THE EVE OF DESTRUCTION?

LOCAL GROUPS AND LARGE-SCALE NETWORKS DURING THE LATE FOURTH AND EARLY THIRD MILLENNIUM BC IN CENTRAL EUROPE

DANIELA HOFMANN, DORIS MISCHKA & SILVIANE SCHARL (EDS)

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Thomas Link studied Prehistoric Archaeology at the University of Heidelberg. His Master's thesis gave an overview of the end of the Neolithic tell settlements in the Carpathian Basin. For his PhD, he analysed the features from a Linear and Stroke Ornamented Pottery settlement at Dresden-Prohlis. From 2007 to 2015 he worked as a scientific associate at the University of Würzburg and carried out field research at the Final Neolithic settlement of Burgerroth and other sites. Since 2015, he has been working at the State Office for Cultural Heritage Baden-Württemberg as senior editor for archaeological publications.

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The pre-Corded Ware horizon in central Europe and why it matters — an introduction to the volume

Daniela Hofmann, Doris Mischka and Silviane Scharl

Framing the picture

The worst of times? A brief history of research into the emergence of the Corded Ware horizon in central Europe

The turn to the third millennium calBC is now one of the most discussed transitions in central European prehistory. Archaeologically speaking, the emergence of beaker-using cultures like the Corded Ware and Bell Beaker phenomena has a long history of research, during which models repeatedly oscillated between those stressing substantial outside input and those according a greater role to the spread of shared symbols and ways of thinking, rather than populations (see e.g. Clarke 1976; Derenne *et al.* 2022; Shennan 1977; Strahm 2004; 2010). Recently, the interpretative tide has turned rather decisively to the former option with the publication of aDNA analyses indicating a substantial population turnover associated initially mainly with steppe migrants who became the bearers of the Corded Ware culture (Haak *et al.* 2015). As often happens, this clearly defined discontinuity in one strand of evidence was used as a convenient anchor on which to hang other kinds of changes, thus enhancing the impression of a radical break in all areas of life. Linguistic change is an obvious example, with the spread of Indo-European languages prominently named in aDNA-based studies (Haak *et al.* 2015). Over time, this became amalgamated with additional strands of evidence, such as the establishment of the nuclear family as the basic social building block (e.g. at Eulau, Bentley 2013; Haak *et al.* 2008), the adoption of new economic systems with a greater reliance on pastoralism (Wilkin *et al.* 2021), or the rise of an individualistic ideology strongly focused on the role of the male warrior (Kristiansen *et al.* 2017). Given these ever increasing differences, ever more catastrophic events were needed to explain why this transition happened, with a large role played by violent take-over (Kristiansen and Earle 2022, 136) and mass-fatality events such as plagues (Andrades Valtueña *et al.* 2017; Rascovan *et al.* 2019).

Almost all of these individual components have since been strongly nuanced in a sometimes heated debate (e.g. Furholt 2018; 2019; 2021; Vander Linden 2016). For example, the frequency of battle axe deposition increases long before the Corded Ware horizon (Schultrich 2022; this volume), while there is no immediately striking rise in

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other archaeological evidence of warfare — the existing mass graves (e.g. Schroeder *et al.* 2019) rather continue a longer-term pattern of occasional outbursts of Neolithic interpersonal violence (e.g. Fibiger 2017). In addition, experimental work attempting to re-create the use-wear patterns on Dutch Corded Ware axes has suggested that their most likely use was as agricultural tools involved in removing roots from newly cleared ground (Wentink 2020, 109–27). The alleged ideological underpinnings in Indo-European mythology concerning male warrior brotherhoods and bands of violent youths (e.g. Kristiansen *et al.* 2017) have since been shown to be based on much later texts which cannot necessarily be projected as far back as the Neolithic, and to rely on highly selective and politically motivated readings of such written sources associated with the rise of nationalist ideologies in the earlier part of the twentieth century (Burmeister 2022). Overall, the increased focus on individual warriors is visible first and foremost through new Corded Ware funerary practices, but has much earlier roots.

In terms of economic changes, there are large gaps in our knowledge both for various pre-Corded Ware cultural entities and for the regional diversity encountered in the Corded Ware, although recent studies suggest that this could have been considerable (e.g. in the eastern Baltic, Pääkkönen *et al.* 2020; Piličiauskas *et al.* 2020). Over the long term, and spanning the duration of the Neolithic, there appears to be a general trend towards an increasing diversification of resource use, partly in line with the exploitation of different kinds of environments. This is visible in the archaeological record, for example in the divergent economic choices between residents of circum-Alpine lake villages (e.g. Hofmann 2013, 211–16), but also in collated isotopic data which suggest a trend towards greater dietary variation (Münster *et al.* 2018; Schier 2020). This means that practices such as increased reliance on herding or on dairy products could have been in place considerably earlier than the Corded Ware. Indeed, lipid analysis of an admittedly small sample of Cham culture sherds from Riedling in southern Bavaria has shown that a dairy-based economy already existed here at this earlier time (Dunne *et al.* 2023). Before we can confidently state that a single, better adapted economic system was introduced by newcomers from the steppes, and that this involved different mobility patterns than before, we will need more longer-term studies of regional trajectories.

Recent bioarchaeological evidence confirms these general impressions by stressing varying levels of continuity in aDNA signatures and considerable regional and even site-based diversity. For instance, a long-term coexistence of migrant and resident populations, with late and slow admixture, appears to characterise the Swiss sample (Furtwängler *et al.* 2020) — a scenario that also fits the archaeological evidence (Ebersbach *et al.* 2017, 5–7) — while several papers now stress a “Neolithic resurgence” in the genetic evidence, implying population admixture rather than catastrophic replacement (e.g. Papac *et al.* 2021). This is an exciting aspect with implications that remain to be fully studied. Even the Eulau evidence suggests that the nuclear family was not the only important social reference group — graves other than the famous 99, such as burial 98, contain other constellations, in this case closely related children with a putative stepmother (Haak *et al.* 2008, 18228). How the work of making kin, which is always social and not just biological, changed with the arrival of new populations, or whether there were continuities, will have to be investigated across future studies (see also Turek 2023). Increasingly, the idea of a catastrophic plague pandemic that depopulated large parts of central Europe before the Corded Ware arrival is also seen critically — the plague pathogen is undoubtedly present, but its putative demographic impact now looks far less certain (Fuchs *et al.* 2019). Taken together, the co-existence of groups with various genetic signatures, and the evidence for syncretism and combination of traditions across several lines of archaeological evidence, also open the possibility that linguistic replacement may not have been as instantaneous as generally supposed, and that more complex models may be necessary (Demoule 2023, 419–53; Heggarty *et al.* 2023; Hofmann *et al.* 2024, 116–23; Robb 1993).

In sum, over the past few years it has become clear that the undoubted changes in material expression introduced with the transition to the Corded Ware can be linked to the arrival of new genetic signatures in central Europe, but that this process was by no means as destructive for previous Neolithic populations as had first been argued. New burial rites, now widely shared also between traditionally defined archaeological cultures, are the most visible innovation (Furholt 2019), but even this was not directly “imported” from the Eurasian steppes, but rather required adaptations and transformations as it merged with local mortuary traditions (e.g. Kaiser and Winger 2015). In addition, earlier ritual preferences often continued across this divide (e.g. Nielsen and Johannsen 2023). Many other elements initially suggested to relate to a Corded Ware “invasion” have much longer roots. This means that new narratives of the transition are required, a goal that currently comes up against its own set of problems.

What next? A research agenda for the pre-Corded Ware horizon

Currently, the main barrier to a full understanding of the Corded Ware phenomenon is the extremely uneven state of knowledge regarding the preceding cultural horizon. In some areas, there is a wealth of available evidence, although often for only certain aspects of life (and death). In northern central Germany and adjacent areas for example, the excavation of collective graves of the Wartberg culture (e.g. Drummer 2022; Hinz 2007; Schierholt 2012; on settlement see also Rinne *et al.* 2021) and an increased focus on communication networks between closely associated groups, such as Globular Amphora and Bernburg (most recently Müller 2023, 217–50), have provided a wealth of evidence on mortuary practice and communication networks. In contrast, the circum-Alpine lake villages with their detailed settlement records are some of the best-documented case studies for economic flexibility and settlement impermanence (e.g. Bleicher and Harb 2017; 2018). Yet it is rarely discussed in depth in how far these trends are representative for other areas.

In many other regions of central Europe, the picture is considerably more vague. The reasons for this are multiple. Material culture, in particular pottery but to an extent also lithics, becomes simpler and typologically less diagnostic after about 3500 BC, so it is hard to recognise in the archaeological record and has traditionally attracted more uneven scholarly interest. This means that basic relative chronologies are occasionally still contested (see for example the controversies concerning the dating of Cham culture pottery, Gohlisch 2005, 131–42). In addition, on mineral soils at least, it is often difficult to identify domestic architecture, and Late Neolithic pits, burials lacking diagnostic grave goods and other features often turn up as isolated instances interspersed with the remains of other time periods (e.g. Claßen *et al.* 2018; Engelhardt 2011; Modderman 1977, Beilage 3; Tolksdorf *et al.* 2020; Zuber 2009), which are then often prioritised in reports and scholarly publications. This drop in the number of houses remains hard to interpret — it is possible that a general population decline is responsible, but this is not always borne out by other evidence, such as pollen records documenting human impact (e.g. Gerlach and Eckmeier 2012; Meurers-Balke *et al.* 1999, 30–31). Alternatively, the establishment of a more mobile settlement system could have led to the development of ephemeral forms of architecture that are difficult to identify archaeologically. Even where there are more substantial remains, such as the ditched enclosures of the Řivnáč or Cham cultures (e.g. Burger 1988; Ottaway 1999; Zápotocký and Zápotocká 2008), it can be hard to assess their permanence and their role in the regional settlement system. In spite of these problems, it is evident that long-distance networks existed, as for example shown by the production of non-local pottery shapes with inspirations in far-away regions (Dunne *et al.* 2023) or imported stone artefacts (e.g. "daggers", summarised in Kieselbach 2012).

In the coming years, our challenge is therefore to document these pre-Corded Ware societies in much more detail. This will require targeted fieldwork to fill in remaining blanks, as well as the judicious use and in-depth analysis of the existing archive using the full suite of (bio) archaeological methods now available. Strategies will have to be explicitly geared towards the identification of potentially highly mobile societies, and to differentiating different forms of mobility and migration within a high-resolution chronological framework. Moreover, we have to gain a deeper understanding of subsistence strategies and social aspects in these societies. All this requires a better grounding in reliable absolute dating frameworks. Only then will we be able to accurately pinpoint the appearance of the different novelties associated with the emergence of the Corded Ware, to identify potential links between them, and to assess what their social consequences may have been, both before and after the appearance of new genetic signatures.

It is clear that such a task cannot be accomplished quickly and will need sustained attention over many years to come. This volume sees itself as one of the initial steps in this direction. It is the result of a DFG-funded workshop organised by Clara Drummer, Renate Ebersbach, Philipp Gleich, Daniela Hofmann, Doris Mischka and Silviane Scharl and hosted online by Erlangen-Nürnberg University in the pandemic year 2021. Under the heading "The eve of destruction? Local groups and global networks during the late 4th and early 3rd millennium BC in central Europe and beyond" over 30 researchers came together to collate new research on the period between roughly 3500 and 2700 BC and to debate the significance of these regional studies for the emerging pan-European picture. Most of the original participants are represented here with a written contribution. Although not all relevant regions and topics can be addressed in a collection of this kind, taken together the contributions eloquently show that the pre-Corded Ware societies of central Europe were more than crisis-prone remnants of a failed Neolithic economic system, eking out a fragile existence on the eve of their inevitable demise. Rather, these were dynamic, innovative and well-connected groups who were characterised by adaptability and resilience, and who had an active role to play in the unfolding changes.

The contributions

The contributions in the volume are arranged roughly regionally, from south to north. In this section, we pull out some of the connecting thematic threads that unite the volume and show that, in spite of all the regional diversity, we are dealing with many of the same problems. These concern the cultural diversity of the pre-Corded Ware horizon, which makes it hard to provide a general synthesis but which would have considerably influenced subsequent trajectories. The social groups active at this time were also embedded in long-distance networks through which novelties would have travelled. Together with a new aesthetic of material culture, which renders many objects "culturally undiagnostic" in archaeological terminology, this can make it rather hard to fit the available evidence into clearly delimited and statically defined archaeological culture groups — this all the more so since new and varied strategies of mobility appear to have been widely adopted at this time. Partly, these changes prefigure what are generally thought to be Corded Ware culture innovations, leading to a pattern of partial continuity. This also involves the new ritual expressions, which may well have functioned as a central arena in which groups with diverse roots and migration histories could have created common ground.

Diversity

All our authors agree that the second half of the fourth millennium is characterised by marked diversity in material culture and practices, and that this forms a complex background patchwork on which later developments are enacted. This is also the case for those areas from which the "steppe migrants" are generally thought to come, as Elke Kaiser details in her contribution on the pre-Yamnaya horizon. Throughout the northern Black Sea area and adjacent regions, there is great variation in burial traditions, and details of the rite, as well as grave goods and mortuary structures, are flexibly combined. Echoes of this diversity are also present in the succeeding Yamnaya horizon. This tension between variation and similarity is well-known from other regions and periods — for instance, Pieter Modderman's (1988) description of the Linearbandkeramik culture as showing "diversity in uniformity" is an almost perfect mirror image to Sebastian Schultrich's (this volume) characterisation of the Later Neolithic as "united in diversity" and Marzena Szmyt's (this volume) contrast between cultural uniformity and differentiation. In both cases, whether one assesses a phenomenon as "similar" or not to another largely depends on the scale of analysis and the level of detail. This is exacerbated by research traditions that rely on a traditional form of the culture concept that prioritises internal uniformity and clearly defined boundaries. This problem has been long pointed out (e.g. Eggert 1978; Gross 2017; Wahle 1941; Wotzka 2000) and is here taken up again in contributions by Thomas Link and Elke Kaiser, as well as Silviane Scharl and Ingrid Koch. All bemoan the fragmentation of research traditions that has resulted, and which makes it hard to recognise and characterise situations in which spatial or chronological patterns in one set of materials and practices do not vary in line with those in another. Not only have many aspects of daily life and mobility been neglected as a result, but also material culture that was perceived as undiagnostic, for example the lithic traditions in the Rhineland discussed by Scharl and Koch, has been effectively ignored. Our maps of the fourth millennium also show bounded blobs separated by large blank areas where research has been uneven, as in the Franconian example presented by Link. These kinds of gaps create artificially neat boundaries between the traditional culture groups. This may not be warranted — the material from Burgerroth, for example, combines elements of Cham and Alpine foreland material culture with more northerly inspirations and some elements that appear locally specific.

In addition, the fourth millennium sees the coexistence of varied expressions in spatially circumscribed areas. For example, Szmyt's contribution charts the identity boundaries drawn by different communities in the Polish lowlands, in particular in the ritual sphere. In spite of similarities in daily life, economic orientation and levels of mobility, late Funnel Beaker and Globular Amphora-using communities established clear distinctions between each other in death, partly mediated through contact with other areas and people, such as regions using Baden culture material or northern hunter-gatherers. A similar situation also exists for instance in southern Scandinavia (e.g. Iversen 2015; 2020; Nielsen and Johannsen 2023).

Dealing with diversity certainly remains a challenge, both theoretically and methodologically. While the use of polythetic culture models based on David Clarke's (1968, 35–38) pioneering concept have been repeatedly called for (e.g. Furholt 2020), in practice this would require considerable groundwork: the establishment of a new culture-independent nomenclature, new styles of mapping and a concerted theoretical debate on how to identify which aspects of material culture may have been used in conscious boundary signalling between groups (e.g. Hofmann *et al.* submitted). It would also require re-balancing our scales of analysis. Choosing the large-scale and general or the small-scale and messy is a choice that also immediately foregrounds radically different possibilities of engaging with the kinds of social negotiations and competing interests that were a feature of past as much as of present communities (Hofmann *et al.* 2024).

Networks and contacts

This intriguing pattern of diversity and difference, and of innovations and ideas travelling between traditionally defined culture groups, presupposes robust networks and contacts, and one key question addressed by our contributors is how these might have been organised. Pottery remains central here, given that shapes and decoration styles are, at least on the face of it, easy to trace. For southern central Europe, Philipp Gleich presents the results of his recent re-evaluation of textile-roughened or cord-rolled pottery, an element that connects several traditionally defined culture groupings of the pre-Corded Ware horizon over long distances. In spite of techniques varying in detail, this implies a transmission network at a very large scale, from the Baltic to the Carpathians. Similarly, Joachim Köninger identifies non-local elements in the Horgen culture pottery of the Alpine foreland, most likely introduced through mobility along the river Danube, but in this case crossing areas where such designs are rather less well known at the time. It is, however, not just pottery that is introduced along this communication axis, but also knowledge about wheeled vehicles and new kinds of crops. Since a necessary condition for the spread of innovations is the existence of social ties between the communicating individuals, and related to this a certain degree of social intimacy as a prerequisite for the transmission of knowledge (e.g. Hofmann *et al.* 2022, 266; Tostevin 2007; 2019, 203), these networks allow further consideration of the social connections underpinning them (Scharl 2019; 2023).

Some lines of transmission seem rather indirect and mediated across many different steps, whereas more direct links are evident for instance in the Baden imports at Alpine foreland sites like Arbon-Bleiche 3 (De Capitani 2002, 156–61, 209–20), or the many forms with central eastern European inspiration recovered at the Lower Bavarian enclosure of Riedling (Dunne *et al.* 2023). More work is necessary on the precise mechanisms of transmission. Where sourcing studies have been undertaken, as at Riedling, even the exotic-looking pottery has been locally produced, while various hybrid vessel forms mixing "local" and "foreign" elements are documented here and also in the Alpine foreland (e.g. Burri 2007; Dunne *et al.* 2023; Stapfer 2017).

Not just pottery is involved, however, and other contributors to our volume trace additional lines of communication, visible for example in ritual innovations such as the anthropomorphic stone stelae in Franconia discussed by Martin Nadler, the widening syncretism in the burial practices of hunter-gatherers in Finland addressed by Marja Ahola, or the increasing importance of battle axes documented by Schultrich. As both Köninger and Link point out therefore, revising our models for contact is an important future research priority. What sorts of personal meetings and interactions were taking place both in routine contexts and at possible meeting sites like enclosures? Who were the main actors involved, and how far and for how long did individuals and groups move? Were these networks constant and long-lasting, or rather dependent on individual connections, and therefore potentially shorter-lived, more mutable and episodic, with distinct bursts and troughs?

Mobility

Tackling transmission networks leads us back to the thorny problem of understanding mobility patterns and — connected to these — settlement patterns and economic choices. This is perhaps the least well understood aspect of this horizon. Several of our contributors stress that settlements in general have become more ephemeral at this time, with little evidence especially on mineral soils. Pit huts like those documented at Burgerroth and discussed by Link are the exception. Yet overall, heightened mobility seems to be largely inferred from the absence of larger domestic structures and the thin scatter of features such as refuse pits, as is for instance the case in Scharl and Koch's Rhineland study. For the Globular Amphora culture, Johannes Müller also documents an increase in mobility and an economic and symbolic role for pastoralism. In many other regions, there is little detailed evidence available to reconstruct specific economic adaptations.

Using the Cham culture as an example, a recent synthesis of the animal bone and crop spectra (Dunne *et al.* 2023) shows a high degree of diversity. This may be because new kinds of landscape zones, such as the lower mountain ranges, are now also being exploited (e.g. Pelisiak 2016; Schmotz 2019, 70–71; Valde Nowak 2002; Valde Nowak and Kienlin 2002), but this begs the question of what this variability represents and how it was organised. One relevant model has been built up using the Alpine foreland sites with their wetland preservation. Here, settlements are frequently abandoned after less than a human generation, and individual houses can have even shorter biographies than that. Generally speaking, it appears that households and groups of households specialised on the acquisition of certain kinds of resources, often from intensively managed and maintained fields and forests. Nevertheless, there was enough flexibility in the system to alter preferences in response to environmental changes (e.g. Billamboz *et al.* 2010; Ebersbach 2010; Heitz *et al.* 2021; Hofmann *et al.* 2016). In his contribution, Niels Bleicher draws out a slow trend towards greater settlement permanence over time, but also stresses the importance of continued mobility. He documents that the changes in settlement layout between the Horgen and Corded Ware cultures are not sudden and clearly marked, but rather the result of a long drawn-out transitional phase in which different kinds of layouts existed side by side, and ideas surrounding them likely spread through increased connectivity.

Whether this pattern is also applicable to mineral soils is so far an open question, partly also because village plans comparable to those from the Alpine foreland are virtually non-existent in areas further to the north, and are certainly not dated with equivalent precision. However, there are also other indicators that may caution against a too simple application of the Alpine system to all other landscape zones. Certainly, the Alpine foreland shows neither the investment in new ritual expressions evidenced in, for example, the Globular Amphora culture (see contribution Müller), nor the enclosed sites common for instance in the Cham and Řivnáč cultures, and even in Franconia, as Nadler's contribution summarises for this volume. The role of these sites in the wider settlement system remains fundamentally uncharacterised — are these permanent central places in a settlement hierarchy otherwise consisting of small, mobile groups, or are they temporary aggregation sites?

Framing models for the mineral soils of central Europe will require careful synthesis of the scattered information available, as well as much closer spatial and above all chronological control. In particular, identifying episodic use or gaps in the settlement record of a particular site or region is a tremendous methodological challenge. Given the small assemblages of both animal and human bone from many regions, it will also be imperative to apply the full suite of bioarchaeological methods to what has been excavated and to try out new routes like sedaDNA. However, one of the most urgent tasks remains the structured consideration of different possible patterns of mobility and how these could even be reflected in the archaeological record.

Continuity

If considerable mobility could already have characterised the pre-Corded Ware horizon, then the transition to the Corded Ware becomes ever more fuzzy. This continuity across material culture traditions and practices is the clearest evidence we have against catastrophic and genocidal models of culture change, when a much clearer break would be expected. Documenting these long lines of persistent practices is thus a key concern for many of our contributors. Continuities have for example been documented in the typological development of battle axes, traced by Schultrich, or in the persistent use of Late Neolithic chipped stone artefacts in the Rhenish Corded Ware horizon documented by Scharl and Koch. Most strikingly, such overlaps are also evident in the sphere of burial and other rites, which are often seen as the clearest expression of a dramatic discontinuity at this point. Looking at the wider archaeological and anthropological literature, innovations in ritual practice can often be catalysts for the integration of different groups in migration or frontier situations (see Hofmann *et al.* 2024, 83–96, 152), and this possibility also deserves to be considered more widely in the European Neolithic.

In our volume, both Ahola (see also Ahola 2020) for Finland and Quentin Bourgeois and co-authors for the Netherlands succeed in documenting evidence to this effect. In particular Bourgeois and colleagues identify considerable overlap between Funnel Beaker and Corded Ware burial and depositional practices, such as burial locations and the items included in graves, or the treatment of axes before deposition. In spite of the distinctiveness of Corded Ware burials, therefore, people following the new rites also adapted local and regional influences. Similarly, Jan Piet Brozio argues for a slow trend towards emphasising individual identities in burials of the late Funnel Beaker horizon, prefiguring later Corded Ware practices. Clara Drummer also shows that Corded Ware ways of burial existed side by side with previous traditions in the German lower mountain ranges, and suggests a scenario of smaller migrating groups slowly filtering into the area, rather than sudden and complete replacement. Finally, Corded Ware culture use is documented for the Neolithic sacred landscape around Mount Říp in the Czech Republic, discussed by Jan Turek and his co-authors. The area had already seen sequences of monumental construction for several centuries, and although Corded Ware burials and deposits do look different from these earlier activities, the importance of the area itself and of the marked natural hill at its centre is unbroken. Change takes place in a wider framework of continuity, or, as Drummer characterises it, a general mood of mutual accommodation.

