 2016. New data about chronology of the impact of the Hunyadihalom-Lažňany horizon on Younger Danubian cultures north of the Carpathian Mountains. *Recherches Archéoloqiques* 8:7–27.

Repeated Author. 2018. Can we talk about the Copper Age in Lesser Poland? Contribution to the discussion. In *Multas per gentes et multa per saecula. Amici magistro et collegae suo Ioanni Christopho Kozłowski dedicant.*, edited by P. Valde-Nowak, K. Sobczyk, M. Nowak and J. Źrałka. Kraków: Institute of Archaeology, Jagiellonian University in Kraków.

Witczak, Krzysztof. 2016. The earliest Alhanian loanwords in Greek. Paper read at First International Conference on Language Contact in the Balkans and Asia Minor, November 3rd-5th, at Thessaloniki.

Włodarczak, Piotr. 2001. The absolute chronology of the Corded Ware Culture in the south-eastern Poland. In *Die absolute Chronologie in Mitteleuropa 3000-2000 v. Chr.*, edited by J. Czebreszuk and J. Müller. Poznań/Bamberg/Rahden.

Repeated Author. 2008. Corded Ware and Baden Cultures. Outline of Chronological and Genetic Relations based on the Finds from Western Little Poland. In *The Baden Complex and the Outside World. Proceedings of the 12th Annual Meeting of the EAA in Cracow 19-24th September 2006*, edited by M. Furhold, M. Szmyt and A. Zastawny. Bonn: Dr. Rudolf Habelt.

Repeated Author. 2017. Battle-axes and beakers. The Final Eneolithic societies. In *The Past Societies: Polish lands from the first evidence of human presence to the Early Middle Ages 2 (5500-2000 BC)*, edited by P. Urbańczyk. Warszawa: Institute of Archaeology and Ethnology, Polish Academy of Science.

Repeated Author. 2017. Kurgan rites in the Eneolithic and Early Bronze age Podolia in light of materials from the funerary ceremonial centre at Yampil. In *Podolia*

"Barrow Culture" Communities: 4th/3rd-2nd Mill. BC. The Yampil Barrow Complex: Interdisciplinary Studies. Poznan.

Repeated Author. 2017. Małopolska at the beginning of the Bronze Age (2000-1600 BC) In *The Past Societies. Polish lands from the first evidence of human presence to the Early Middle Ages 3 (2000-500 BC)*, edited by U. Bugaj. Warszawa: Institute of Archaeology and Ethnology, Polish Academy of Science.

Repeated Author. 2017. Towards the Bronze Age in south-eastern Poland (2300-2000 BC). In *The Past Societies: Polish lands from the first evidence of human presence to the Early Middle Ages 2 (5500-2000 BC)*, edited by P. Urbańczyk. Warszawa: Institute of Archaeology and Ethnology, Polish Academy of Sciences.

Woudhuizen, Frederik Christiaan. 2006. The ethnicity of the Sea Peoples, College voor Promoties, Erasmus Universiteit Rotterdam, Rotterdam.

Wutke, Saskia, Edson Sandoval-Castellanos, Norbert Benecke, Hans-Jürgen Döhle, Susanne Friederich, Javier Gonzalez, Michael Hofreiter, Lembi Lõugas, Ola Magnell, Anna-Sapfo Malaspinas, Arturo Morales-Muñiz, Ludovic Orlando, Monika Reissmann, Alexandra Trinks, and Arne Ludwig. 2018. Decline of genetic diversity in ancient domestic stallions in Europe. *Science Advances* 4 (4):eaap9691.

Yang, Melinda A., Xing Gao, Christoph Theunert, Haowen Tong, Ayinuer Aximu-Petri, Birgit Nickel, Montgomery Slatkin, Matthias Meyer, Svante Pääbo, Janet Kelso, and Qiaomei Fu. 2017. 40,000-Year-Old Individual from Asia Provides Insight into Early Population Structure in Eurasia. *Current Biology* 27 (20):3202–3208.E9.

Yanko-Hombach, Valentina, Allan S. Gilbert, and Pavel Dolukhanov. 2007. Controversy over the great flood hypotheses in the Black Sea in light of geological, paleontological, and archaeological evidence. *Quaternary International* 167–168:91-113.

Yates, D. 2007. *Land, Power and Prestige: Bronze Age Field Systems in Southern England*. Oxford: Oxbow Books.

Yoon, Sook Hee, Wonseok Lee, Hyeonju Ahn, Kelsey Caetano-Anolles, Kyoung-Do Park, and Heebal Kim. 2018. Origin and spread of Thoroughbred racehorses inferred from complete mitochondrial genome sequences: Phylogenomic and Bayesian coalescent perspectives. *PLOS ONE* 13 (9):e0203917.

Yushkova, M. A. 2010. Metallicheskie izdelija epokhi bronzy na severo-zapade Rossii. *Известия Самарского научного центра Российской академии наук* 12 (2):272-277.

Zaitseva, G., V. Skripkin, N. Kovaliukh, G. Possnert, P. Dolukhanov, and A. Vybornov. 2009. Radiocarbon dating of Neolithic pottery. *Radiocarbon* 51 (2):795-801.

Zakościelna, A. 2010. *Studium obrządku pogrzebowego kultury lubelsko-wołyńskiej*. Lublin.

Zalizniak, Leonid L. 2016. Mesolithic origins of the first Indo-European cultures in Europe according to the archaeological data. *Ukrainian Archaeology*:26-42.