Our contributors thus identify two kinds of potential continuity. On the one hand there is the prefiguring of Corded Ware practices in the diverse background of earlier Neolithic societies. This suggests a kind of pre-adaptation by the local population, who would therefore have been more likely to accept these elements of the Corded Ware lifestyle. Indeed, an increased mobility and re-orientation towards wider-scale networks could even have created the social links and dynamics that made the Corded Ware migration possible in the first place. The second model, on the other hand, rather stresses the continued coexistence of earlier practices alongside new, Corded Ware ones. This presupposes a different kind of cultural interaction, whereby communities with different traditions existed side by side for some time, maintaining their distinctiveness and merging only later. Which of these scenarios is correct, or whether we are looking at a combination of the two, is currently hard to establish, partly — as several of our contributors discuss — because of continued issues with ^{14}C dating and with disentangling material culture chronologies.

Whichever scenario is correct, however, these kinds of overlap and continuity militate against a complete and catastrophic replacement of Late Neolithic culture by the oft-invoked "steppe peoples". This also opens the question of whether Late Neolithic societies were in some way in decline or facing internal challenges that may have led them to assimilate elements of steppe practices. In this context, both Müller and Brozio accord a crucial role to the Globular Amphora culture, which may have revitalised declining Funnel Beaker-using societies through the introduction of new ritual elements such as cattle burials. The reasons for this perceived Funnel Beaker culture decline, also visible in various demographic indicators, were likely complex and composite, involving both environmental challenges and increasing social tensions. In southern Germany, in contrast, the most marked phase of catastrophic drought occurs between 2745 and 2727 denBC, as documented by Joachim Pechtl and Alexander Land. This falls after the initial establishment of Corded Ware communities in the region and is therefore not a trigger for either immigration or radical changes in Late Neolithic societies. However, Pechtl and Land suggest that the Corded Ware economic system may have been pre-adapted to react more flexibly to these kinds of challenges, so that this ecological crisis could have helped to increase the attraction and reach of this way of life. This is an interesting hypothesis which will need to be tested further.

What is already clear, given either pre-adaptation or continued co-existence or both, the search of a single crisis as the main driver for the arrival of Corded Ware communities across central Europe is not warranted. While in some regions, such as across the TRB network, communities may already have been struggling, in other areas the main challenges post-date the first appearance of Corded Ware material, and other changes and transformations similarly do not coincide with this putative break. Taken together, this volume shows the urgent need to expand large-scale, general models of "the" transition with more regionally and locally specific work in order to draw out the many pathways by which Final Neolithic things and practices became established in central Europe.

Outlook

Taken together, the papers in our volume thus go a long way in shifting the frames of the debate. Evidence for diversity in the pre-Corded Ware horizon, some of which prefigures later changes and continues beyond the divide, the importance of contacts and new forms of mobility, and the potential coexistence of communities of different origin all make it less and less likely that the changes identified as the beginning of the Final Neolithic were as sudden, dramatic and destructive as some models would have us believe. This pattern has also been identified beyond the central European case studies that are our focus here (e.g. Ebersbach *et* al 2017; Iversen 2020; Nyland *et al.* 2023; Piličiauskas *et al.* 2020). Yet, as we have pointed out throughout this introduction, much also remains to be done. We need better theoretical models for different kinds of interactions across frontier zones (e.g. Parker 2006), both the data and the vocabulary to characterise different kinds of mobile societies accurately, new tools for cataloguing and representing the complex distribution patterns we see, and not least a lot more ground work in excavating, analysing and synthesising many different strands of evidence. As is becoming clear, the simplest model on offer is not generally the only likely one, or even the best fit (see e.g. Maier *et al.* 2023 for aDNA narratives). To get closer to the lived reality of mosaic processes like the Final Neolithic transition, we need to radically widen the frame of the debate and introduce a mosaic of approaches to revitalise our discussions. We hope that this book can serve as a stepping stone and inspiration for beginning this task.

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The times they are a-changin'

The Final Copper Age between the eastern Carpathians and the Don river

Elke Kaiser

Abstract

The population-genetic studies published since 2015 provide evidence for an emigration from the eastern European steppe zone during the early third millennium BC to various western regions. These results, and some of the interpretations associated with them, caused controversial discussions in the archaeological community. However, in order to understand the processes and changes in the early third millennium BC, the directly preceding period in south-eastern and eastern Europe needs to be better understood. This paper gives an overview of the current state of research for the cultural chronological situation between 3500 and 3000 BC in eastern Europe. During this time, the Cucuteni-Trypillian cultural complex dissolved and, with its dissolution, the cultural border between forest and grass steppe opened. In the entire northern Black Sea region, plenty of interactions can be observed between numerous cultural groups. Alongside settlements, graves are frequently discovered in the forest-steppe zone. After 3000 calBC, these graves are the predominant archaeological source. In general, we conclude that the varied mosaic of material culture of the fourth millennium BC has not yet been studied sufficiently.

Keywords: Late Aeneolithic, Early Bronze Age, northern Pontic region, transformation processes

Introduction

In 2015, two studies were published that analysed the genome-wide sequences of prehistoric individuals from large parts of Eurasia (Allentoft *et al.* 2015; Haak *et al.* 2015). One of their most important results was that the aDNA of those buried in kurgans of the Yamnaya cultural complex showed a specific genetic composition that was initially termed "Yamnaya ancestry" because it was verified here for the first time. Later, it was also called "steppe ancestry". Comparable genetic components have also been found in the aDNA sequences of individuals from the end of the Neolithic (Corded Ware culture) and from the Early Bronze Age in central Europe. For some of the individuals studied, biostatistical admixture analyses showed a large proportion of this steppe ancestry in addition to the "Early Neolithic" und "Western Hunter-Gatherer" ancestries already known from older periods.

In D. Hofmann, D. Mischka and S. Scharl (eds) 2025. *The eve of destruction? Local groups and large-scale networks during the late fourth and early third millennium BC in central Europe*, 25–52. Leiden: Sidestone Press.

In the meantime, the number of genome-wide sequenced individuals from prehistoric Eurasia has increased considerably (e.g. Mathieson *et al.* 2018; Papac *et al.* 2021 and many more). Thanks to this, many more facets could be added to the palaeogenetic reconstructions of population dynamics over large areas in various periods of time. In 2015, W. Haak and colleagues for the first time attempted to explain the changes in the genetic composition of central European people buried in graves of the Corded Ware culture and the Single Grave culture with massive immigration from the steppe. This and other interpretations revived simplistic ideas of immigration, often in the sense of invasions, which had long been banished from archaeological discourse for good reasons. Accordingly, they have raised scepticism (Furholt 2019; Heyd 2016; Kaiser 2021) but also approval (Kristiansen 2017). Genetic studies of population dynamics continue, and more highly interesting insights may be expected due to methodological advances both in the laboratory as well as in the evaluation of the results.

In addition, controversial discussions between archaeologists and palaeogeneticists show how important it is to understand cultural-historical processes in order to interpret aDNA data correctly. Archaeological research also still has much to achieve, even regarding the basics. In comparison with other widespread phenomena, such as the Corded Ware culture and the Bell Beaker culture, the Yamnaya cultural complex is only known and described inadequately outside of eastern Europe because the literature in Ukrainian and Russian is inaccessible to many researchers. In Western literature, the Yamnaya cultural complex — or the Yamnaya cultural-historical community — is described rather schematically as a homogeneous block of kurgan burials with standardised burial customs, the so-called Yamnaya package. More differentiated research in eastern Europe, on the other hand, has clearly defined numerous regional variants. Even more simplistic is the idea to group the archaeological cultural group preceding the Yamnaya cultural complex as "pre-Yamnaya". This inadequately summarises a complex and, in many aspects, still insufficiently studied cultural area between the eastern Carpathians and the Caucasus or the Volga–Ural interfluve.

The international conference "The eve of destruction", on which this volume builds, looked into the archaeologically verifiable interactions, innovations, and networks at different scales in central Europe that either preceded the occurrence of the Corded Ware culture or were concurrent with it. The transition to this cultural complex was accompanied by numerous changes in various spheres, such as settlement, burial custom and economic system. To be able to comprehend these transformations, particularly in their intensity, a longer period of time needed to be examined. In my paper, I am going to do this for the northern Black Sea region and the adjacent areas. We can only understand the changes that accompanied the spread of the Yamnaya cultural complex if we also consider the preceding period. In the following, I will therefore first present the cultural-historical entities of the forest and grass steppe zone between the eastern Carpathians and the Don river during the last centuries of the fourth and early third millennia BC. Then I will take stock of the current state of research. In order not to go beyond the limits of this paper, I will draw an artificial line at the Don river. Including the north Caucasus with the Maykop-Novosvobodnaya cultural complex and the region between the Don and Ural rivers would be going too far, although they belong to the overall picture.

Fluid borders

Before 3500 BC, the northern Black Sea region and the adjacent areas were divided into two cultural spheres. The settlements of the Cucuteni-Trypillia cultural complex were situated in the forest steppe in the north, whereas the sites of the so-called Steppe Aeneolithic lay in the grass steppe. For more than one millennium, these two vegetation zones were obviously being shaped by different cultural-historical processes. In this context, the differences in natural landscapes between grass and forest steppe must not be considered to be a visual border but rather a gradual transition with an increasing number of trees, depending on the soil and the availability of water (Walter and Breckle 1999). In terms of cultural history, though, it seems there was a border for a long time that slowly dissolved only in the second half of the fourth millennium BC. This also provided the basis for the various perspectives on the changes of that time. Those who work on the eastern Trypillian sites located in today's Republic of Moldova and Ukraine describe the Trypillia phase C2 as a time when the previously comparatively homogeneous material culture dissolved (see, amongst others, Dergachev 2022; Kruts 2012). In the eastern Carpathians to the west, the Cucuteni phase B2 ended around 3500 BC according to specialists (Drummer *et al.* 2016, fig. 7). It was followed by independent archaeological cultures, such as the Horodiştea-Erbiceni. Researchers who focus on the grass steppe, on the other hand, emphasise that the interactions between protagonists in both steppe zones and between the west and the east of these zones increased (Rassamakin 1999; 2003).

This contribution aims to overcome these traditional research perspectives and to provide a picture of the archaeological entities of the whole area that is as complete as possible (Figure 1). Increasing regionalisations are described for the entire Cucuteni-Trypillia cultural complex. Including phase C1, the complex is divided into a western and an eastern part (see Shatilo 2021, 32–44 and references therein). Beginning with Trypillia stage C2,

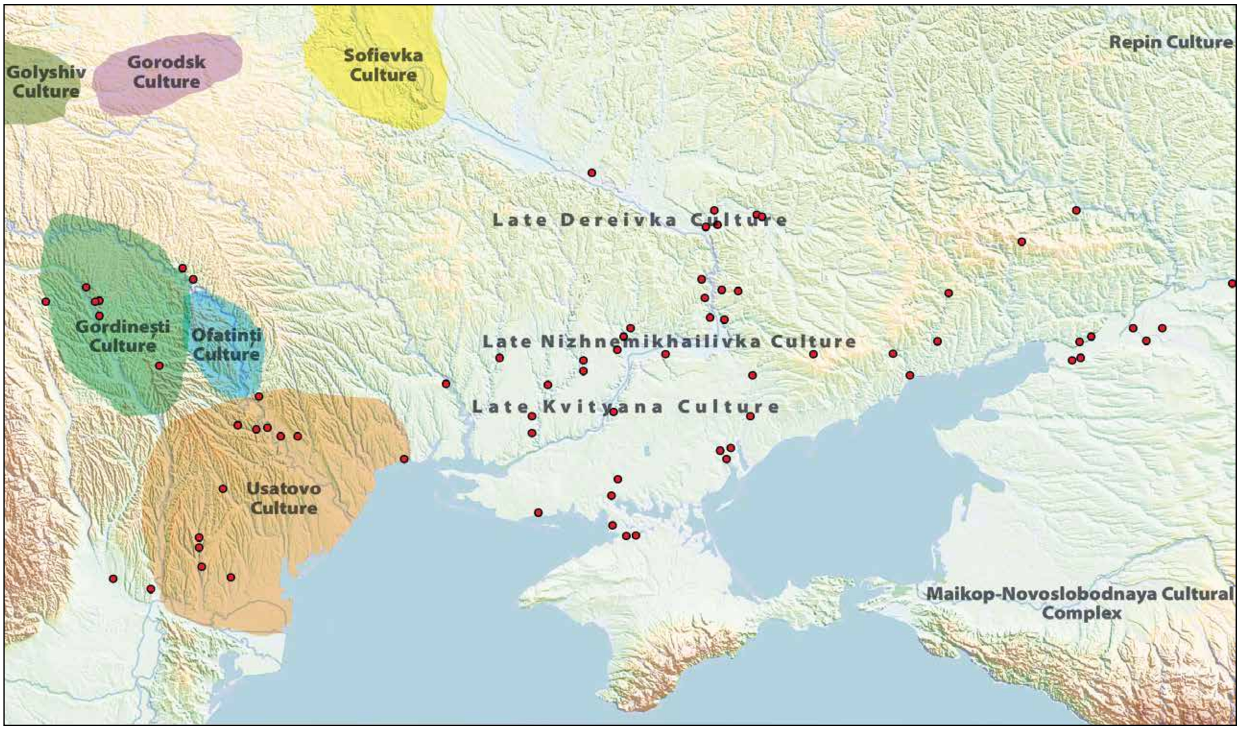


Figure 1. Archaeological cultures in the forest and grass steppe north of the Black Sea and in adjacent areas. Red dots: burials of the Zhivotilovka-Volchansk culture. Areas of the Trypillia C2 cultures are shown in different colours. The spatial distribution of the different burial traditions according to Rassamakin (1999; 2004) cannot be shown as distinct areas (map from Manzura 2016, fig. 1).

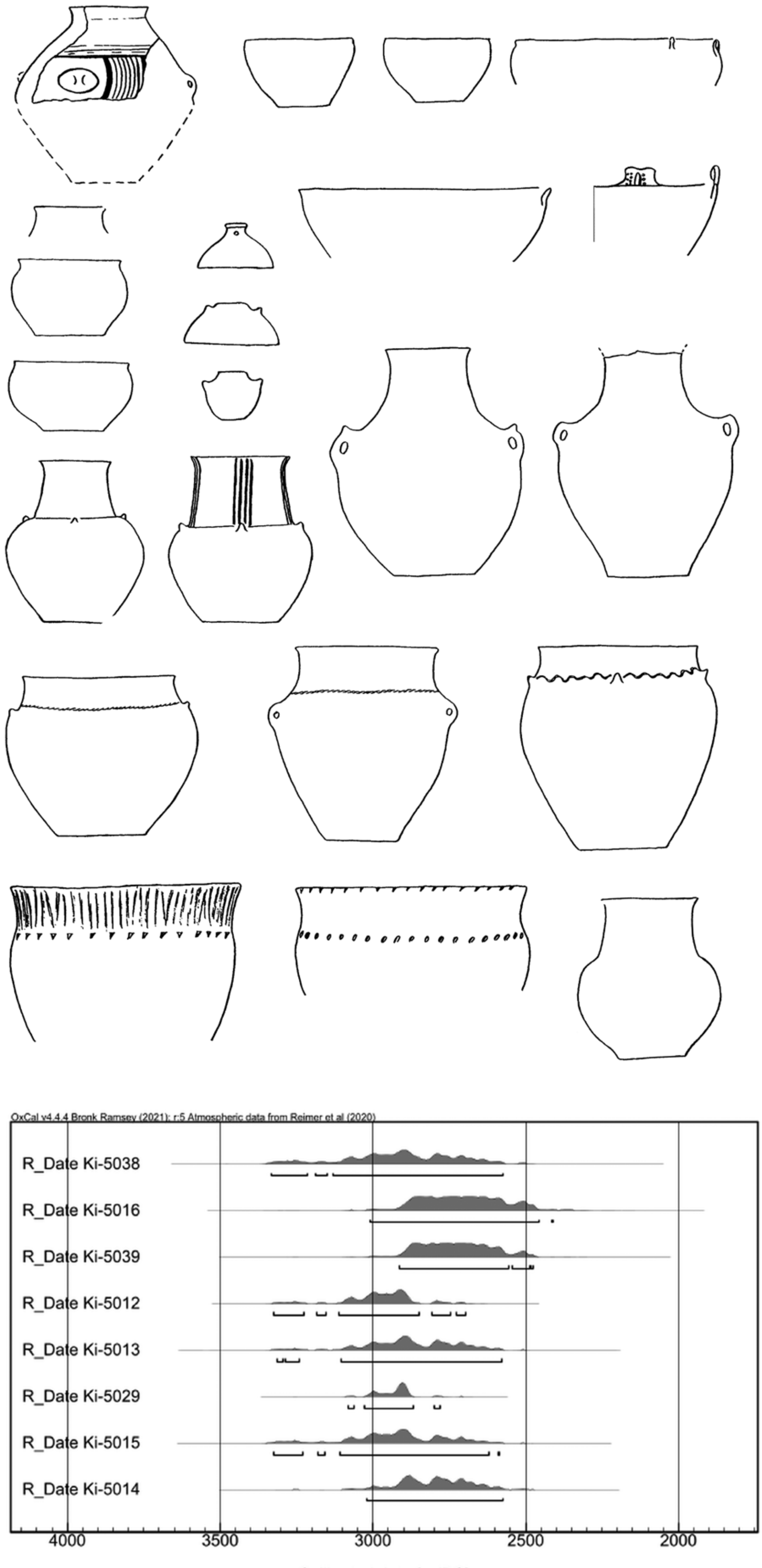
however, the regional groups become distinctly smaller in their spatial extent (Figure 1). During the early phase of C2, settlements remain the almost only source and thus constitute a continuity with the previous phases. Only burials of the late phase have been found. In the following, I will outline the main groups of the late phase of C2. We need to bear in mind that the research community is in disagreement regarding many questions, such as the correct taxonomic classification as a cultural group, cultural type, phenomenon etc., but also whether these groups need to be seen as continuous Trypillian traditions.

Archaeological groups in the forest-steppe zone

Sofievka group

The sites of the Sofievka group are situated along the Dnipro river (Figure 1). V.I. Kruts (1971) first described this group and defined it as an independent archaeological phenomenon within stage C2. Later, he also referred to it as the Middle Dnieper local group (Kruts 2012, 243). M.I. Videiko (1995), on the other hand, assumes only individual imports from the Trypillian culture and treats the Sofievka group as independent from Trypillia. A total of 25 settlements are known to date (Dergachev 2022, 75; Shatilo 2021, tab. 8), but none of them has been examined entirely. Only semi-sunken dwellings have survived. Apart from the settlements, there are four cemeteries with relatively small areas of 40–100 m^2, each with a large number of cremation burials. For instance, 145 graves were uncovered at the eponymous site and as many as 195 at Krasnyi Khutor (Dergachev 2022, 76). The dead were cremated and their remains buried in either urns or as unseparated cremations in small pits. The custom of cremation burials is singular among the regional groups of the Trypillia C2 phase.

The pottery recovered from the settlements is mostly made with more care than that from the graves (Dergachev 2022, 78). An important characteristic is that the pottery found is almost exclusively unpainted (Figure 2a). Flat-based bowls and pots with a tapered neck and small handles or appendages on opposing sides are typical of the Sofievka group. Decoration is rare and mostly consists of impressions or incisions. Occasionally, vessels have been found with a zoomorphic lid that brings to mind types from the Usatovo group, as well as specimens with painted patterns, possibly representing imports from other groups of Trypillia C2 (Dergachev 2022, fig. 34).

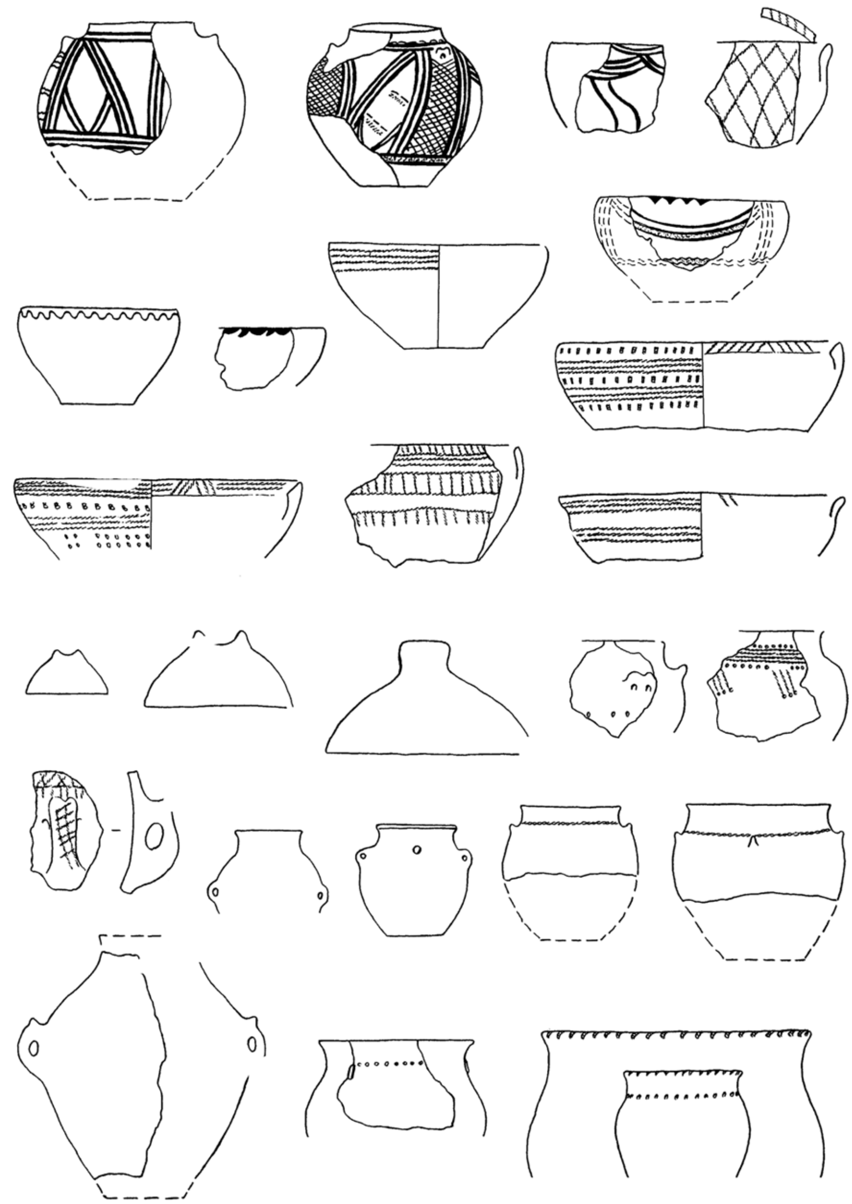


a

b

Figure 2. a) Pottery types of the Sofievka culture (Dergačev 1991, pl. 11); b) calibrated radiocarbon dates for sites of the Sofievka culture (for details, see Appendix 1).

a



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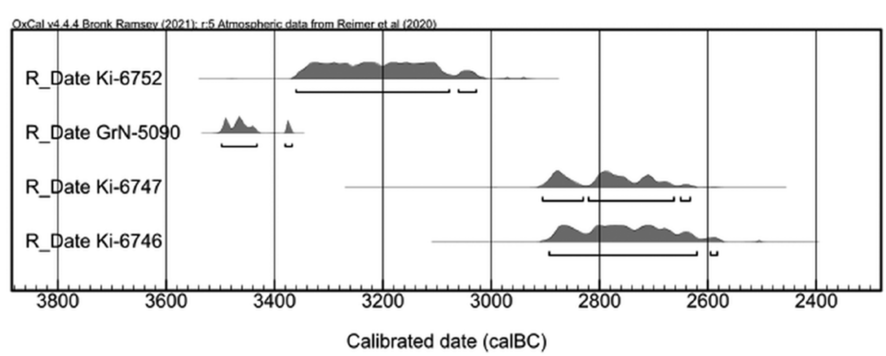

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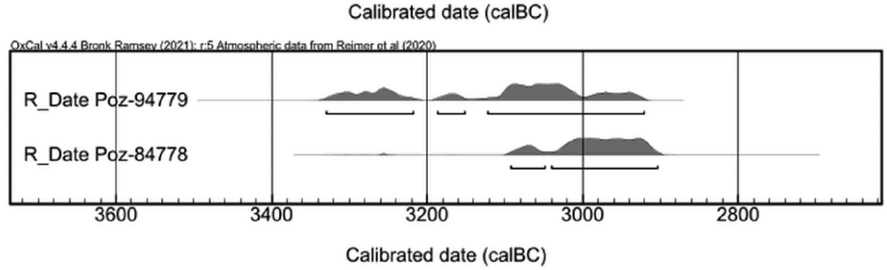


Figure 3. a) Pottery types of the Gorodsk culture (Dergačev 1991, pl. 9); b) calibrated radiocarbon dates for sites of the Gorodsk culture; c) calibrated radiocarbon dates for sites of the Golyshev culture (for details, see Appendix 1).

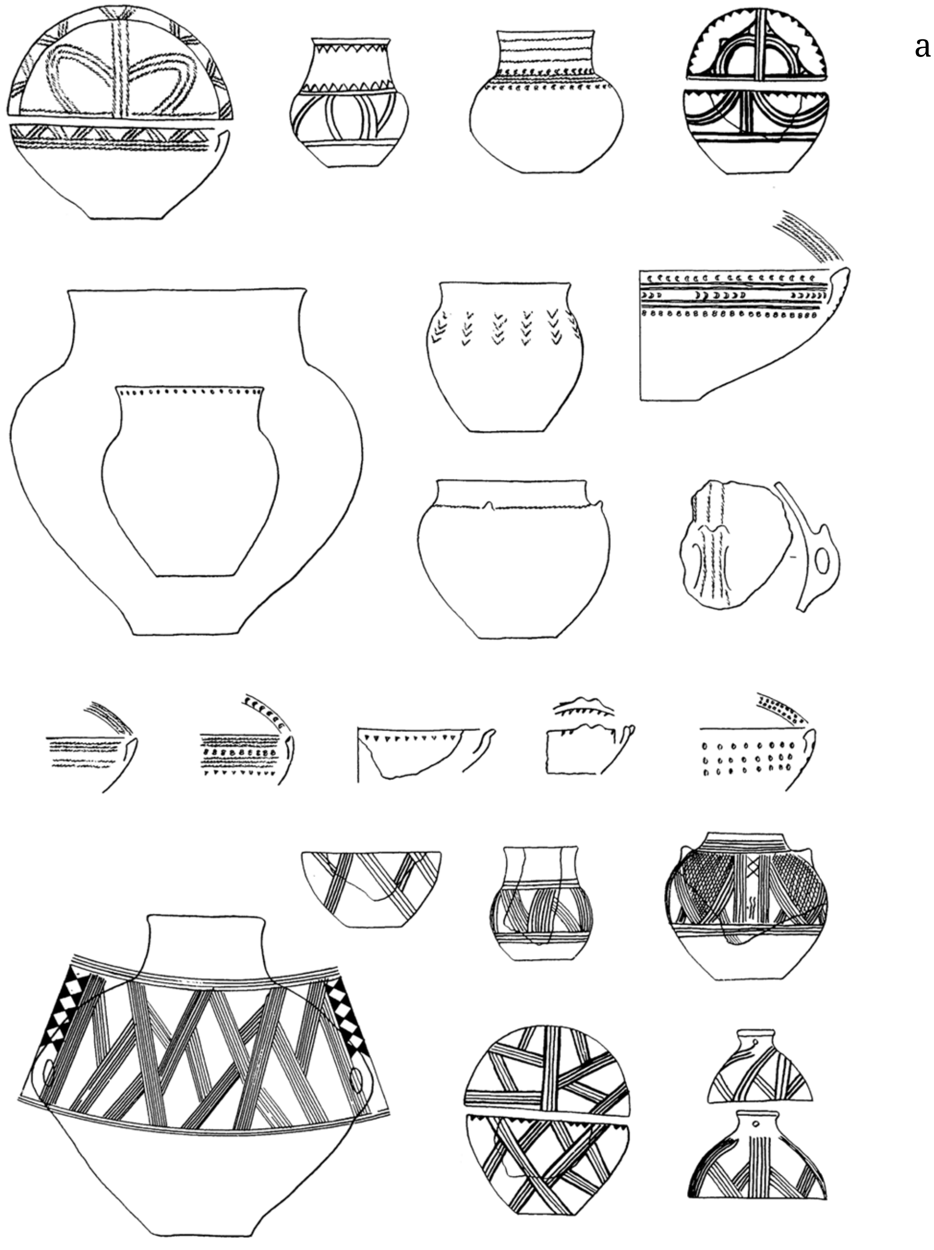


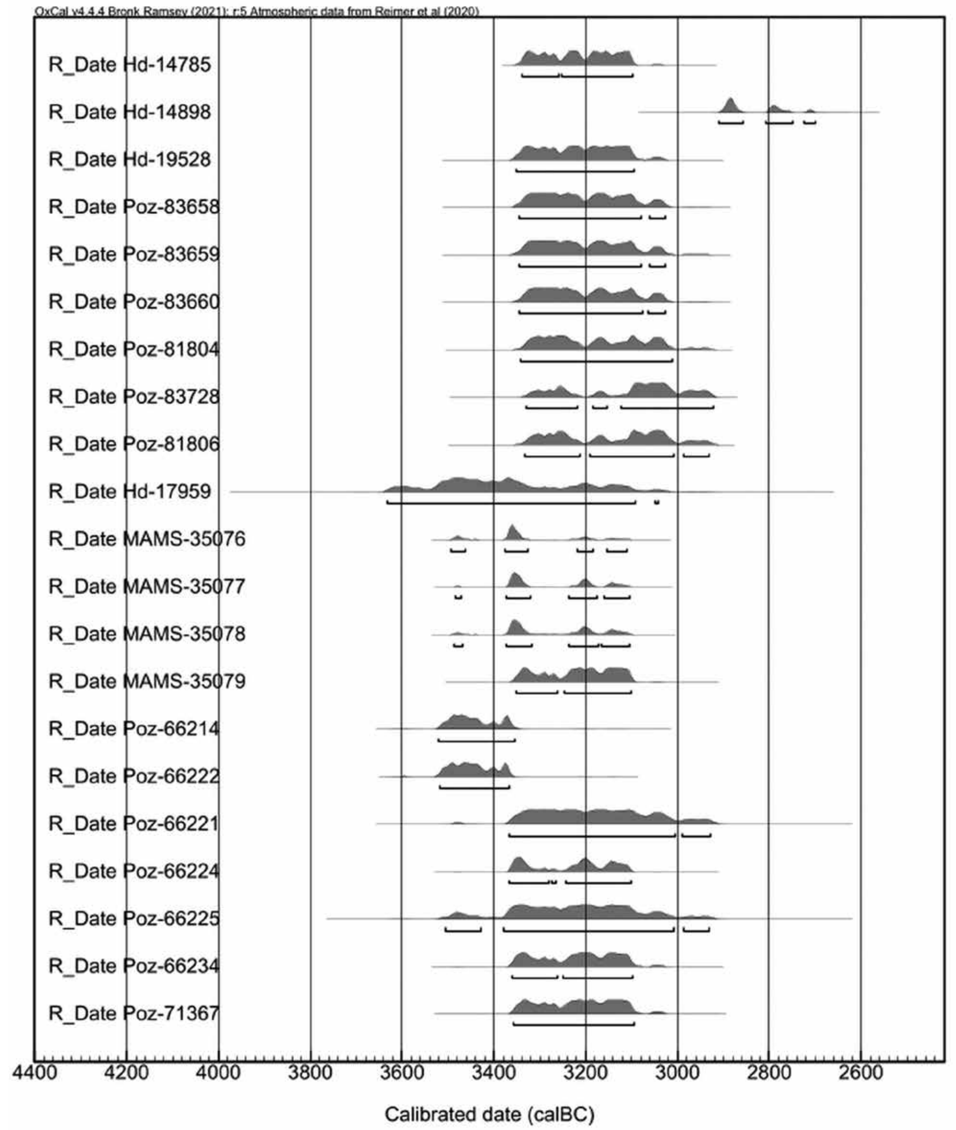
Figure 4. a) Pottery types of the Gordineşti culture (Dergačev 1991, pl. 7); b) calibrated radiocarbon dates for sites of the Gordineşti culture (for details, see Appendix 1).

Eight samples from the burial ground of Sofievka have been dated using radiocarbon analysis (Figure 2b). They were taken from calcined bones and charcoal from graves and pits (Videiko 1999). The ^{14}C-ages are comparatively young, and five of them match age determinations for the Yamnaya cultural complex, i.e., the first half of the third millennium calBC. After calibration, three of the dates have yielded long time spans. This is not only due to the large standard deviations but also to the flat calibration curve. The older ranges lie between 3350 and 3000 calBC. It remains an open question whether these date ranges may have been caused by a systematic error in the laboratory in Kyiv, where the only analyses for this group were conducted, or by taphonomic processes, or by other influences on the samples. All in all, the dates appear to be 200–300 years too late (see also Diachenko and Harper 2017).

Gorodsk group

Of this group, only settlements have survived, including the eponymous settlement of Gorodsk (Figure 1). All ten sites are located in eastern Volhynia (Dergachev 2022, fig. 29). Both semi-sunken dwellings and clay platforms, i.e. ground-level structures, have survived. According to V.A. Dergachev (2022, 66), the clay platforms are only partially preserved. He sees this as an indication that the initial construction

b



was less massive. Fine pottery painted in the Trypillian tradition makes up 11–14 % of all pottery finds. Lattice motifs occur relatively often. According to Dergachev (2022, 69), the coarse pottery accounts for 60–70 %, but he does not explain the discrepancy with the fine ware. Various types of tempers were used for the coarse pottery (Figure 3a). Certain types, such as pots with a set-off neck that might bear small cusp-like extensions, are reminiscent of vessels found in the Sofievka group. Dergachev (2022, 69 fig. 31) emphasises the similarity with the vessel tradition of the Gordineşti group, although his illustration does not prove this convincingly.

A total of four radiocarbon dates are available (Videiko 1999). The two dates for samples from the settlement of Sandraki fall between 2900 and 2600 calBC, which makes them far too late (Figure 3b; Appendix 1). The two ^{14}C-dates for samples from the settlement of Gorodsk lie well before 3000 calBC, but their calibrated time spans do not overlap. The older date points to the thirty-fifth century calBC, the other one to the last third of the fourth millennium calBC.

1026 animal bones from the settlement of Gorodsk have been analysed, of which some 60 % were from domesticated animals, including almost 20 % pigs. Horses make up 12 % (Figure 13b) of the total, but it is still impossible to determine whether horses were already domesticated in this period.

Golyshev group

The group of sites in western Volhynia defined as the Golyshev group mainly comprises settlements (Figure 1), but a kurgan at Vishinivka, close to the city of Lviv, is also included (Antoniewicz 1925). Dergachev (2022, 71) notes that at least some of the settlements known so far need

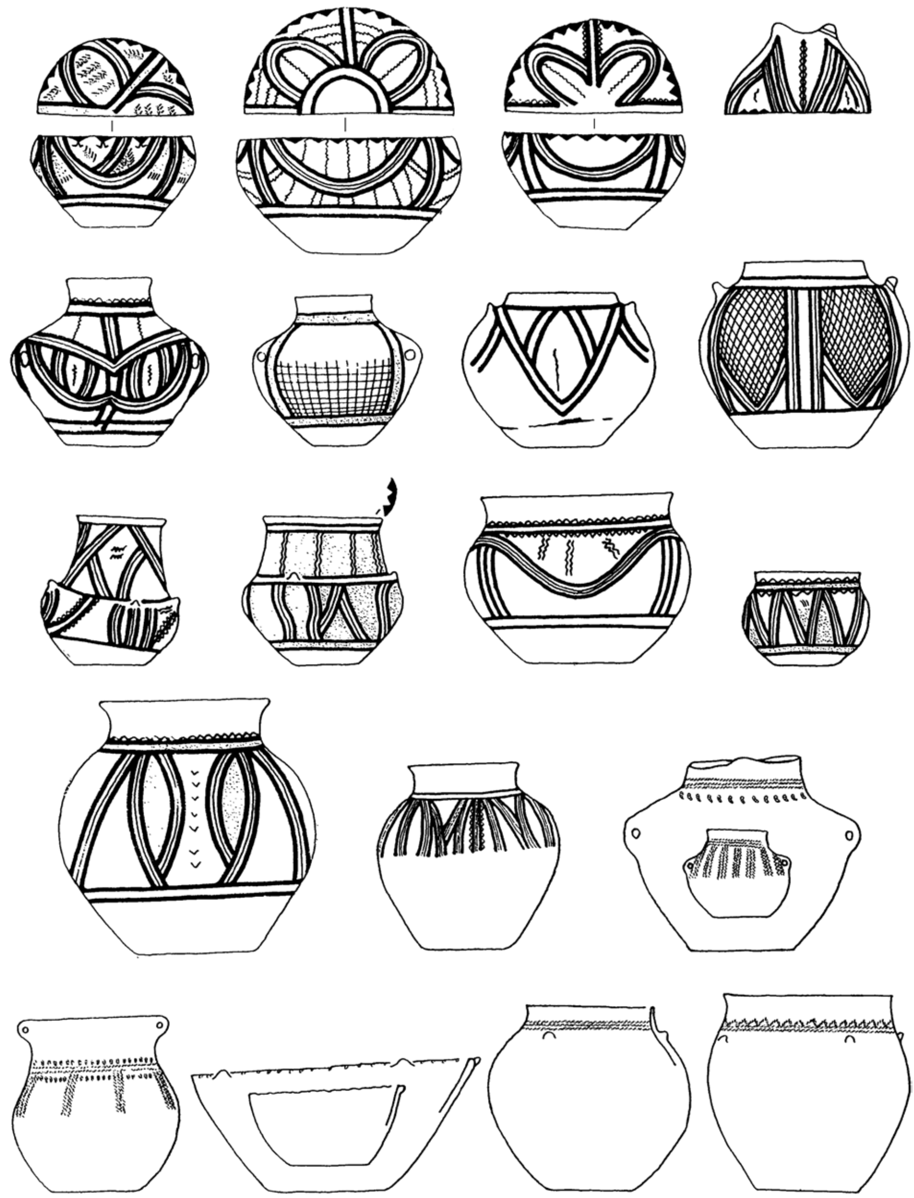


Figure 5. Pottery types of the Ofatinţi (Vykhvatintsi) culture (Dergačev 1991, pl. 3).

to be checked more carefully for their assignment to the Golyshev group. He also refers to a few recent studies, which, however, are not available to me. In at least some of them, larger quantities of Funnel Beaker pottery seem to have been found, in addition to late Trypillian pottery. According to Dergachev (2022, 71), the settlements are located on slightly elevated sites and exhibit the same kinds of house remains as the Gorodsk group: semi-sunken dwellings and so-called rudimentary clay platforms.

The few painted vessels are conspicuously heavily fragmented, which means that often an assignment to complete shapes is only possible with reservations (Dergachev 2022, fig. 33). The coarse ware constitutes 97–98 % of the pottery material and displays various types of tempers and shapes. Overall, Dergachev (2022, 73–75) repeatedly stresses the similarities to the Gordineşti group. Nonetheless, the question arises to what extent a differentiation between the two archaeological groups of Gorodsk and Golyshev is justified in Volhynia.

Two radiocarbon dates from neighbouring settlements are available (Figure 3c). The older one from Vinniki-Zhupan (Poz-94779) falls within a flat area of the calibration curve and thus results in a long time span; the slightly later one, on the other hand, dates a sample from Vinniki-Lisivka to the thirty-first to thirtieth century calBC (Dergachev 2022, 75).

Gordineşti group

This group appears in the literature under various names. Kruts (2012, 233) calls it the Kasperovskaya (Gordineşti) group. In the Romanian literature it is named after the sites of Horodiştea and Erbiceni (Alaiba 2004; Dumitrescu 1945). Dergachev (2022, 34) refers to it as the Gordineşti-Tsviklovtsy group. G. Sîrbu (2019) established the independent character of the Gordineşti group, assigned more sites to it belonging to a larger area, and classified it as a "culture." He started with the approximately 60 settlements between the middle course of the Dnistro and the upper reaches of the Prut river, which today corresponds to the national territory of the Republic of Moldova. Altogether, across the study region, around 120 sites are assigned to this group (Dergachev 2022, 34). Its core zone lies on the Prut, and its settlements are on both sides of the river on Romanian and Moldavian territory (Ghenadie Sîrbu, pers. comm.). More sites are known east of the Dnistro up to the southern Buh (Figure 1).

The settlement areas comprise between 0.5 and 5 ha. Ditches are evidenced for a few of them, sometimes accompanied by banks, for instance at the eponymous site of Gordineşti 2. Many of the settlements lie on naturally protected hills (Dergachev 2022, 36; Sîrbu and Król 2021). In virtually all settlements, clay platforms were found that may have provided the bases of ground-level buildings. Regarding this group (or culture), Dergachev (2022, 36) also speaks of reduced platforms as opposed to the massive burned clay deposits in the Trypillian settlements of the previous phases. Pits of various sizes and depths are likewise characteristic of these sites; some of them constitute semi-sunken dwellings.

A total of 16 burial grounds are known. The funerary practices and grave constructions are particularly heterogeneous. In the microregion Yampil, Ukraine, for example, graves were excavated from kurgans. They have been assigned to the Gordineşti group, and radiocarbon dates are available for them. Flat graves are known as well, but so far only from two sites: two graves were excavated at Gordineşti (opposite the settlement) and three at Cunicea. In addition, there are burials in settlement layers (e.g. at Tsviklovtsy, Pocrovca 5) and in settlement pits, the latter referred to as reburials (Dergachev 2022, 39).

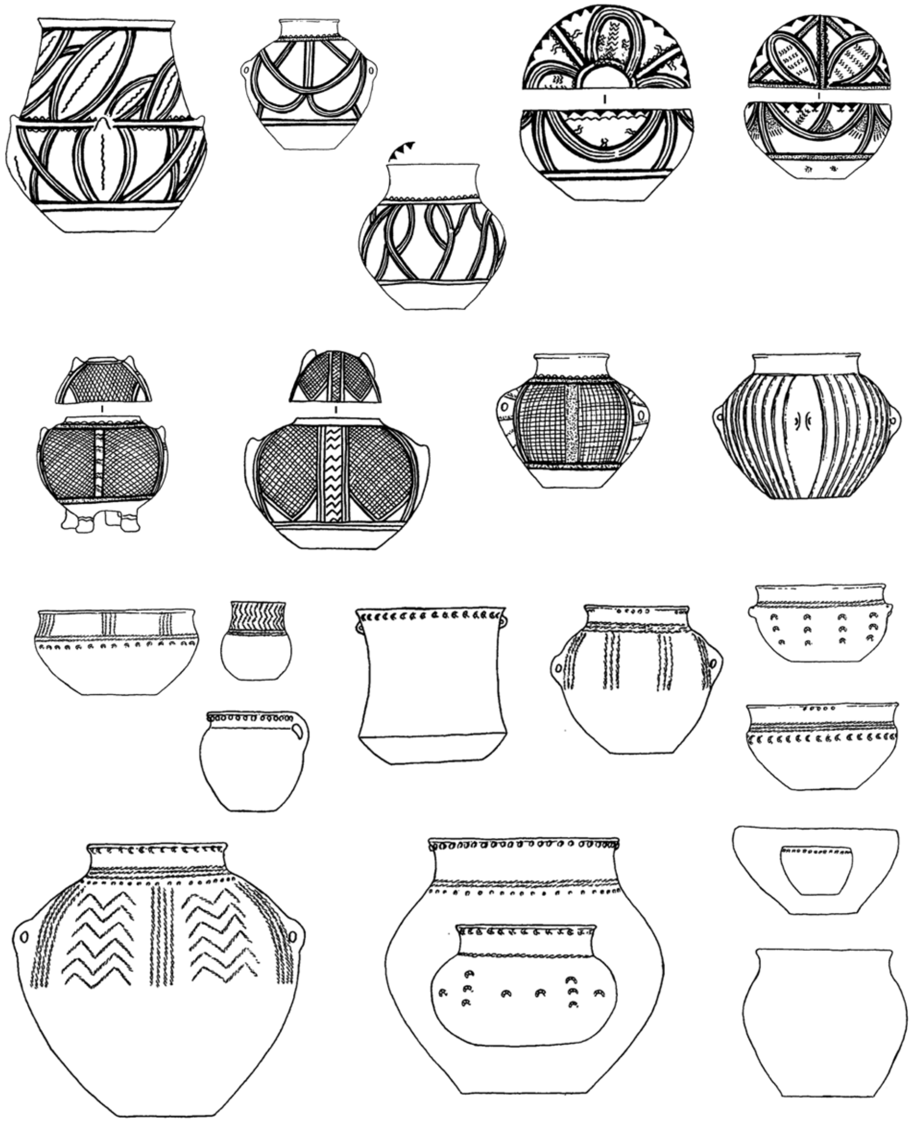
Large quantities of pottery were recovered from the settlements. Thirty percent was fine pottery, almost all of which was painted. Hemispherical bowls, pot-bellied amphorae with two opposing handles on the shoulder-wall carination, and similar types without a handle suggest traditions from older phases of the Cucuteni-Trypillian cultural complex (Dergachev 2022, 38 fig. 13). The coarse ware is tempered in various ways and of heterogeneous types, and its decoration consists of deep impressions and incisions (Figure 4a).