Zaliznyak, L.L. 1999. Tanged point cultures in the Western part of Eastern Europe. In *Tanged Points Cultures in Europe*, edited by S. K. Koslowski, J. Gurba and L. L. Zaliznyak. Lublin: Maria Curie-Sklodowska University Press.

Zalloua, Pierre, Catherine J. Collins, Anna Gosling, Simone Andrea Biagini, Benjamí Costa, Olga Kardailsky, Lorenzo Nigro, Wissam Khalil, Francesc Calafell, and Elizabeth Matisoo-Smith. 2018. Ancient DNA of Phoenician remains indicates discontinuity in the settlement history of Ibiza. *Scientific Reports* 8 (1):17567.

Zastawny, Albert. 2015. The Baden complex in Lesser Poland - Horizons of cultural influences. In *The Baden culture around the Western Carpathians*, edited by M. Nowak and A. Zastawny. Kraków: Krakowski Zespół do Badań Autostrad.

Zavodny, Emily, Sarah B. McClure, Martin H. Welker, Brendan J. Culleton, Jacqueline Balen, and Douglas J. Kennett. 2018. Scaling up: Stable isotope evidence for the intensification of animal husbandry in Bronze-Iron Age Lika, Croatia. *Journal of Archaeological Science: Reports*.

Zeng, Tian Chen, Alan J. Aw, and Marcus W. Feldman. 2018. Cultural hitchhiking and competition between patrilineal kin groups explain the post-Neolithic Y-chromosome bottleneck. *Nature Communications* 9 (1):2077.

Zhang, Cheng, Pan Ni, Hafiz Ishfaq Ahmad, M Gemingguli, A Baizilaitibei, D Gulibaheti, Yaping Fang, Haiyang Wang, Akhtar Rasool Asif, Changyi Xiao, Jianhai Chen, Yunlong Ma, Xiangdong Liu, Xiaoyong Du, and Shuhong Zhao. 2018. Detecting the Population Structure and Scanning for Signatures of Selection in Horses (Equus caballus) From Whole-Genome Sequencing Data. *Evolutionary Bioinformatics* 14:1176934318775106.

Zhang, Ye, Xiyan Wu, Jiawei Li, Hongjie Li, Yongbin Zhao, and Hui Zhou. 2018. The Y-chromosome haplogroup C3*-F3918, likely attributed to the Mongol Empire, can be traced to a 2500-year-old nomadic group. *Journal of Human Genetics* 63 (2):231-238.

Zhernakova, Daria V., Vladimir Brukhin, Sergey Malov, Taras K. Oleksyk, Klaus Peter Koepfli, Anna Zhuk, Pavel Dobrynin, Sergei Kliver, Nikolay Cherkasov, Gaik Tamazian, Mikhail Rotkevich, Ksenia Krasheninnikova, Igor Evsyukov, Sviatoslav Sidorov, Anna Gorbunova, Ekaterina Chernyaeva, Andrey Shevchenko, Sofia Kolchanova, Alexei Komissarov, Serguei Simonov, Alexey Antonik, Anton Logachev, Dmitrii E. Polev, Olga A. Pavlova, Andrey S. Glotov, Vladimir Ulantsev, Ekaterina Noskova, Tatyana K. Davydova, Tatyana M. Sivtseva, Svetlana Limborska, Oleg Balanovsky, Vladimir Osakovsky, Alexey Novozhilov, Valery Puzyrev, and Stephen J. O'Brien. 2019. Genome-wide sequence analyses of ethnic populations across Russia. *Genomics*.

Zhernakova, Daria V., Igor Evsyukov, Elena Lukianova, Anna Zhuk, Mikhail Rotkevich, Anton Logachev, Gaik Tamazian, Ksenia Krasheninnikova, Alexei Komissarov, Anna Gorbunova, Andrey Shevchenko, Sergey Malov, Nikolay Cherkasov, Dmitrii E. Polev, Genome Russia Consortium, Oleg Balanovsky, Vladimir Brukhin, and Stephen J. O'Brien. 2019. The Genome Russia Project: a reference database of whole genome sequences across Russia. In *Centenary of Human Population Genetics*. Moscow.

Zhilin, Mikhail. 2017. Mesolithic bone arrowheads from Ivanovskoye 7 (central Russia): Technology of the manufacture and use-wear traces. *Quaternary International* 427:230-244.

Zhivlov, Mikhail. 2015. Неиндоевропейский субстрат в финно-волжских языках. In *X Чтения памяти С.А. Старостина, 27 марта 2015*.

Zhong, Hua, Hong Shi, Xue-Bin Qi, Zi-Yuan Duan, Ping-Ping Tan, Li Jin, Bing Su, and Runlin Z. Ma. 2013. Extended Y chromosome investigation suggests postglacial migrations of modern humans into East Asia via the northern route. *Mol Biol Evol* 28 (1):717-727.

Zimmermann, Thomas. 2007. Anatolia and the Balkans, once again? Ring-shaped idols from Western Asia and a critical reassessment of some Early Bronze Age items from İkiztepe, Turkey. *Oxford Journal of Archaeology* 26 (1):25-33.

Zwyns, N., and L. V. Lbova. 2018. The Initial Upper Paleolithic of Kamenka site, Zabaikal region (Siberia): A closer look at the blade technology. *Archaeological Research in Asia*.