A fairly large number of radiocarbon dates are available (Figure 4b) for samples on human bones from graves, as well as on animal bones and plant remains from settlements. With few exceptions, the calibrated time spans fall between 3500/3400 and 3100/3000 calBC. The one distinctly later radiocarbon date was based on a sample from layer 2 of Horodiştea (Lazarovici 2010: Hd-14898, see Appendix 1), possibly a later part of the settlement or an intrusion. A total of seven graves of this group from barrow 1 at Prydnistryanske, Ukraine, have been dated (Goslar *et al.* 2015; see Poznan dates in Appendix 1). Secondary burials were placed in the same kurgan during the Yamnaya und the Catacomb cultural complex. Using Bayesian modelling, the periods of use could be identified more clearly for all the cultural entities, which resulted in 3360–3090 calBC for the Gordineşti group (Goslar *et al.* 2015, fig. 7). Thus, of the groups of the later phase of Trypillia C2, we currently have the best absolute dates for the Gordineşti group.

Ofatinţi or Vykhvatintsi group

This group was named after the site of Ofatinţi in the Republic of Moldova. For a long time, it was known under its former name, Vykhvatintsi. L. Shatilo (2021, 43 tab. 9) lists about 30 sites, but her research on the roughly 25 settlements was not very successful. The group was spread along the middle course of the Dnistro river and its tributary Răut (Figure 1). Based on the find material, the upper layer of the multiphase settlement Solonceni II has been assigned to the late phase of Trypillia C2 (Entsiklopediya 2004, 487–89). Remains of clay platforms were discovered neither here nor in the settlement of Tsiklovtsy, district Kamenets-Podolskyi, published by T. Movsha (1964). Mainly pits and the remains of a semi-sunken dwelling with hearths daubed with clay were found. Dergachev (2022, 26) and Shatilo (2021) both refer to clay platforms discovered in settlements of this group. However, so far the settlements have only been examined insufficiently, and thus the ground-level daub houses cannot be described in more detail.

Four flat-grave cemeteries have been documented, including the eponymous one (Dergachev 2022, 26). The dead lay in rectangular or oval burial pits in a crouched position, predominately on their left side (77 %) and with their heads towards the east and north-east. Both arms were usually bent, the hands placed in front of the face. With few exceptions, all graves contain grave goods, predominantly vessels, but also anthropomorphic figurines and objects made of copper alloy, bone or stone. Dergachev (2022, 28–29) divides the vessels into 50–70 % painted fine ware and complementary coarse pottery. The complex patterns on the fine pottery are predominately black or dark brown; various types have survived (Figure 5). Most of the coarse pottery is undecorated; only in the neck area, horizontal patterns were sometimes applied. So far, no radiocarbon dates are available for this group.



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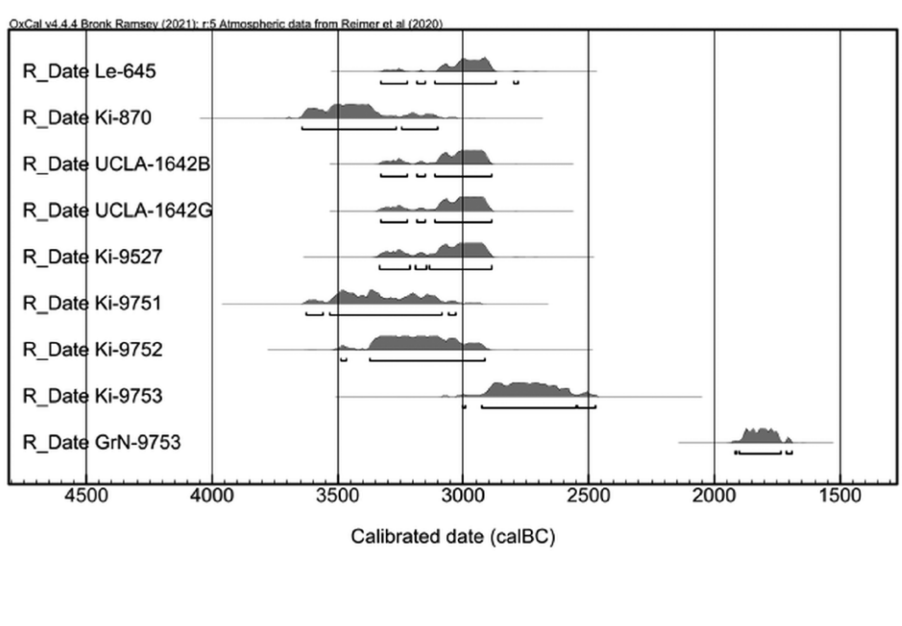
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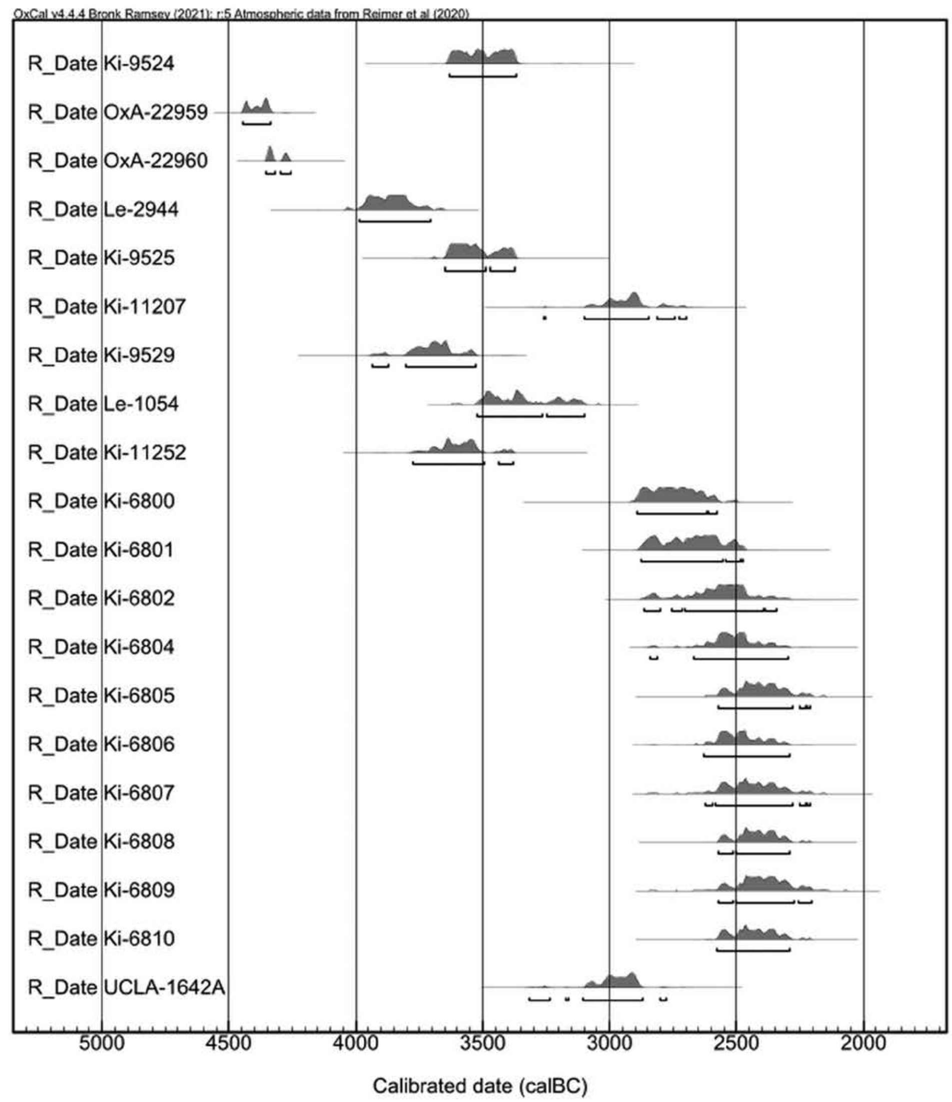


Figure 6. a) Pottery types of the Usatovo culture (Dergačev 1991, pl. 4); b) calibrated radiocarbon dates for the settlement of Mayaki; c) calibrated radiocarbon dates for burials of the Usatovo culture (dates with a standard deviation of more than ±100 years are excluded; for details, see Appendix 1).

For the late phase of Trypillia C2, more groups of types are described, such as Listvin, Sharin, Serezlievka and so on (see, amongst others, Dergachev 2022; Diachenko and Harper 2017; Shatilo 2021, tabs 9–10). Their presentation is omitted here because they are classified differently in research, for example regarding whether they can actually be considered as clearly definable cultural groups. Already when distinguishing the two groups Gorodsk and Golyshev in Volhynia, the taxonomical evaluation is not obvious. Regarding the forest steppe, this paper is therefore limited to the previously described groups, not least for reasons of space.

Archaeological groups in the grass-steppe zone

Usatovo group

The sites of the Usatovo group are located in the grass steppe between the mouth of the Dnistro flowing into the Black Sea and the Siret river, as well as north of the Danube delta (Figure 1). In total, 120 kurgan and 60 flat graves are assigned to it (Govedarica and Manzura 2011, 54). The group is named after the settlement of Usatovo-Bolshoi Kuyalnik, excavated by M.F. Boltenko during the 1920s, and later by others. A cemetery was also uncovered. From Mayaki, the other settlement assigned to this group, only the remains of a complex ditch system have been preserved (Petrenko *et al.* 2015, 46–53). The presumed inner area of this settlement was destroyed by the floods of the Dnistro river. In addition, kurgan and flat graves that were contemporaneous with the settlement were excavated in the immediate vicinity. Dergachev (2022, 89) includes Folteşti and Stoicani as settlements. They are located on the west side of the Prut river in modern-day Romania and were fortified. However, the graves are the main archaeological source even if large quantities of animal bones have been recovered from these two settlements and have been analysed (see below). All

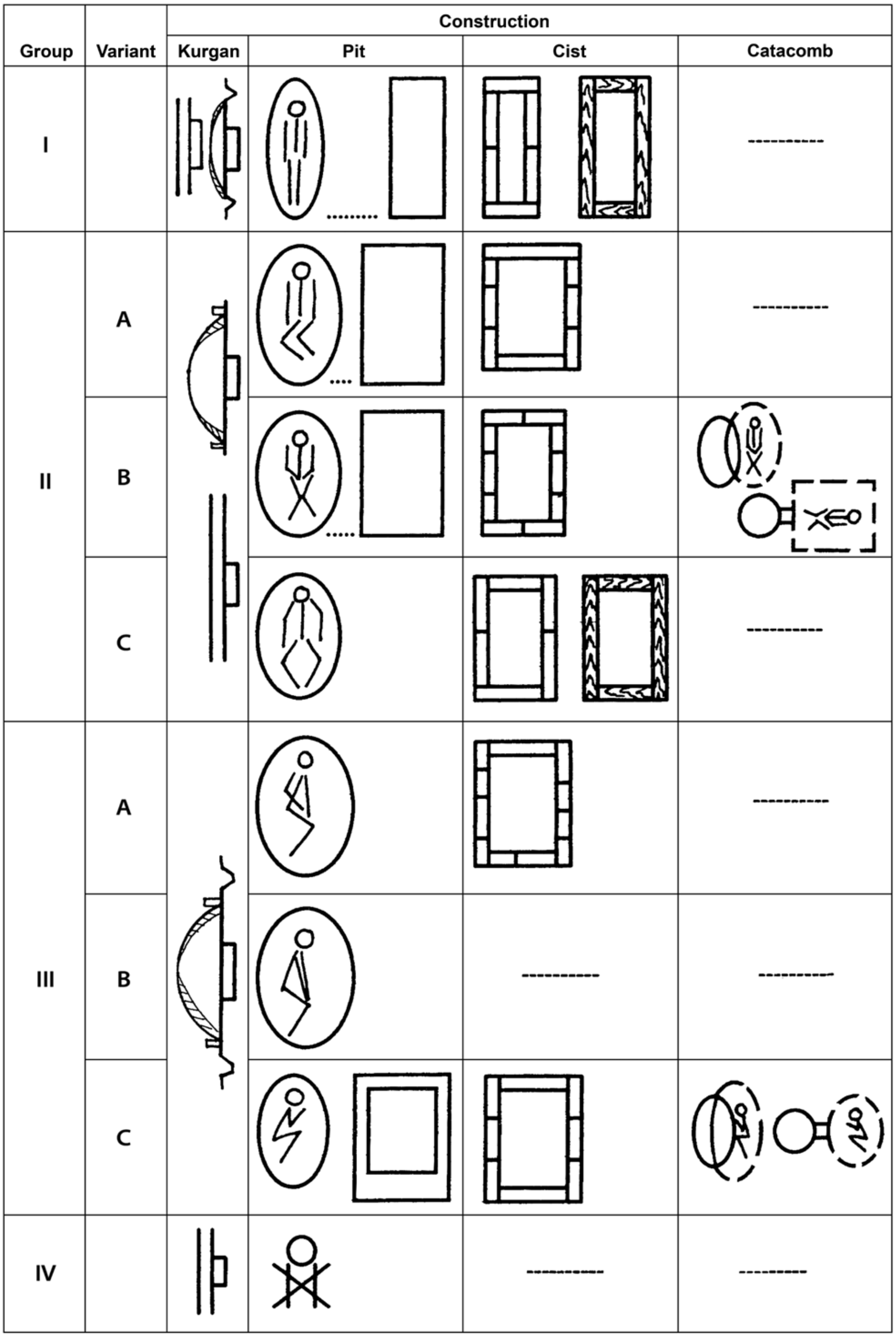


Figure 7. Classification scheme of burial rites and grave design in the northern Black Sea region during the Aeneolithic (Rassamakin 2004, fig. 1).

a

b

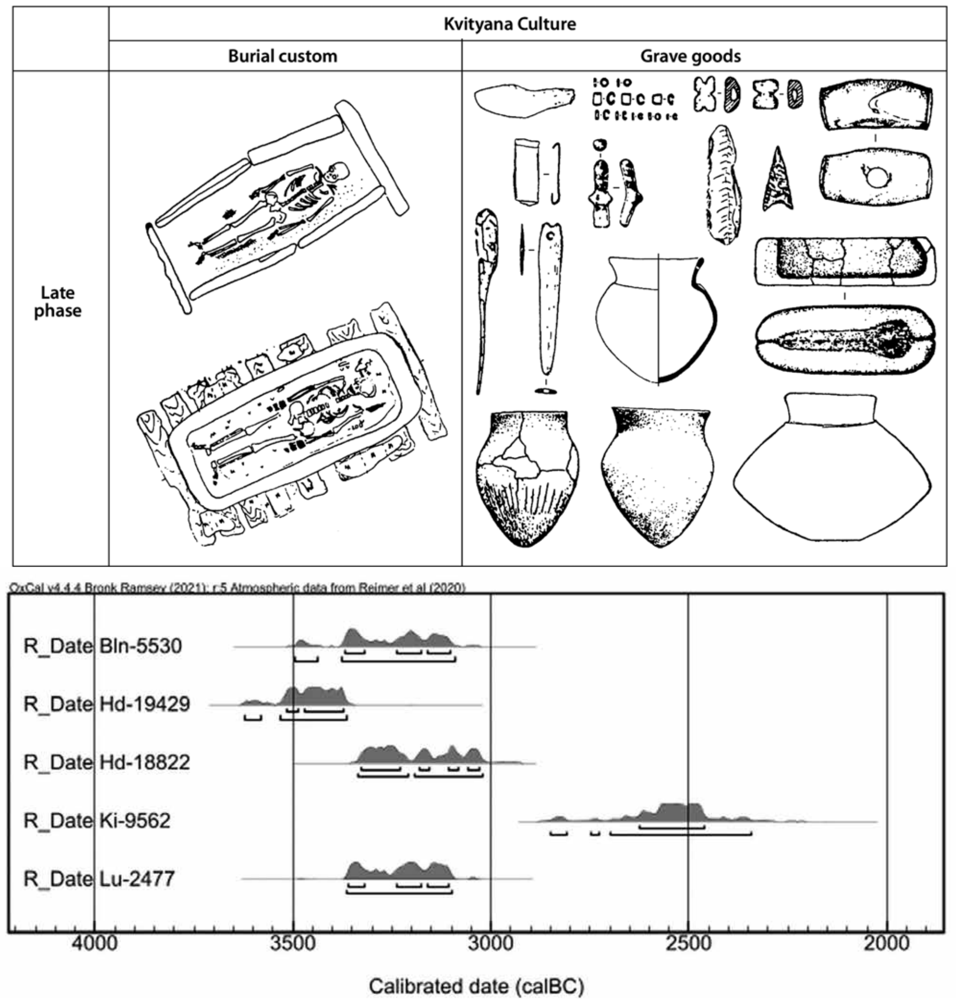


Figure 8. a) Burial rites and inventory of the Late Kvityana culture (burial tradition I according to Rassamakin 2004, fig. 115); b) calibrated radiocarbon dates for graves of burial tradition I (for details, see Appendix 1).

four settlements were located on elevated plateaus along rivers, but still differ in their preservation and structures. In Usatovo-Bolshoi Kuyalnik, numerous stone structures were uncovered. In Stoicani, the remains of two pit houses were discovered on a promontory that had fortification ditches at its open end. In Folteşti, semi-sunken dwellings were found during extensive excavations. Concentrations of sherds from the Usatovo culture and burnt daub have been interpreted as the remains of ground-level houses (Dergachev 2022, 91–94).

All graves are characterised by a specific posture of the dead, namely in crouched position, predominantly (up to 77 %) lying on the left side with their head oriented towards the east. Smaller numbers of individuals were buried lying on their back or on their right side. In these cases, their orientation was also changed to north or west, respectively (Dergachev 2022, fig. 43.4–5). The burial pits are oval to rectangular. Dergachev (2022, 98) assumes that families were buried in kurgans or groups of flat graves. Apart from several vessels, the dead were also given anthropomorphic figurines and artefacts of various materials. Around 30 % of the kurgan burials contained metal objects; in the flat graves, the percentage is somewhat lower at 12 % (Dergachev 2022, fig. 49). The types of objects vary: awls, flat axes and dagger blades were found, as well as spiral rings and beads that can be made of copper alloys or silver.

In the settlements, coarse ware makes up 90 % and fine ware 10 % of pottery finds (Kruts 2012, 243). The deceased were apparently given fine vessels much more frequently. Dergachev (2022, 111–33) stresses that simply distinguishing between fine ware in the sense of painted thin-walled pottery on the one hand, and coarse ware consisting of thick-walled undecorated vessels or vessels with impressed or incised patterns on the other, is not very useful (Figure 6a). He therefore classifies the pottery into the following categories: ten groups of various shapes and decorations for painted pottery and 11 groups for vessels made using various technologies, which he distinguishes largely based on the temper.

Numerous radiocarbon dates are available for the monuments of the Usatovo group, but the calibrated time

Figure 9. Graves of burial tradition II (Rassamakin 2004, figs 34.5–7, 36.3, 37.7).

spans significantly differ from each other in some cases (Figure 6b–c). These discrepancies are most likely caused by several effects. At least for the individuals buried at Mayaki, a reservoir effect cannot be ruled out. In one project, individuals from three kurgans were dated and, along with others, analysed for the stable isotopes carbon and nitrogen (Petrenko *et al.* 2015). Grave 2, kurgan 7 (OxA-22959) and grave 2, kurgan 9 (OxA-229960) yielded time spans between 4400 and 4200 calBC (Figure 6c). Grave 9 from kurgan 3 also showed an absolute date in the first half of the fourth millennium calBC (Petrenko *et al.* 2015, 63–69). The relatively high isotope values for nitrogen were seen as an indication of food resources from freshwater bodies that may have caused a corresponding reservoir effect.

For Figure 6b–c, only the radiocarbon ages with standard deviations of less than ±100 years were evaluated. In addition, the dates from the radiocarbon laboratory in Kyiv were not included when temper in pottery sherds had been analysed. However, neither the dates for the settlements (Figure 6b) nor the dates for the graves (Figure 6c) yield consistent time spans. A

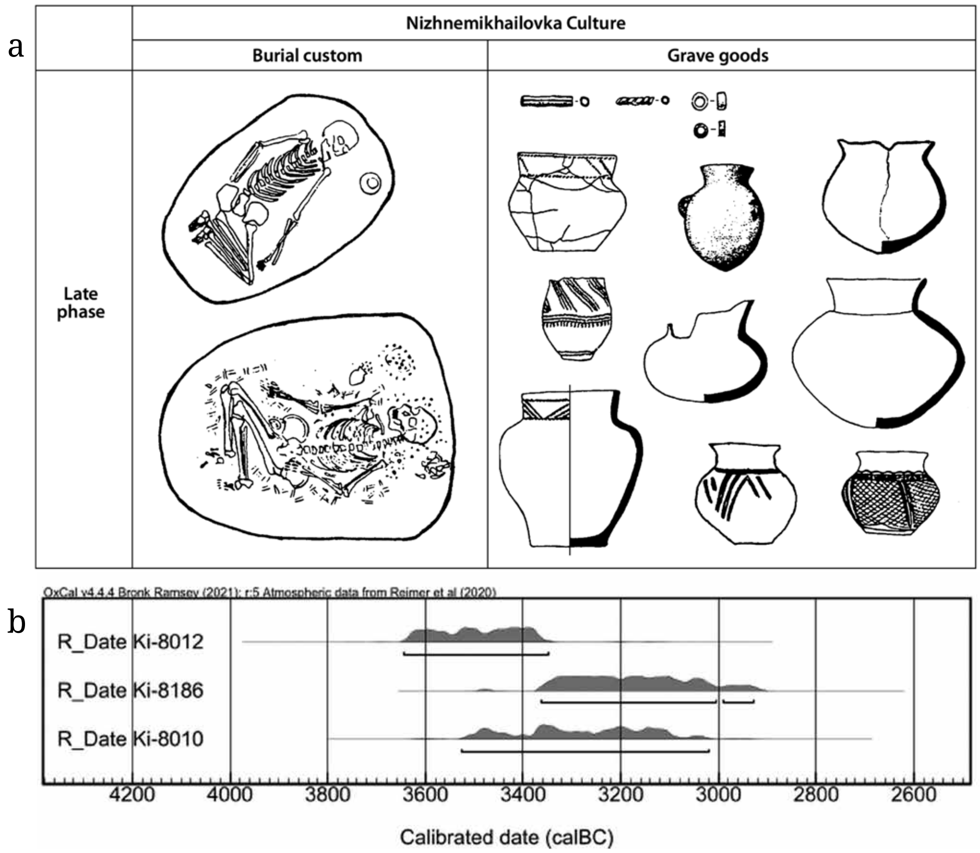


Figure 10. a) Burial rites and inventory of the late Nizhnemikhailivka culture (burial tradition III according to Rassamakin 2004, fig. 124); b) calibrated radiocarbon dates for graves of burial tradition III A–B (for details, see Appendix 1).

whole series of dates fall into the third millennium calBC (Ki-6800–6810, see Appendix 1). They stem from graves at the Akkembetskiy kurgan, district of Odessa — the archaeological material has yet to be published (Szmyt and Chernyakov 1999). The absolute dates of additional graves from this kurgan, into which secondary burials were placed at various times, correspond to the stratigraphic sequence according to M. Szmyt and I. Chernyakov (1999), but appear altogether too late.

Groups of the Final Steppe Aeneolithic

The Steppe Aeneolithic north of the Black Sea is described mainly on the basis of graves, but a few settlements are also known, some of which have been excavated. Y.Y. Rassamakin (1999; 2004) compiled and classified around 1000 graves. He distinguished four burial traditions on the basis of the criteria flat grave/kurgan burial, grave structure, position and orientation of the dead (Figure 7). During the fourth millennium BC, various burial traditions existed simultaneously. For this period, the burial traditions I and III are divided into two phases (early and late), whereas the early phase of burial tradition II dates to the fifth millennium BC, and its late phase to the fourth millennium BC (Rassamakin 1999, fig. 3.5; 2004, fig. 125). The graves of the early phase of burial tradition II correspond to the horizon of the so-called sceptre graves (Govedarica 2004), also named the Novodanilovka-Suvorovo group (Telegin 1986, 311–20; Telegin *et al.* 2001, 57–108); they will not be considered here.

Burial tradition I

Burial tradition I (group I in Figure 7) comprises graves where the dead were placed into simple oval to rectangular burial pits or stone cists in extended supine position (Figures 7, Figure 8a). The graves may have been covered with wooden beams and there are regional differences in grave design. The heads of the dead are mostly oriented towards the north-east, more rarely towards the south-west. In the grass steppe between the Don and the lower Danube river, there are noticeably more kurgan burials than flat graves, with a larger concentration on both sides of the Dnipro river and its rapids (Rassamakin 2004, figs 3–4). The graves and skeletons are often coloured with ochre. Grave goods are rare in the Steppe Aeneolithic. The extended burials contained shaped pieces of ochre, vessels with a pointed base, anthropomorphic figurines of the Serezlievka type, necklaces made of bone and copper and occasional objects made of rock, flint, copper or bone (Rassamakin 1999, fig. 3.21–22; 2004, fig. 115 top).

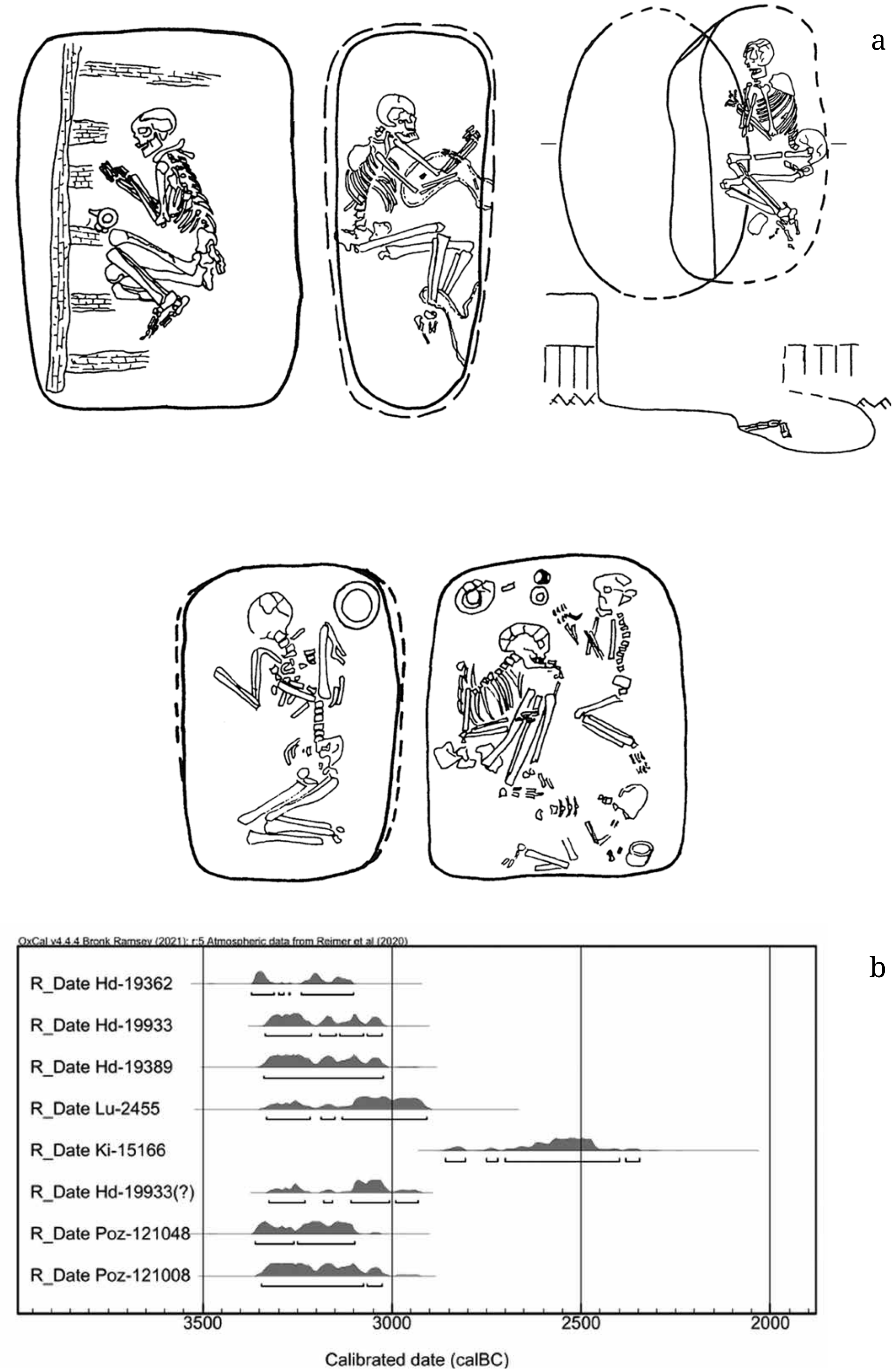


Figure 11. a) Graves of the Zhivotilovka-Volchansk culture (burial tradition III C according to Rassamakin 2004, figs 47.3, 48.1–2.5–6); b) calibrated radiocarbon dates for graves of burial tradition III C (for details, see Appendix 1).

Rassamakin assigned the extended burials to the Kvityana group (or culture, named after a burial ground at the Dnipro rapids; Figure 1). In previous research, these burials are also referred to as the post-Mariupol type (Kovaleva 1984). B. Govedarica und I. Manzura (2011, 56–58) discussed the extended burials in the north-western Black Sea region, where around 30 such grave complexes have been documented. They are mostly secondary burials in kurgans with primary burials of the Usatovo group or the preceding Cernavoda-1 culture. There are, however, also reverse sequences where a grave with an extended supine burial predates the burials of the presumed older cultural groups. In the west Pontic region, comparable observations have also been made (Alexandrov 2011), so that the relative chronological classification of the extended burials in kurgans during the Late Aeneolithic still remains open: they possibly date not only to the end of the Aeneolithic, but also to the Early Bronze Age.

So far, five radiocarbon dates for graves of burial tradition I from the northern Black Sea region are available (Figure 8b). Except for one very late date pointing to the third millennium BC, all the others fall into the second half of the fourth millennium BC (Rassamakin 2013, fig. 4) and thus correspond to the archaeological expectation. Additional insights will require more radiocarbon dates and a comparative study of this obviously widespread burial custom. Individual small settlements with Kvityana pottery are known and classified based on the comparison with pottery from graves of the same cultural group (Rassamakin 2004, 206–07 fig. 136).

Burial tradition II

Rassamakin (2004, 35–48) divided burial tradition II into four groups. Group 1 comprises 56 flat grave cemeteries with more than 312 burials (Rassamakin 2004, fig. 5). The other three groups describe kurgan burials that are distinguished according to various characteristics. Rassamakin (2004, 46) also noted that no uniform burial ritual can be identified. The only shared characteristic is the supine position with bent legs, the knees either upright, or lying on one side, or in a rhomboid position. Only the flat graves can be described consistently, thanks to additional, repeatedly occurring similarities. As already mentioned, the supine burials with bent legs can be divided into two phases, the older one dating to the fifth millennium BC. Close to the Dnipro, the relative chronology of the flat-grave cemeteries of the later phase can only be determined more specifically when vessel imports from the Cucuteni-Trypillian cultural complex are among the grave goods. However, these imports range from phase B2 to phase C2 (Rassamakin 2004, 207–08) (Figure 1). Dereivka 2, close to the settlement of the same name, is one of the cemeteries with flat graves. The problematic radiocarbon dates from the cemetery and the settlement, which was for a long time presumed to be a centre of horse domestication (Telegin 1986), have been discussed repeatedly (most recently by Rassamakin and Kaiser 2020), but a definitive explanation for the diverging absolute dates has yet to be provided.

Burial tradition III A–B

The burial tradition III A–B (group III, variants A and B in Figure 7) is characterised by the crouched position of the dead, who lay on their side with legs moderately bent at the knees and hips (Figure 10a). They were placed into oval to rectangular burial pits under or in a kurgan. The soil and the skeleton are usually heavily coloured with ochre. To achieve a large colour spectrum, various types of haematite were apparently used. The kurgans always have the same characteristic structure: they are surrounded by a ditch, and the inner kurgan consists of black earth or blocks of sod topped by a layer of clay — presumably the material from the ditch (Rassamakin 1999, fig. 3.27). The kurgan was apparently used for additional ritual acts because places for offerings containing charcoal, ash, animal bones, pottery sherds and so on were often found in the ditch or in the kurgan. During the late phase, the grave goods mainly consisted of vessels, but the graves were rarely equipped at all. In isolated cases, beads or other small pieces of jewellery were found. Some vessels were imported from Trypillia C2 groups (Rassamakin 2004, fig. 124 top).

Kurgans with graves in burial tradition III A–B are spread from the western Azov region to the lower Danube river (Figure 1). They border the distribution area of the Kvityana-group graves (burial tradition I) to the south and can mainly be found near the coast (Rassamakin 2004, fig. 9). Below the Kakhovka reservoir on the Dnipro river, there is also the settlement of Mikhailivka, which was excavated in the 1950s (Lagodovs'ka *et al.* 1955). Three layers were identified. The top layer is consistently associated with the Yamnaya cultural complex. Using three radiocarbon dates, N. Kotova and L. Spitsyna dated the middle layer to the long time span of 3600–3000 calBC (Kotova and Spitsyna 2003). They assumed this layer to be contemporaneous with Trypillia stage C1, based on imported pottery from various sites that they thought were synchronous with the middle layer. Rassamakin (2004, 201), on the other hand, dated the bottom layer of Mikhailivka to the transition from Trypillia C1 to C2. He assigned at least some of the graves of burial tradition III A–B to this layer and called it the Nizhnemikhailivka culture (nizhne = lower).

The chronological classification of the two bottom layers of this settlement is therefore contradictory. However, the settlement is important in order to understand the transregional chronology in the eastern

European steppe. Kotova und Spitsyna (2003) synchronised the find material of the middle layer of Mikhailivka with sites such as Repin in the southern Urals and the settlement of Konstantinovka on the lower Don river (see also Anthony 2001). Rassamakin (2004, 185) also recognises such references in the material that supposedly comes from an upper horizon of the middle layer. If the radiocarbon dates for the middle layer are taken as a *terminus ante quem*, the lower layer of Mikhailivka is thus to be dated before 3600/3500 calBC (Figure 10b). A more recent phase of the Nizhnemikhailivka culture could therefore hardly last until the second half of the fourth millennium BC.

Burial tradition III C

Burial tradition III C is also characterised by a crouched position of the dead on their left side, but the legs tend to be bent more at the hips than in variants A–B (Figure 11a). The arms are also bent so that the hands are in front of the upper body or the skull (Rassamakin 2004, 58). I. Manzura (2016) compiled more than 150 graves from more than 90 kurgans (Figure 1). Forty-one percent of the graves are central burials of a kurgan. Their orientation varies: the dead who lie on their left side are mostly oriented towards the south-east and east. Those who were buried on their right side often have their heads oriented towards the south (Manzura 2016, fig. 4). In addition to the rectangular and oval burial pits, there are also catacomb graves (Figure 11a). Often, the pits were covered with wooden beams. Compared with the other burial traditions, these graves are more often equipped with grave goods, i.e. in more than 71 % of the cases. Among the grave goods, pottery predominates, often representing imports or imitations. Vessels have been identified that were either in the tradition of the Maykop-Novosvobodnaya cultural complex or were comparable to those of the Trypillia C2 stage (Rassamakin 1999). However, vessels and objects reflecting other cultural traditions were also used as grave goods. This variety among the artefacts can possibly be explained by the fact that the graves were distributed over the entire northern Black Sea region, mainly in the grass steppe; a main area, however, cannot be determined (Manzura 2016, fig. 1) (Figure 1).

A total of eight radiocarbon dates are available. All but one point to a time between 3350 and 3000 calBC (Figure 11b). In contrast to the other burial traditions in the grass steppe, no settlements are known that were associated with these graves.

The graves are called the Zhivotilovka-Volchansk group. For Rassamakin (1999) and Manzura (2016), there is no question that they reflect different cultural influences that range from the Maykop-Novosvobodnaya cultural complex to the Late Trypillia culture and the Usatovo group. Manzura (2016, 71) refers to the steppe zone of this period as a "melting pot."

An epoch-making upheaval? The beginning of the Yamnaya cultural complex

This variety of archaeological cultural groups ended with the emergence of the Yamnaya cultural complex. For now, this transition cannot be described in more detail — neither chronologically, nor for individual regions — mainly due to the insufficient number of radiocarbon dates for the groups portrayed above. Presumably, there was a gradual change from a mosaic of various expressions of material culture towards a complex that is archaeologically reflected almost exclusively in the form of kurgan burials (Kaiser 2019, 24–31). The most important characteristic is the burial in a kurgan that was constructed above a central pit grave (hence the name: "yama" means "pit" in Russian and Ukrainian). In addition, numerous pit graves were dug into already existing kurgans. The deceased were buried in a crouched position on their back or side (Figure 12). The base of the grave or the buried person was usually coloured with ochre. Other attributes are found in the grave design, for example the cover made of blocks of stone, or more often of wooden beams, a step at the side, as well as plant material at the base. Only every third to fifth grave was equipped with one or two vessels. Both the percentage of burials with grave goods and the vessel types often vary considerably from region to region. The defining characteristic of this cultural complex is therefore not the pottery, but the burial custom and grave structure.

The Yamnaya cultural complex was spread from the Urals to the eastern Tisza region, as well as the eastern Balkans. Numerous regional variants have been distinguished in research, but the differences in grave structure, burial customs and grave goods are gradual in comparison to the many archaeological groups of the late fourth millennium BC. We can safely speak of a homogenisation of the material culture in the funerary sphere. Settlements have been systematically excavated mainly along the middle and lower Dnipro river, albeit in small numbers (Kaiser 2019, 107–21). Settlements are known from areas close to rivers, especially along the Dnipro. The animal bone spectra from six Yamnaya settlements examined along the Dnipro show consistent percentages of cattle (around 60 %) and sheep/goat (20–30 %). Wild animals represent less than 5 % (see below).

There are more than 300 radiocarbon dates available for the Yamnaya cultural complex (Rassamakin and Nikolova 2008). D. Diaconescu (2015) used Bayesian modelling to evaluate ^{14}C-dates of kurgan burials from the Balkans to the Azov region, for which stratigraphic observations are also available. He was thus able to date an early phase of the Yamnaya cultural complex to 3100–2900 calBC, a classical phase to 2900–2600 calBC and a late phase to 2700–2400 calBC. Some of the kurgans he analysed contained burials assigned to Final Aeneolithic

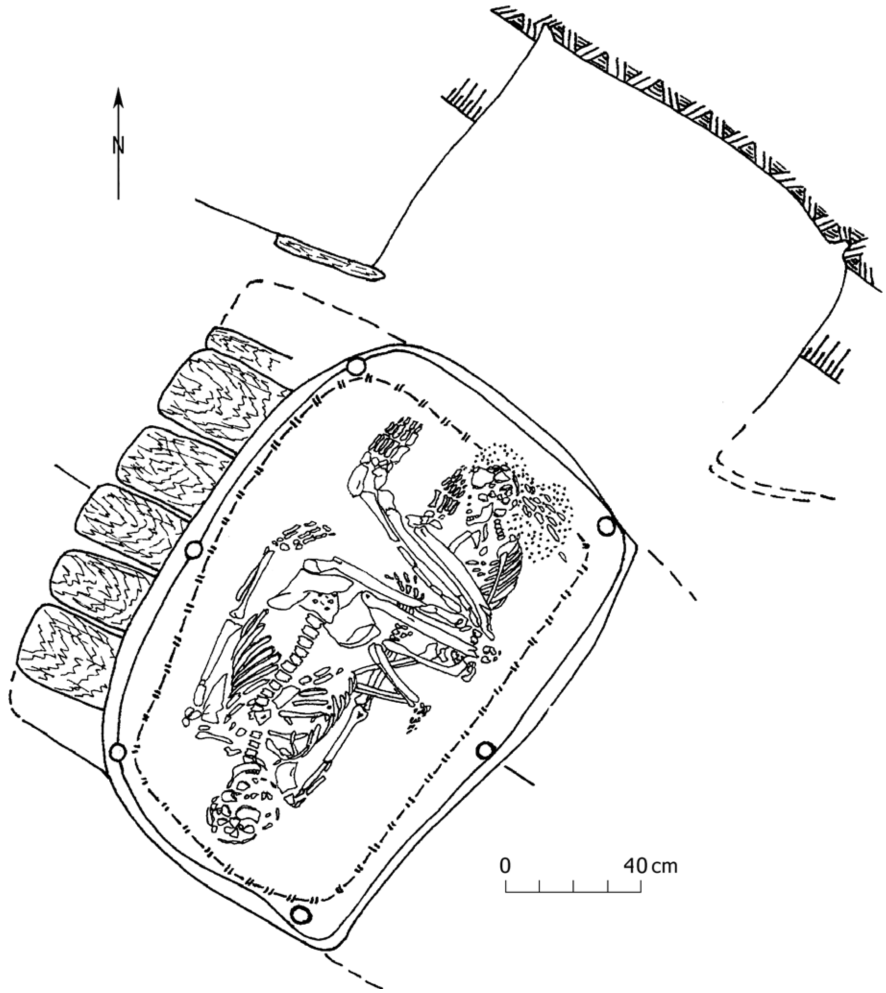


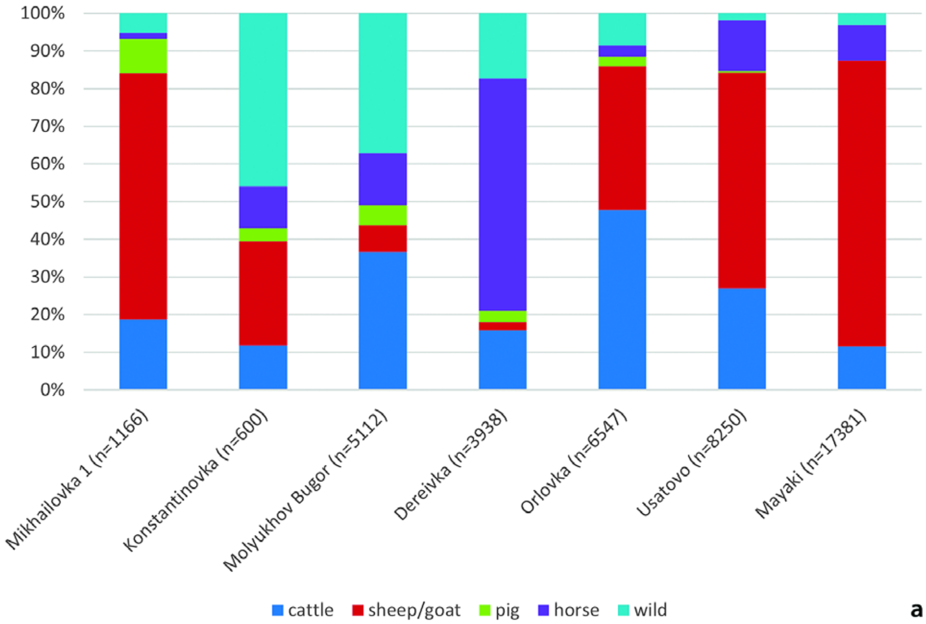
Figure 12. Grave with typical characteristics of the Yamnaya culture: Sugokleya kurgan, grave 10, in the city of Kirovohrad, Ukraine (Nikolova and Kaiser 2009, fig. 17).

groups dating to between 3400 and 3050 calBC. Based on radiocarbon dates, D.W. Anthony (2021) likewise argued for the beginning of the early phase of the Yamnaya cultural complex as early as around 3300 calBC. However, he does not provide any statistical analyses of the ^{14}C-dates but argues with typological similarities in the Nizhnemikhailivka and Repin cultures (or cultural group, see above). A better understanding of this transition from the Final Aeneolithic to the Yamnaya horizon will only be possible when more material will be published, this is especially true for the find complexes of the Repin culture.

Taking stock

The second half of the fourth millennium BC constitutes a time of upheaval. The Cucuteni-Trypillian cultural complex that had spread in the forest steppe between the eastern Carpathians and the Dnipro river eventually dissolved. It was replaced by a larger number of regionally limited cultural entities that have been evaluated very differently in research. The focus often lies on the assessment of the dissimilarities in the material remains. Continuities in the production of pottery, particularly fine ware painted in varied and complex patterns, and in the structure of houses — large rectangular clay platforms developed to so-called rudimentary platforms — were interpreted as the continuation of traditions of the Cucuteni-Trypillian cultural complex. Accordingly, a late Trypillia stage C2 was distinguished in Moldavian-Ukrainian-Russian research (Dergachev 2022). Romanian archaeology saw this differently and dates the end of the last phase, Cucuteni B2, to around the middle of the fourth millennium BC. Sites such as those of the Horodiştea-Erbiceni group were considered to be independent cultural entities. In the Republic of Moldova, however, sites with comparable remains are assigned to the Gordineşti group and are thus placed in the same tradition as the Trypillia culture.

Regardless of how strongly individual researchers emphasise the continuities in material research, the cultural border between forest and grass steppe undisputedly dissolved during that time (Manzura 2016 coins the term “broken border”). In most of the regional groups of the Late Trypillia phase C2,



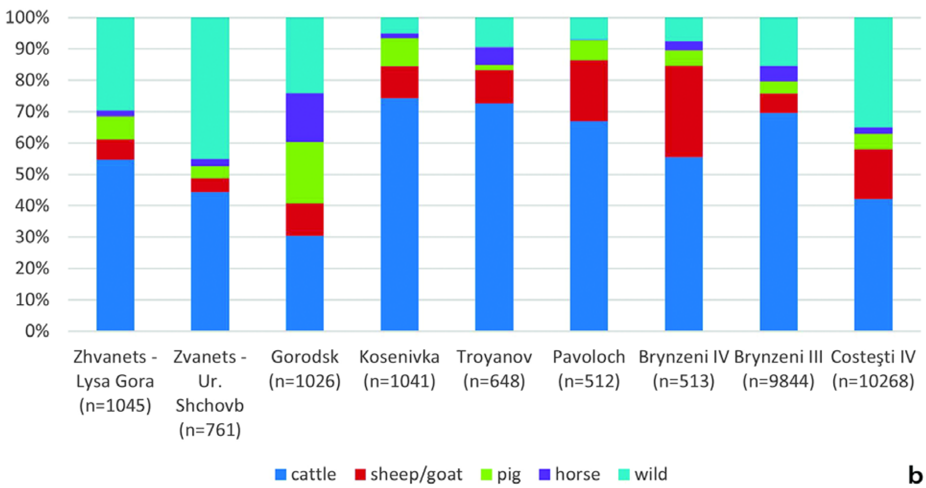


Figure 13. Faunal remains in a) Aeneolithic settlements of the grass steppe ; b) Trypillian settlements of stage C2.

graves appear again for the first time since the Neolithic. To what extent they can be attributed to influences from the Steppe Aeneolithic cannot yet be answered. Research on the Steppe Aeneolithic is extremely diverse. Various scholars have distinguished numerous cultures (or groups; for an overview, see Rassamakin 1999, tab. 3.1.). Here as well, two fundamentally different concepts can be identified: N.Y. Merpert (1974; 1991) and V.N. Danilenko (1974) interpreted the Aeneolithic graves in the eastern European steppe region as an early phase of the Yamnaya cultural complex (or cultural-historical community), thus placing them in a long-lasting tradition. Others, such as D.Y. Telegin (1985) and O.G. Shaposhnikova (1985), defined Aeneolithic cultures (or groups) and evaluated the occurrence of Yamnaya graves as a new phenomenon. Rassamakin's work, repeatedly referred to here, adheres to this concept.

Whereas the cultural borders in the northern Black Sea region of the late fourth millennium BC are archaeologically hardly discernible, they are still being stressed in research aimed at understanding cultural-historical processes, as I have already pointed out at the beginning of this paper. The publications on Trypillia C2 sites are usually limited to the forest steppe and include the Usatovo group only because painted pottery was found in its graves and settlements. Although the interactions with the forest steppe and the Late Trypillian culture are stressed in the publications on the Final Steppe Aeneolithic, their focus is on reconstructing the emergence of the Yamnaya cultural complex with its comparatively homogeneous burial rite. This is quite understandable because the Yamnaya graves indeed dominate the archaeological picture for several centuries from 3100/3000 BC onwards. First, though, the transformations preceding this cultural complex have to be described and analysed comprehensively. To do this, the entire area between the eastern Carpathians and the Don river needs to be considered. In another step, the insights have to be related to the Maykop-Novosvobodnaya cultural complex and to the archaeological cultures in the Volga-Ural region.

According to the current state of research, the main changes from 3500 BC onwards are as follows:

- In the forest steppe, the dead were buried in a way that is archaeologically identifiable again for the first time. Heterogeneous funerary practices are discernible, and in some areas kurgans were created or, in the grass steppe, existing ones re-used.
- The number and size of the settlements in the forest steppe obviously decreased. There is, however, still a lack of sufficient data to evaluate settlement patterns, the settlements' inner structure, construction designs and so on, and these still need to be compared for the individual regional groups.
- Subsistence economy can hardly be assessed based on the available data, although the osteological material from some of the settlements has been studied (Zhuravlev 2001; 2008). Figure 13b compiles the data for the settlements that have been assigned to various regional groups of Trypillia stage C2. Whether they belong to the early or the late phase of C2 is not taken into account because not all sites could be assigned to a particular phase. The percentage of horse bones is given, too. It remains an open question, however, whether these were already domesticated animals. In five of nine settlements, the percentage of wild animals is between less than 10 % and at most 20 %; hunting obviously played a minor role. In another four settlements, the bones of wild animals have higher percentages. Are the reasons for these discrepancies in the faunal spectra chronological or rather regional? We need to await additional archaeozoological studies to be published together with the excavation results of the settlements in order to gain reliable indications of possible changes in the subsistence economy of the late fourth millennium BC.
- The same applies to the few settlements of the Steppe Aeneolithic where excavations and archaeozoological studies have been simultaneously conducted (Figure 13a). Very few settlements from the grass steppe are known. Mayaki and Usatovo can be assigned to the Usatovo group for archaeologically reliable reasons despite the inconsistent absolute dates, which have already been pointed out. I have already discussed elsewhere (Kaiser 2010) whether the livestock profile of mainly small ruminants being kept at both Mayaki and Usatovo is specific to this time and for the north-western steppe region, which might thus constitute a significant change in the subsistence economy. Due to the previously described problematic absolute dating of the settlement layers, we cannot assess whether the percentages of animal bones from the lower layer of the settlement at Mikhailivka on the Dnipro river should chronologically be directly related to the two sites of the Usatovo group, or whether they are older by a few centuries. Also for other settlements from the end of the Steppe Aeneolithic, we either lack radiocarbon dates, or they differ enormously, as in the case of the Dereivka site, so that we need to assume that the sites were established and occupied at different times (Rassamakin and Kaiser 2020).
- Agriculture is another important area of the subsistence economy. Charred plant remains have survived in settlements of the Cucuteni-Trypillian cultural complex. They indicate the cultivation of certain types of grain (Pashkevych and Videiko 2006). According to Kyiv archaeobotanist G. Pashkevych, however, there was no systematic sampling by means of wet-sieving or flotation: "Carbonized grains were found in some settlements of this culture, but the record is formed mainly from pottery impressions" (Pashkevych 2003, 290). Accordingly, no quantitative analyses of the few archaeobotanical macro-remains are possible.
- The existing series of radiocarbon dates are not sufficient to reliably classify the regional groups of the Trypillia C2 stage and of the Late Steppe Aeneolithic chronologically. So far, clear discrepancies between the archaeological classification and the absolute dating are visible (Diachenko and Harper 2017). Without reliable absolute dates, it is impossible to compare the changes that took place in the late fourth millennium BC, both with each other and transregionally, and to work out spatial and chronological differences.

Conclusions

Already from 3500 calBC, distinct transformations took place in the area of distribution of the Cucuteni-Trypillia cultural complex. Their causes are still in the dark. The current state of research cannot conclusively determine whether the increasingly observed interactions with population groups in the grass steppe, the so-called Steppe Aeneolithic, are one of the causes, or whether they only developed noticeably as a result. This overview illustrates that the last centuries of the fourth millennium BC have not been studied sufficiently, and this includes all of the described archaeological groups. Each of them requires that additional sites, as far as they still exist, are excavated and analysed systematically with the help of scientific methods; above all, though, they must be reliably dated. Only on such a basis will comparisons within the respective cultural groups be possible so that the conventional definition based on pottery typologies can be supplemented with new arguments and information — and can also be changed if necessary, at least within Trypillia stage C2.

The transregional relations between the described protagonists in the eastern European steppe region constitute the next step. The contacts with the Maykop-Novosvobodnaya cultural complex, which are discernible from imports and imitations but could not be described in detail here, as well as the contacts with other cultures, such as the Globular Amphora culture, the Baden culture, and various others, will then have to be assessed on a reliable material basis, as will the formation of the Yamnaya cultural complex. Nevertheless, we can already say now that the changes in the steppe region were not caused by the formation of the Yamnaya cultural complex but had already begun much earlier.

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Appendix 1. List of radiocarbon dates presented in the article

Figure	Lab number	Site	Sample material	Radiocarbon age (bp)	calBC (95.4 %)	Literature
2b	Ki-5038	Krasnyi Khutor. Bur. 2	Cremated bone	4280 ± 110	3331–2576	Kovalyukh *et al.*1995, 138 tab. 1
	Ki-5016	Krasnyi Khutor. Bur. 6	Cremated bone	4140 ± 110	3011–2411	Kovalyukh *et al.*1995, 138 tab. 1
	Ki-5039	Krasnyi Khutor. Bur. 98	Cremated bone	4160 ± 90	2913–2476	Kovalyukh *et al.*1995, 138 tab. 1
	Ki-5012	Sofievka Bur. 1	Cremated bone	4320 ± 70	3327–2698	Kovalyukh *et al.*1995, 138 tab. 1
	Ki-5013	Sofievka cemetery 1963 (c) sq. 11	Cremated bone	4270 ± 90	3314–2577	Kovalyukh *et al.*1995, 138 tab. 1
	Ki-5029	Sofievka cemetery (a)	Cremated bone	4300 ± 45	3082–2780	Kovalyukh *et al.*1995, 138 tab. 1
	Ki-5015	Zavalovka Bur. 6	Cremated bone	4290 ± 90	3327–2586	Kovalyukh *et al.*1995, 138 tab. 1
	Ki-5014	Zavalovka Bur. 6	Cremated bone	4230 ± 80	3022–2576	Kovalyukh *et al.*1995, 138 tab. 1
3b	Ki-6752	Gorodsk settlement	Animal bone	4495 ± 45	3360–3028	Videiko 1999, 48 tab. 5
	GrN-5090	Gorodsk settlement	Shell	4651 ± 35	3499–3369	Videiko 1999, 48 tab. 5
	Ki-6747	Sandraki settlement sq. 3–7, hearth	Animal bone	4210 ± 45	2907–2633	Videiko 1999, 36 tab. 1
	Ki-6746	Sandraki settlement sq. 3–7, hollow	Animal bone	4175 ± 50	2893–2585	Videiko 1999, 36 tab. 2
3c	Poz-94779	Vynnyky-"Zhupan" settlement	Information not available	4430 ± 35	3330–2922	Dergachev 2022, tab. 1
	Poz-94779	Vynnyky-"Lysivka" settlement	Information not available	4370 ± 35	3092–2905	Dergachev 2022, tab. 1
4b	Hd-15024	Horodiștea II settlement, 1969, S. L., H1	Animal bone	4377 ± 21	3082–2914	Lazarovici 2010, 83
	Hd-14785	Horodiștea I settlement, S. L., -1.50–1.70m, pit 2	Animal bone	4495 ± 18	3340–3099	Lazarovici 2010, 83
	Hd-14898	Horodiștea III settlement, S. L., H1	Animal bone	4235 ± 30	2910–2701	Lazarovici 2010, 83
	Hd-19528	Grumezoaia, burial	Human bone	4499 ± 24	3352–3095	Lazarovici 2010, 83, 252
	Poz-83658	Gordineşti II – stînca goală settlement	*Triticum sp*.	4480 ± 35	3346–3028	Sîrbu *et al.* 2020
	Poz-83659	Gordineşti II – stînca goală settlement	*Triticum sp.*	4480 ± 35	3346–3028	Sîrbu *et al.* 2020
	Poz-83660	Gordineşti II – stînca goală settlement	*Triticum sp.*	4475 ± 35	3344–3026	Sîrbu *et al.* 2020
	Poz-81804	Gordineşti La Izvor, bur. 1	Human teeth	4460 ± 35	3342–3013	Sîrbu *et al.* 2020
	Poz-83728	Gordineşti II – stînca goală settlement	Animal bone	4430 ± 35	3330–2922	Sîrbu *et al.* 2020
	Poz-81806	Hancăuți I La Frasin settlement	Animal bone	4445 ± 35	3335–2933	Sîrbu *et al.* 2020
	Hd-17959	Hancăuți I settlement, 1986, surface IV, complex of firing pots no.1	Charcoal and wood	4621 ± 95	3634–3043	Sîrbu *et al.* 2020
	MAMS-35075	Gordineşti I, bur. 1	Human teeth	4511 ± 25	3493–3111	Sîrbu *et al.* 2020, 128 tab. 1
	MAMS-35076	Pocrovca, bur. 98	Human bone	4579 ± 25	3485–3105	Sîrbu *et al.* 2020, 128 tab. 1
	MAMS-35078	Pocrovca, bur. 98	Human bone	4560 ± 25	3489–3104	Sîrbu *et al.* 2020, 128 tab. 1

Figure	Lab number	Site	Sample material	Radiocarbon age (bp)	calBC (95.4 %)	Literature
	MAMS-35079	Pocrovca, bur. 98	Human bone	4562 ± 28	3353–3101	Sîrbu *et al.* 2020, 128 tab. 1
	Poz-66214	Pridnestryanske I, bur. 1	Wood	4640 ± 40	3521–3356	Goslar *et al.* 2015, 261 tab. 2
	Poz-66222	Pridnestryanske II, bur. 2	Wood	4655 ± 35	3518–3366	Goslar *et al.* 2015, 261 tab. 2
	Poz-66221	Pridnestryanske II, bur. 1	Charcoal	4485 ± 35	3366–2929	Goslar *et al.* 2015, 261 tab. 2
	Poz-66224	Pridnestryanske III, bur. 1	Human bone	4540 ± 35	3368–3102	Goslar *et al.* 2015, 261 tab. 2
	Poz-66225	Pridnestryanske III, bur. 2	Human bone	4530 ± 35	3506–2931	Goslar *et al.* 2015, 261 tab. 2
	Poz-71367	Pridnestryanske III, bur. 2	Wood	4510 ± 40	3359–3097	Goslar *et al.* 2015, 261 tab. 2
	Poz-66234	Pridnestryanske IV, bur. 10	Human bone	4520 ± 40	3361–3099	Goslar *et al.* 2015, 261 tab. 2
6b	Le-645	Mayaki settlement ditch 1	Charcoal	4340 ± 65	3328–2782	Petrenko *et al.* 2015, 66 tab. 2
	Ki-870	Mayaki settlement ditch 3?	Charcoal	4670 ± 100	3644–3102	Petrenko *et al.* 2015, 66 tab. 2
	UCLA-1642B	Mayaki settlement ditch 1?	Charcoal	4375 ± 60	3328–2899	Petrenko *et al.* 2015, 66 tab. 2
	UCLA-1642G	Mayaki settlement ditch 1?	Charcoal	4375 ± 60	3328–2899	Petrenko *et al.* 2015, 66 tab. 2
	Ki-9527	Mayaki settlement ditch 4	Animal bone	4380 ± 70	3333–2899	Petrenko *et al.* 2015, 66 tab. 2
	Ki-9751	Mayaki settlement ditch 1	Animal bone	4600 ± 90	3627–3030	Petrenko *et al.* 2015, 66 tab. 2
	Ki-9752	Mayaki settlement ditch 1	Animal bone	4490 ± 90	3491–2914	Petrenko *et al.* 2015, 66 tab. 2
	Ki-9753	Mayaki settlement	Animal bone	4180 ± 90	3005–2476	Petrenko *et al.* 2015, 66 tab. 2
6c	OxA-22959	Mayaki kurgan 7, bur. 2	Human bone	5530 ± 32	4446–4336	Petrenko *et al.* 2015, 59
	OxA-22960	Mayaki kurgan 9, bur. 2	Human bone	5471 ± 24	4357–4257	Petrenko *et al.* 2015, 60
	Le-2944	Mayaki kurgan 3, bur. 9	Human bone	5080 ± 60	3982–3712	Petrenko *et al.* 2015, 66 tab. 2
	Ki-9524	Aleksandrovskiy к., bur. 35	Human bone	4720 ± 70	3634–3371	Petrenko *et al.* 2015, 66 tab. 2
	Ki-9525	Aleksandrovskiy к., bur. 22	Human bone	4760 ± 70	3647–3372	Petrenko *et al.* 2015, 66 tab. 2
	Le-1054	Dancu 2, bur. 2	Charcoal	4600 ± 80	3524–3101	Petrenko *et al.* 2015, 66 tab. 2
	Ki-11252	Utkonosovka, kurgan 3, bur. 2	Charcoal	4830 ± 70	3773–3378	Petrenko *et al.* 2015, 66 tab. 2
	Ki-6800	Akkembetskyi sacrifice	Animal bone	4170 ± 60	2893–2581	Szmyt and Chernyakhov 1999
	Ki-6801	Akkembetskyi sacrifice	Animal bone	4045 ± 65	2875–2476	Szmyt and Chernyakhov 1999
	Ki-6802	Akkembetskyi bur. 6	Human bone	4020 ± 65	2863–2344	Szmyt and Chernyakhov 1999
	Ki-6803	Akkembetskyi bur. 6	Human bone	4090 ± 60	2872–2476	Szmyt and Chernyakhov 1999
	Ki-6804	Akkembetskyi bur. 9	Human bone	3990 ± 60	2842–2296	Szmyt and Chernyakhov 1999
	Ki-6805	Akkembetskyi bur. 10	Human bone	3930 ± 55	2574–2209	Szmyt and Chernyakhov 1999
	Ki-6806	Akkembetskyi bur. 7	Human bone	3975 ± 55	2630–2293	Szmyt and Chernyakhov 1999
	Ki-6807	Akkembetskyi bur. 7	Human bone	3950 ± 60	2622–2209	Szmyt and Chernyakhov 1999
	Ki-6808	Akkembetskyi bur. 7	Human bone	3935 ± 45	2571–2290	Szmyt and Chernyakhov 1999
	Ki-6809	Akkembetskyi bur. 23	Human bone	3920 ± 60	2572–2206	Szmyt and Chernyakhov 1999
	Ki-6810	Akkembetskyi bur. 24	Human bone	3945 ± 50	2575–2290	Szmyt and Chernyakhov 1999
	UCLA-1642A	Usatovo, kurgan 1, bur. 12 (?)	Charcoal	4330 ± 60	3319–2777	Petrenko *et al.* 2015, 66 tab. 2

Figure	Lab number	Site	Sample material	Radiocarbon age (bp)	calBC (95.4 %)	Literature
8b	Bln-5530	Rostov, Verloletnoe Pole, kurgan 1, bur. 8	Human bone	4556 ± 50	3496–3093	Rassamakin 2011, Fig. 10a
	Hd-19429	Orekhov, Tarasova mog., bur. 6	Human bone	4673 ± 44	3622–3363	Rassamakin 2011, Fig. 10a
	Hd-18822	Orekhov, Tarasova mog., bur. 33	Human bone	4460 ± 30	3337–3021	Rassamakin 2011, Fig. 10a
	Ki-9562	Oleksandrivka, kurgan, bur. ?	Human bone	4010 ± 60	2852–2343	Rassamakin 2011, Fig. 10a
	Lu-2477	Sărăteni, kurgan 2, bur. ?	Human bone	4530 ± 40	3367–3098	Rassamakin 2011, Fig. 10a
10b	Ki-8012	Mikhailivka 2nd layer, -2.06 m	Animal bone	4710 ±80	3646–3348	Kotova and Spitsyna 2003
	Ki-8186	Mikhailivka 2nd layer, -1,08–1.26 m	Animal bone	4480 ± 70	3364–2929	Kotova and Spitsyna 2003
	Ki-8010	Mikhailivka 2nd layer, -1.08–1.26 m	Animal bone	4570 ± 80	3526–3021	Kotova and Spitsyna 2003
11b	Hd-19362	Bursuceni, kurgan 1, grave 20	Human bone	4548 ± 28	3370–3103	Rassamakin 2011, Fig. 12a
	Hd-19933	Bursuceni, kurgan 1, grave 21	Human bone	4462 ± 22	3334–3026	Rassamakin 2011, Fig. 12a
	Hd-19389	Crasnoe kurgan 9, grave 10	Human bone	4467 ± 34	3340–3026	Rassamakin 2011, Fig. 12a
	Lu-2455	Sărăteni, kurgan 4, grave 8	Human bone	4410 ± 50	3331–2909	Rassamakin 2011, Fig. 12a
	Ki-15166	Vynohradne Kurgan 2, grave 4	Human bone	4020 ± 60	2858–2347	Rassamakin 2011, Fig. 12a
	Hd-19933(?)	Crasnoe kurgan 9, grave 17	Human bone	4434 ± 23	3326–2930	Rassamakin 2011, Fig. 12a
	Poz-121048	Cimişlia, bur. 6	Human bone	4520 ± 35	3361–3099	Popovici and Kaiser 2021
	Poz-121008	Cimişlia, bur. 8	Human bone	4475 ± 35	3344–3026	Popovici and Kaiser 2021

The arrival of the Corded Ware in eastern Switzerland

A settlement archaeological view

Niels Bleicher

Abstract

I test the hypothesis whether the arrival of the Corded Ware phenomenon in eastern Switzerland caused visible changes in the settlement system that we might interpret as a sign of the sudden arrival of new traditions. For this, I use mainly evidence of dendroarchaeological pile field analyses at lakes Zurich, Constance and Zug. In fact, with the arrival of the Corded Ware we find new spatial patterns in settlement ground plans that are markedly different from the earlier concept of social space, which was dominant for a number of centuries in a large area. However, changes in social space and architecture happen already a century before the arrival of the Corded Ware in the study area, and in some instances the older spatial pattern persists well into Corded Ware times. Settlement durations and relocation dynamics change only gradually, but seem to keep their general character. Altogether, one can state that upon arrival, bearers of the Corded Ware phenomenon met a society that was already changing and took up new inspirations while keeping a number of traditions.

Keywords: lakeside settlements, northern Alpine Foreland, settlement dynamics, social space, dendroarchaeology

Introduction

Recent years have seen genetic results based on Late Neolithic human bones that have given rise to the hypothesis that the spread of what is widely known as the Corded Ware culture involved the migration of people from eastern European steppe areas into central Europe. This seems to have caused a relatively intense genetic shift (e.g. Haak *et al*. 2015). Notably, the results suggested that predominantly male individuals migrated and that they were extraordinarily successful in passing on their genes, which gave rise to inspiring and colourful archaeological interpretations (Kristiansen *et al*. 2017). This narrative has since been challenged and criticised (e.g. Furholt 2018; 2021) and especially the lack of reflection on the actual meaning of genetic data was debated (e.g. Frieman and Hofmann 2019). However, these "steppe" genetic signatures have also been found in Switzerland close to the lake shores (Furtwängler *et al*. 2020). Consequently, the question arises how the cultural change from what was often called "Horgen culture" to the "Corded Ware culture" around 2770 BC

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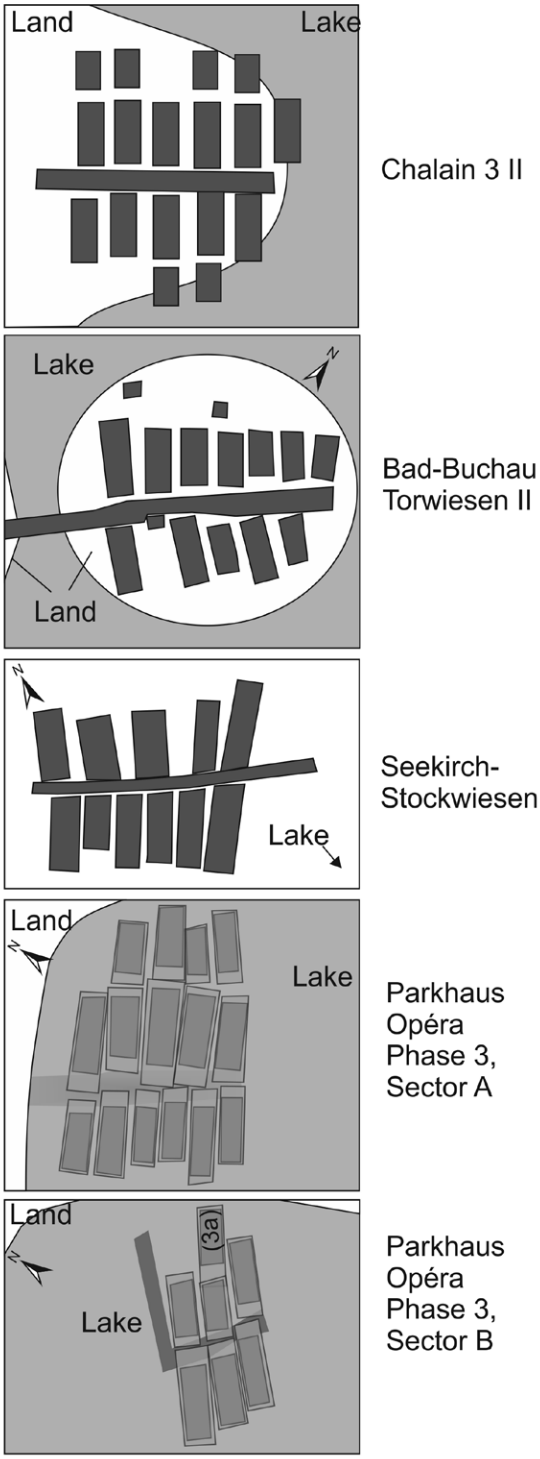

Figure 1. Examples of the "traditional" pattern of social space (Bleicher and Harb 2018).

(Harb 2016) actually took place and whether there are indications that it involved some kind of disruption that could be interpreted as a sign of a sudden advent of new individuals bringing with them — and quickly establishing — new customs.

Material and methods

For this study, I will focus on settlement archaeological data based on dendroarchaeological analyses. These are mainly the results of pile field analyses from lakeside settlements that have been studied in recent years. Those that I will focus on most are situated on the shores of lakes Zurich and Zug, as well as lake Constance (Table 1). Pile field analysis involves a systematic process of iterative dendrochronological testing of archaeological hypotheses on non-random pile arrangements. The method has been described in detail in Bleicher and Burger (2015) and in Bleicher (2015a). In optimal cases, pile field analysis gives results concerning the social space and architecture of the site in question, even though I have argued earlier that the pile arrangements probably mirror only the carrying structure of the buildings and give little information on what was built on this structure or how (Bleicher 2015b).

The rationale of applying these methods to the question of cultural change is as follows: I hypothesise that societal worldviews, social rules and relations are mirrored in the structure of social space. They may also be expressed by means of architecture and carry over into economic choices, which in turn may affect the duration and rhythm of presence and absence at a certain location. We thus might expect changes in spatio-temporal behaviour, i.e. the dynamics of how often and how far people relocate their habitations. Therefore, I test the hypothesis that the arrival of the Corded Ware phenomenon involved disruptive changes in architecture, settlement relocation and especially in social space by tracking and dating actual changes in these aspects in the dataset.

Results

Pile field analysis of Zurich-Parkhaus Opéra has revealed four Horgen period settlement episodes between 3234 and 3055 denBC (all denBC-dates in this article are based on the historical calendar without a year zero). Their dominant settlement structure comprises parallel two-aisled buildings arranged in lines with their narrow sides oriented towards the lake. For the second settlement phase around 3170 denBC, three settlement quarters could be distinguished, with each repeating a spatial pattern that is well known from bog settlements in France and Upper Swabia (Bleicher and Harb 2018). This consists of two lines of parallel buildings forming a central alley. In several cases, there were groups of

Site	Country	Canton / County	Literature
Zurich-Parkhaus Opéra	CH	Zurich	Bleicher and Burger 2015
Zurich-Mozartstrasse	CH	Zurich	Bleicher 2015a
Zurich-Seefeld	CH	Zurich	Bleicher and Walder 2019
Wädenswil-vorder Au	CH	Zurich	Bleicher 2019a
Meilen-Schellen	CH	Zurich	Altorfer and Conscience 2005
Hombrechtikon-Feldbach west	CH	Zurich	Ebersbach *et al*. 2016
Allensbach-Strandbad	D	Baden-Württemberg	Billamboz 2015
Hornstaad	D	Baden-Württemberg	Billamboz 2006
Sipplingen-Osthafen	D	Baden-Württemberg	Billamboz *et al*. 2010
Steinhausen-Sennweid	CH	Zug	Ruoff 2007
Cham-Bachgraben	CH	Zug	Bleicher *et al*. 2023
Immensee-Dorfplatz	CH	Schwyz	Bleicher *et al.* 2021
Pestenacker	D	Bavaria	Schönfeld 2009

Table 1. Sites with pile fields or dendro-data covered in this article.

larger houses standing along the central trackway, while smaller buildings stood in a second row without direct access to the central axis (Figure 1).

A similar pattern was also found in neighbouring sites, although it is less clear, possibly because the pile field analyses were confronted with methodological problems at these sites (Bleicher 2015a; Bleicher and Walder 2019). Furthermore, this spatial pattern was also identified at lake Zug in Cham-Bachgraben (Bleicher *et al*. 2023) and in Küssnacht-Immensee Dorfplatz (Bleicher *et al*. 2021). It has predecessors on the shores of lake Constance as early as 3860 BC (Billamboz 2006) and others as far away as Bavaria that are several hundred years earlier than the Horgen sites in Zurich (Schönfeld 2009). The pattern is known in western Switzerland from the early thirty-sixth century BC onward (Suter and Schlichtherle 2009) and there are numerous further examples. The meaning of this spatial pattern is not yet well researched. For the purpose of this article, it suffices to say that this pattern was a widespread, if not the dominant traditional model of social space in the northern Alpine foreland for at least 1000 years, until the Corded Ware phenomenon arrived.

However, even before this arrival, we already see noteworthy changes in architecture and spatial organisation. While the traditional spatial model persisted until around 2900 BC at Allensbach-Strandbad on the shore of lake Constance in southern Germany (Billamboz 2015; Braun 2015), we find a completely altered spatial pattern in Zurich-Parkhaus Opéra phase 6 in 2887 BC (Figure 2) (Bleicher and Burger 2015). The strict organisation into rows of parallel two-aisled houses oriented towards a central alley has been abandoned, and we instead find houses that can be turned by 90° from the main direction, with no trace of a central alley. The structures are not perfectly clear, but it seems possible that there are even three-aisled buildings. At roughly the same time, at lake Zug in Steinhausen-Sennweid (ZG), we find a row of square buildings (Ruoff 2007) measuring some 5 × 3.75 m. These are clearly different from the two-aisled buildings that we know from Horgen sites and they are also clearly distinguishable from the small huts in the second row that we know from Horgen sites such as Bad Buchau-Torwiesen 2 (Bleicher 2009). Therefore, the changes in layout and building size are two remarkable introductions into the settlement concept and they arrive some 100 years before the Corded Ware phenomenon is attested in our study area.

The oldest dendro-dates that are most likely to be connected with Corded Ware ceramics are from Pfäffikon-Irgenhausen (ZH) and testify to building activity around 2765 denBC (Altorfer 2010, 251). Starting around 2753 denBC, we also have a ground plan of buildings associated with Corded Ware ceramics at Zurich-Parkhaus Opéra. Here, we find large, three-aisled buildings both parallel and at 90° to each other (Figure 3). Furthermore, we find clearly distinct smaller buildings, as well as a relatively large structure with a square layout (Bleicher and Burger 2015). At the neighbouring site of Zurich-Mozartstrasse, in the settlement phase dating to the years between 2605 and 2568 BC, we encounter several further examples of these square buildings and most interestingly, these are accompanied by several buildings with ground plans with two, three or even without any visible aisles (Bleicher 2015). Again, they are arranged either parallel or at 90° to each other. In this

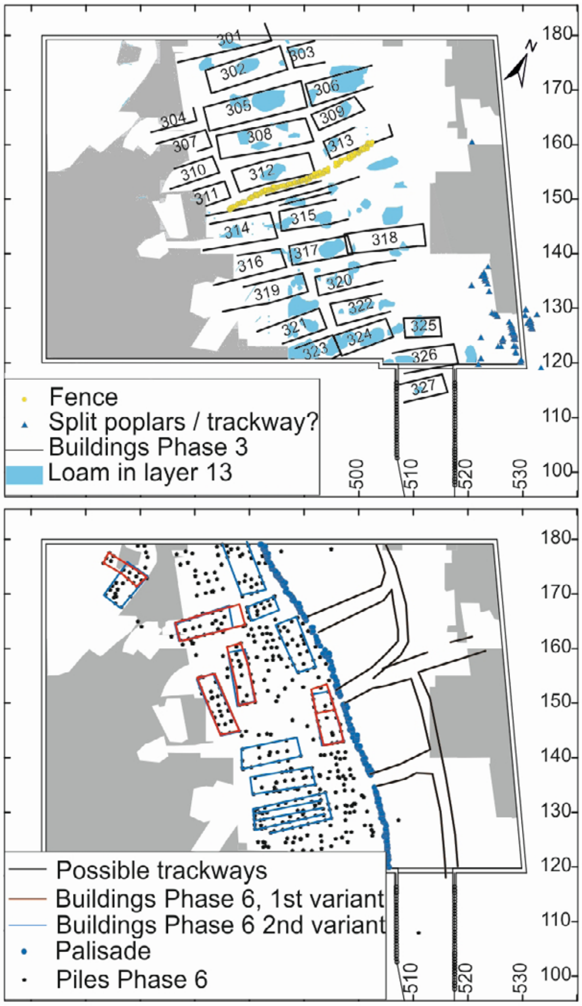

Figure 2. Comparison of developed and late Horgen settlement ground plans in Zurich-Parkhaus Opéra (graphic: N. Bleicher).

somewhat more complete settlement ground plan, two parallel alleys or trackways are visible, entering the site from the shore.

A few hundred metres further south, several parts of the settlement at Zurich-Seefeld were investigated in a series of excavations in recent decades and the site has been dendro-dated to the decades between 2717 and 2675 denBC. Here, we find a similar structure with longer and smaller two-aisled buildings and a square building arranged in a row. Trackways lead to them from the shore (Bleicher and Walder 2019, 201). This new spatial pattern is not restricted to the city of Zurich, as a similar arrangement of a two-aisled and a square building is known in Wädenswil-Vorder Au (ZH), dated to 2570 denBC (Figure 4) (Bleicher 2019a; Wehrle 2021). Square buildings are also known from Meilen-Schellen (ZH), dating to 2560 denBC (Altorfer and Conscience 2005). One example from lake Constance has been recorded in Maurach-Ziegelhütte (D), dating to 2668–2666 denBC (Billamboz and Köninger 2008). This building is also interesting because its piles follow no clear organisation into aisles or rows, similar to the mentioned buildings in Zurich-Mozartstrasse.

However, it is also in Corded Ware settlements that we find examples of the older settlement pattern persisting far into the middle third millennium BC. A classic example of the two rows of parallel double-aisled buildings with a central trackway is Hombrechtikon-Feldbach West (ZH), dating to around 2520 denBC (Figure 5) (Bolliger 2013; Ebersbach *et al.* 2016). A second example is the Corded Ware phase of Cham-Bachgraben (ZG), where yet again the same old settlement ground plan was repeated between around 2550 and 2440 denBC (Bleicher *et al.* 2023). In the latter case, it should be noted that the temporal structure of the settlement is not understood, because the dendrochronological analyses revealed a wide variety of end years without a peak in the distribution frequency that would allow identifying a certain year as the date of building erection.

A further aspect that we can compare is the spatiotemporal settlement behaviour of Corded Ware communities as compared to earlier Late Neolithic groups. Both the settlements in Mozartstrasse and in Zurich-Seefeld had a duration of about 40 years, which is notably longer than the normal settlement duration in Horgen times, which was mostly around eight to 15 years and only rarely reached some 25 years (Bleicher 2009; Bleicher and Walder 2019, 182; Ebersbach 2010). On the other hand, the late Horgen phase of Sipplingen-Osthafen gave evidence of houses that were in use for up to 60 years (Billamboz *et al.* 2010).

A more detailed analysis of settlement relocations in the city of Zurich shows that in the late fourth millennium, settlements were not only frequently relocated, with low individual settlement durations, but people also often chose to establish several settlements in close proximity (Figure 6). In 3204 denBC, for example, there were four separate sites at distances of just a few hundred metres from each other. Interestingly, the Corded Ware settlers in Zurich still moved around the shore, and there are still very short settlement phases of only some eight years. In contrast, other settlements were in use for several decades and we have so far found fewer examples of several contemporaneously occupied sites separated by very small distances (Figure 7).

A similar aspect of separation are fences that run through settlements. These are, again, a feature that is already known in Horgen times and persists well into Corded Ware times. A fence between settlement quarters was documented in Zurich-Parkhaus Opéra both in a thirty-second century BC Horgen village and a twenty-eighth century BC Corded Ware settlement (Bleicher and Burger 2015), but a similar construction was also found in Wädenswil-vorder Au in a settlement from the twenty-

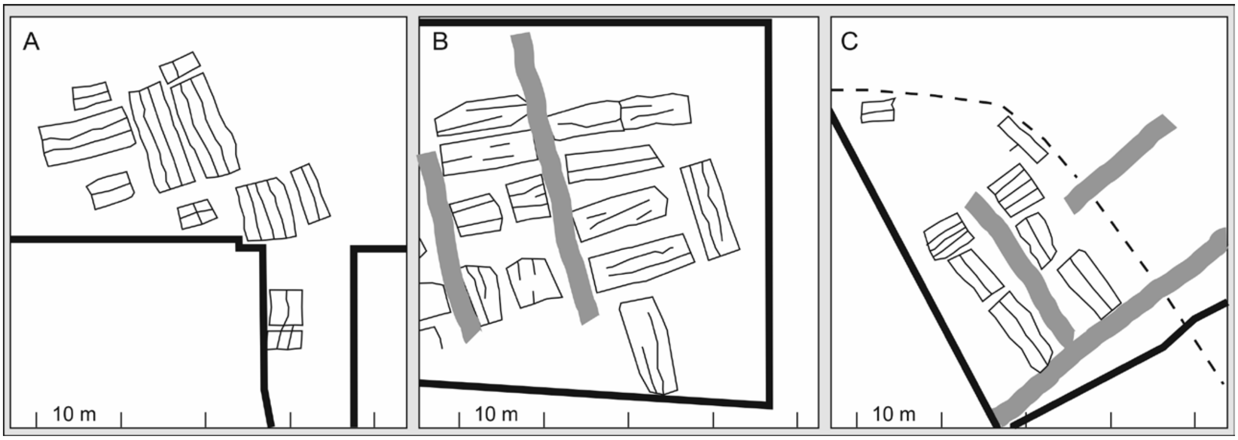

Figure 3. Comparison of three Corded Ware settlements in Zurich. a) Parkhaus Opéra, phase 7 (2753–2747 denBC); b) Mozartstrasse (2605–2568 denBC); c) Pressehaus (2717–2675 denBC). Bold black lines show the edges of excavation; the dashed line indicates the edges of the settlement. Gray bars indicate trackways (from Bleicher 2019b, fig. 408).

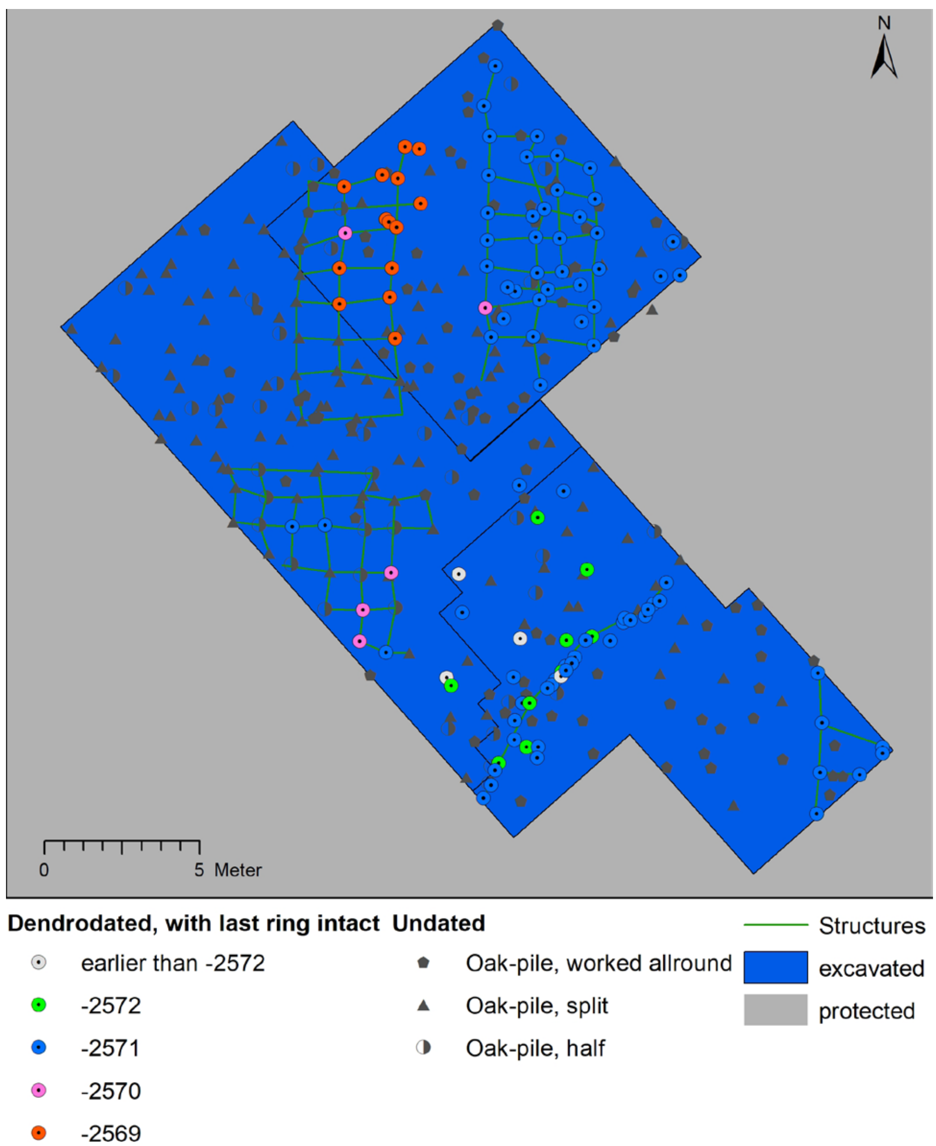

Figure 4. Excavation plan and distribution of piles in the settlement of Wädenswil-Vorder Au (from Bleicher 2019a).

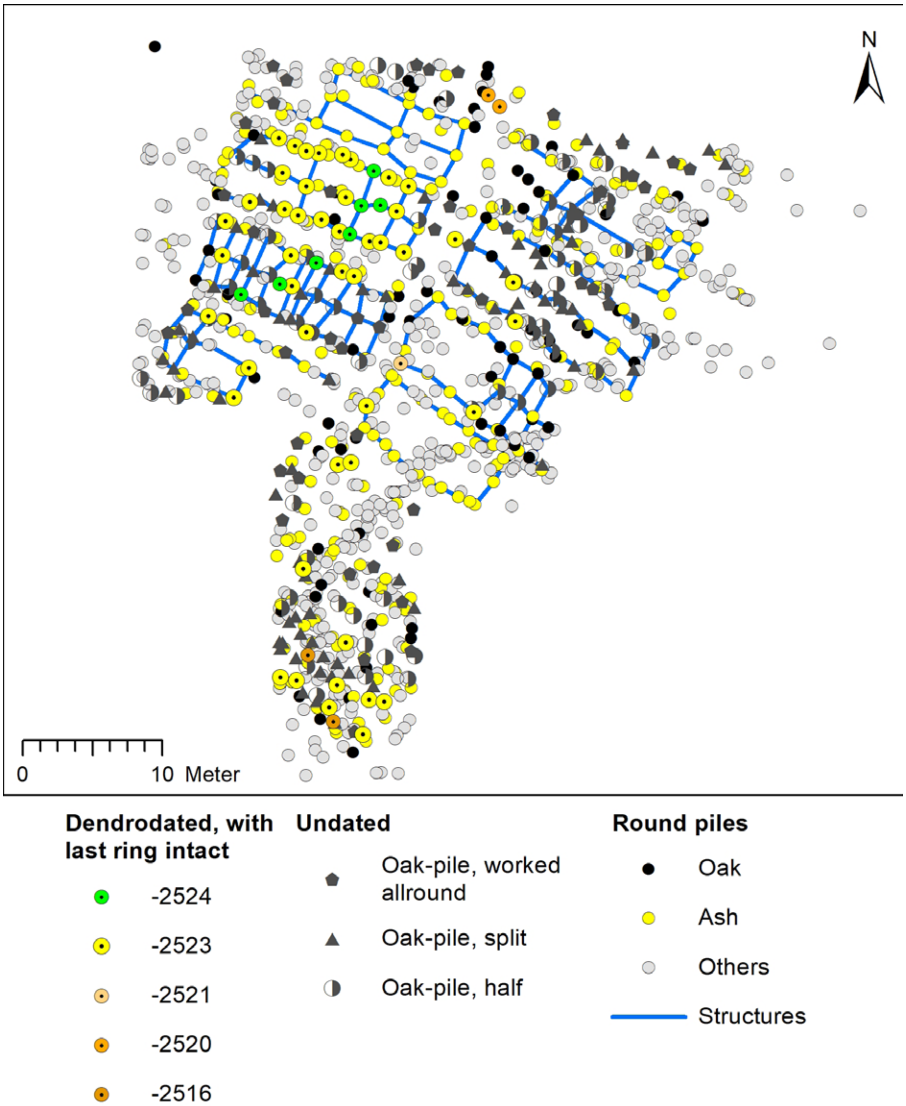

Figure 5. Settlement ground plan of Hombrechtikon-Feldbach West (after Bolliger 2013).

sixth century BC (Wehrle 2021, fig. 4). Thus, in both periods tools for structuring social space and balancing social relations by physical co-localisation and differentiation were available.

Discussion

The arrival of the Corded Ware phenomenon is associated with a new concept of social space in our area, involving a different way of arranging buildings to form a settlement. However, a local and internal development, breaking up earlier Horgen culture spatial patterns, had already begun at least a hundred years before the arrival of the Corded Ware phenomenon. What is more, one of the key features of the new pattern is the square building, which is documented in Steinhausen-Sennweid a full century before the arrival of the Corded Ware in the Zurich region. So, while it is with the arrival of the Corded Ware phenomenon that the new pattern is clearly visible, and repeated in several places and across centuries, the development leading to it actually began much earlier. Most interestingly, the earlier spatial pattern was not abandoned completely but stayed in use for centuries.

The seemingly unstructured or aisle-less buildings with densely set piles are certainly a new element that appears during Corded Ware times. But since two-aisled buildings with a clear central post row continued to be built, this element cannot be taken as indication that there were new settlers who did not know how to build houses in the shallow water. It is probably only a different technical solution for the construction of a foundation. This may have made lower demands on construction timbers in terms of length and straightness. Certainly, these pile constructions support the view, mentioned above, that the piles only carried the platform on which the buildings were erected. What they looked like and whether there was actually a change in architecture is probably impossible to reconstruct.

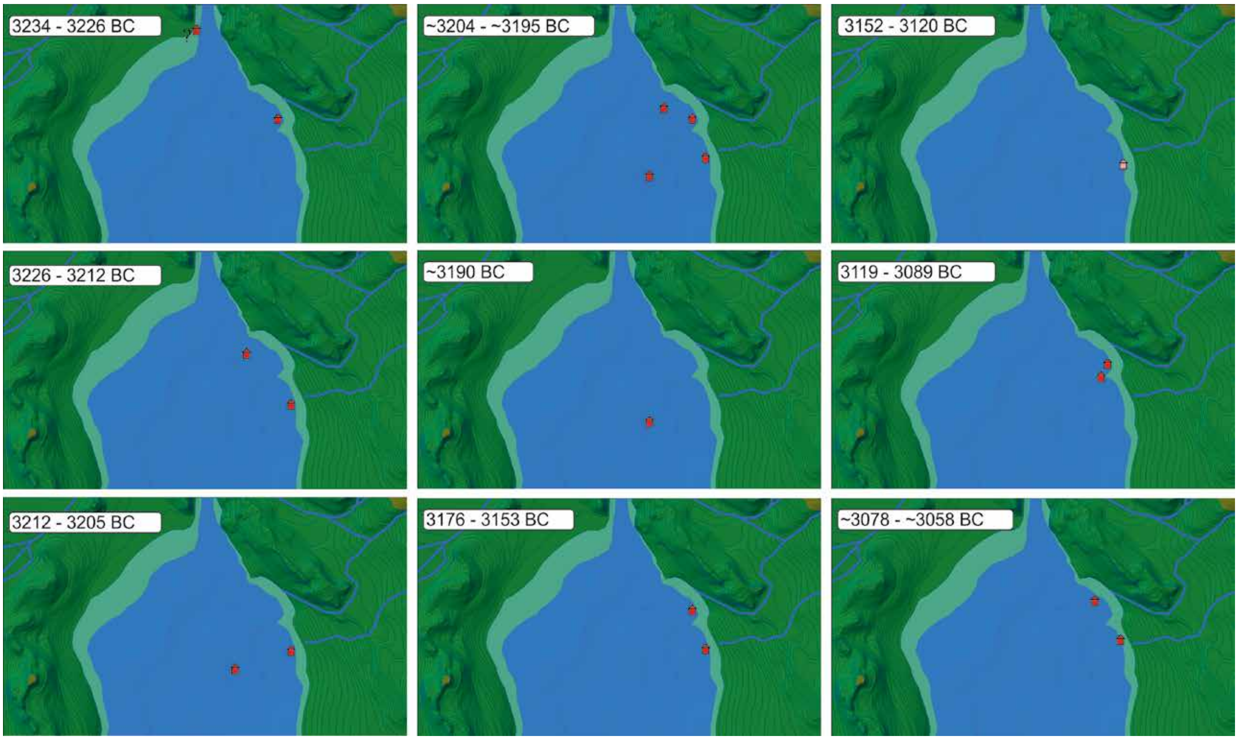

Figure 6. Settlement relocations in Zurich in Horgen times (from Bleicher 2019b, fig. 406).

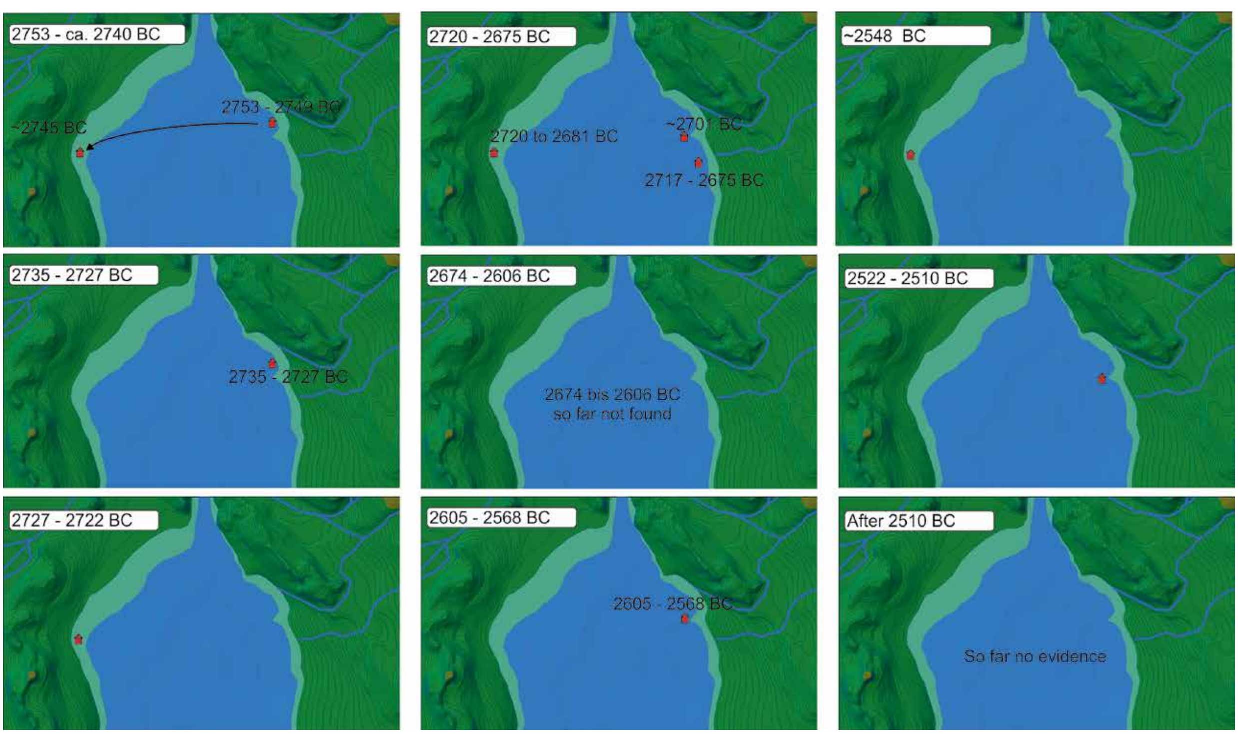

Figure 7. Settlement relocations in Zurich in Corded Ware times (from Bleicher 2019b, fig. 407).

Settlement durations and relocations were at least partly a cultural choice — after all, the settlers at Sipplingen-Osthafen (2917–2855 denBC) show that pre-Corded Ware builders were perfectly able to stay longer when they intended to do so (Billamboz *et al.* 2010). However, more often than not they chose to keep relocating frequently, which was probably a means of constantly performing and confirming the ties of a structured community (Bahss and Bleicher 2022). This is something that obviously changed to a certain degree in some settlements after the arrival of the Corded Ware phenomenon. However, the will to stay a few years longer in one place seems to have emerged only in the course of the Corded Ware period, rather than being present from the beginning, as the earliest Corded Ware settlements in Zurich (Parkhaus Opéra, Phase 7 (2753–2747 denBC) and 8 (2727–2735 denBC)) have durations of around eight years. This fits perfectly into pre-Corded Ware patterns. Even two centuries later, in Hombrechtikon-Feldbach West (Figure 5), the settlement was most likely erected in 2523 denBC and the last repair date is from 2516 denBC, which, again, fits well with Horgen habits. Obviously, Corded Ware settlement systems resulted in occasional and localised longer presences, while in other cases the pre-Corded Ware customs were continued.

Conclusion

Based on a reappraisal of extant data, this paper rejects the hypothesis that the arrival of the Corded Ware phenomenon brought about notable changes in social space, architecture and spatio-temporal behaviour. Important changes to former customs had already happened a hundred years before the Corded Ware phenomenon was manifested in the region. On the other hand, pre-Corded Ware traditions persisted for centuries across the transition. Thus, it seems that the arrival of the Corded Ware probably fuelled an ongoing cultural change to a certain extent, and certainly added new ideas, but it did not establish something altogether new. Although ceramics are markedly different in the Corded Ware horizon, we find no indications of a sudden drastic cultural change that accompanied a massive migration, or even the forceful introduction of new ideas or social structures. Innovations that seem typical for Corded Ware settlements, like their longer duration, the square houses and the new layout, actually only built on earlier foundations.

This is in accordance with the conclusion that Harb (2016) reached for ceramics and other find categories: since in the region of Zurich most cultural deposits from the decades of the transition are not preserved well or were excavated very early and without modern standards, it remains somewhat unclear whether and for how long both ceramic traditions were in use contemporaneously. However, there are very rare examples of ceramics of a hybrid Horgen–Corded Ware style that are notably older than Corded Ware pottery. The same holds true for other artefacts such as arrowheads, which start to resemble what will later be typical during Corded Ware times already a century earlier. In western Switzerland, Harb (2016) argues for a coexistence of both traditions for many decades.

Taken together, it seems that along the Swiss and southern German lake shores, the Corded Ware phenomenon met a society that was already changing and willing to take up further inspiration, while keeping and applying many older customs and traditions.

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Pots without plots?

Danubian and other non-local finds in Horgen cultural contexts of the thirty-second century BC and beyond at lake Constance and in Upper Swabia

Joachim Köninger

Abstract

A significant find assemblage of the thirty-second century BC, with more than 1000 catalogued individual finds, has been obtained from the lakeshore settlement of Nußdorf-Strandbad on the northern shore of lake Überlingen (lake Constance). Non-local elements characterise the ceramics, namely lugs, applied plastic decorations, handles and a large number of spindle whorls. Additionally, other lake Constance settlements have yielded, amongst others, individual sherds with applied sculpted bands or cord ornamentations. Sherds of haematite- and limestone-tempered wares were brought here from the central Alb region further to the north. Very good reference material comes from the context of the Cham culture in Bavaria and the Goldberg III group in Upper Swabia. The associated ^{14}C dates, however, are in general 200 years later. According to the dendro-dated finds from Nußdorf, therefore, there must also have been earlier Cham and Goldberg III phases.

Keywords: lake Constance, Late Neolithic, Horgen culture, Cham culture, Goldberg III group, pottery, Danubian influence, non-local elements

Introduction

There are basic questions of how and why non-local finds or foreign elements reached settlements at lake Constance, involving issues of whether they were imported, local imitations or the result of migration… and where these non-local finds came from and how they got there — as ideas or in the form of the objects themselves. And finally, there is the question of what their appearance means. In the following paper I try to present some aspects of such non-local finds from Horgen culture pile dwellings at lake Constance.

When discussing Danubian and other non-local finds in the thirty-second century BC, we are predominantly talking of ceramic objects. Mostly they belong to the Horgen assemblage of Nußdorf-Strandbad, a pile dwelling settlement on the northern shore of lake Überlingen (Überlinger See), the north-westerly branch of lake Constance (Figures 1–2).

In D. Hofmann, D. Mischka and S. Scharl (eds) 2025. *The eve of destruction? Local groups and large-scale networks during the late fourth and early third millennium BC in central Europe*, 63–94. Leiden: Sidestone Press.

Figure 1. The shallow water zone off Nußdorf with the alluvial cone of the Nußbach (N). In the 1982 aerial photograph, the brownish shoal of Liebesinsel (white arrow) is clearly visible near the mouth of the Nußbach in the centre of the photo (aerial photograph: J. Köninger 1982).

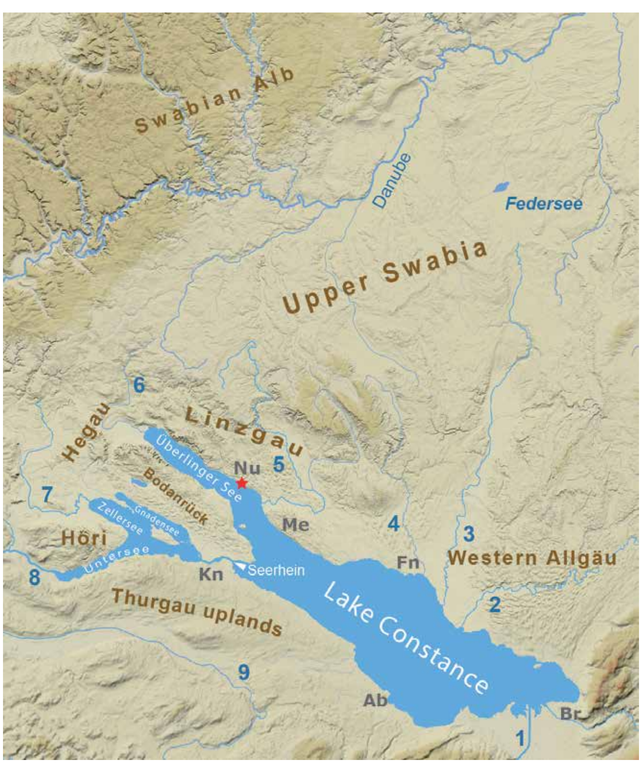

Figure 2. Lake Constance and the northern Alpine foothills: branches of the lake, tributaries, other inland waterways and natural landscapes (base map generated from LiDAR data provided by Landesamt für Denkmalpflege Baden-Württemberg). Locations: Nu Nußdorf-Strandbad; Me Meersburg; Kn Konstanz; Fn Friedrichshafen; Ab Arbon; Br Bregenz; 1 Alpine Rhine; 2 Argen; 3 Schussen; 4 Rotach; 5 Seefelder Aach; 6 Stockacher Aach; 7 Radolfzeller Aach; 8 High Rhine; 9 Thur.

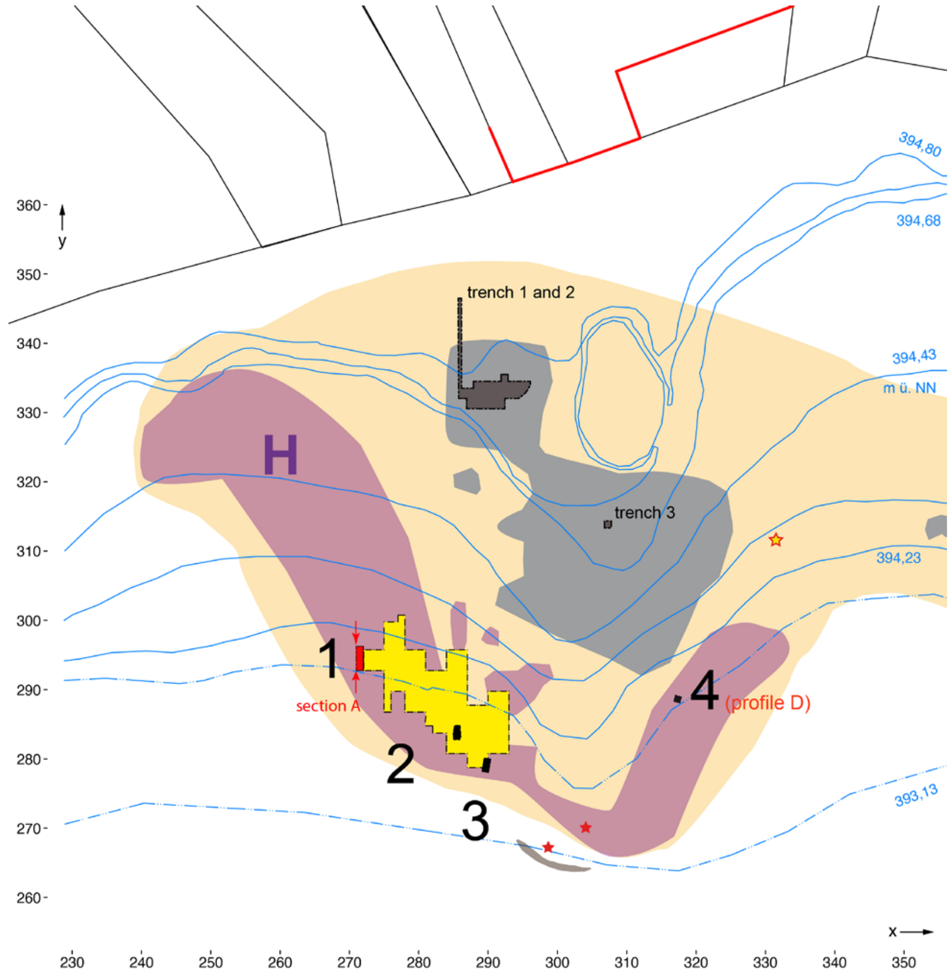

Figure 3. Nußdorf-Strandbad, sondage trenches and recorded surface areas (yellow 1981, 1992-1993) around the Horgen cultural layer (H). 1 Sn19/34, Q193.196.199/ Q349C/D (1992/93); 2 Sn4, Q40 and 41/ A8 (1981/82); 3 Sn5, Q50 and 51/A18 (1981/82); 4 A19 (1981/82) profile D; A exploration point; Q =square; Sn = section; stars: single finds.

Nußdorf-Strandbad

The Nußdorf-Strandbad settlement on lake Überlingen is one of the first pile dwellings to be discovered, having been found in the 1860s. It is located in the shallow zone east of the mouth of the Nußbach, a small stream on the north shore of lake Überlingen. It includes settlement areas of the Younger Neolithic Hornstaader group and the Early Pfyn culture. Additionally, there are scattered finds of the Corded Ware culture and of the Early and Late Bronze Age. The Horgen settlement is situated on the tip of a protruding shoal, the so-called Love Island (Figure 3).

An early inventory of lake Constance pile dwellings was begun with the Lake Constance/Upper Swabia Project of the State Office for Cultural Management Baden-Württemberg (Landesamt für Denkmalpflege Baden-Württemberg) in the winter of 1981/1982 (Billamboz and Schlichtherle 1981, 41–42) and was a prelude to further underwater sondages in 1992 and 1993 (Figure 3) (Köninger 1999, 19–30; Köninger and Schlichtherle 1993, 73–78). The onset of increasing surface erosion, beginning in the 1960s and particularly marked in the 1980s and 1990s, had washed free finds which ended up in private collections. The following paper is based on both the materials collected from secure contexts in the course of the diving sondages, and on recorded finds from the Horgen cultural layer collected from the eroding surface and housed in private collections.

Horgen cultural layer

The Horgen cultural layer, from which the finds come, is mostly between 10–20 cm, but up to 50 cm thick (Figure 4). Apart from erosion processes at the lakeside margin, the cultural layer has been extensively disturbed by shovel excavations probably of the late nineteenth and early twentieth century (see Figure 5). However, in the areas with deeper water on the lakeward side of the settlement, these interventions reach depths of little more than 20 cm. Here, settlement deposits of 50 cm thickness have been preserved in trough-shaped depressions, with layer thickness varying between 15 and 50 cm even over short distances. This unusual pattern can probably be traced back to several mutually reinforcing causes. It is conceivable that there were shallow troughs prior to the deposition of the Horgen cultural layer which were

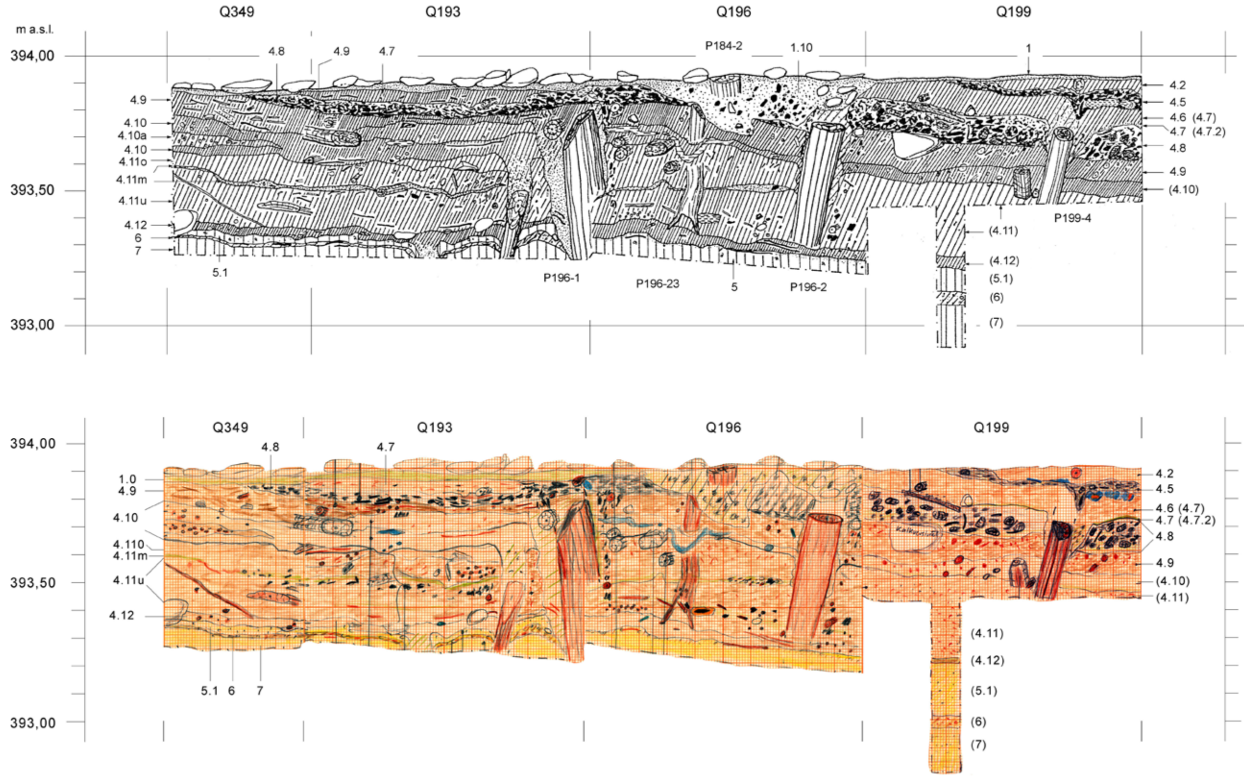

Figure 4. Nußdorf-Strandbad 1992/1993, section A. Original (below) and interpretative redrawing (above) of the section.

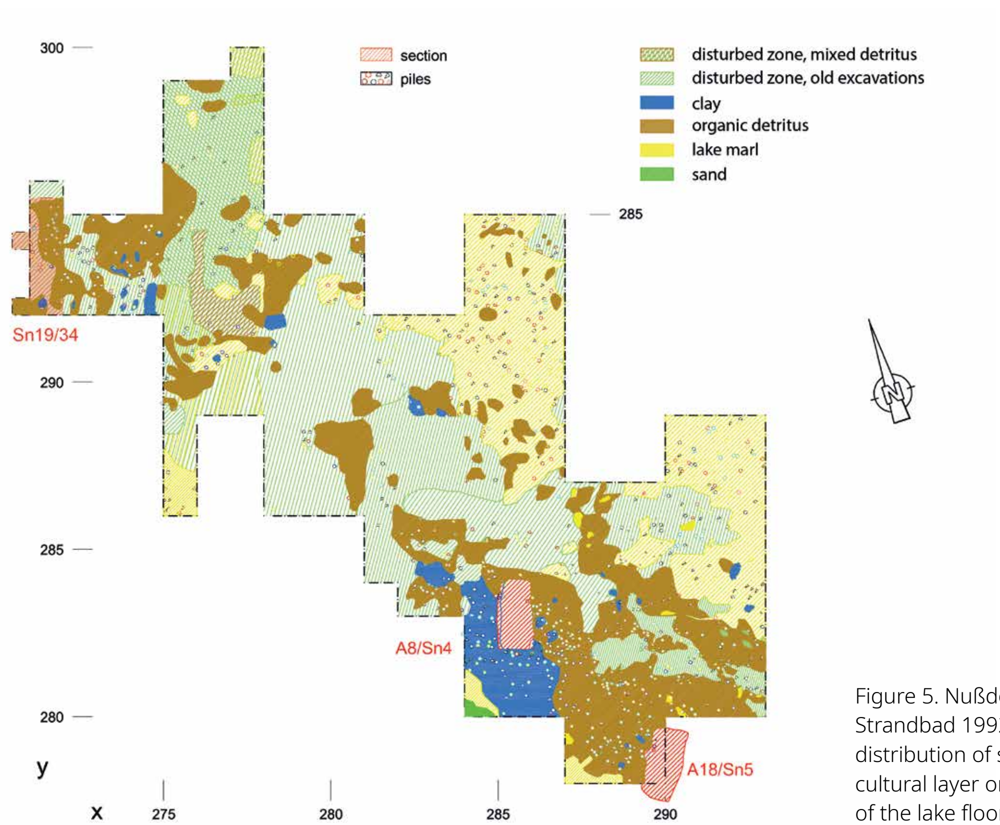

Figure 5. Nußdorf-Strandbad 1992/1993, distribution of sediments and cultural layer on the surface of the lake floor west of Liebesinsel.

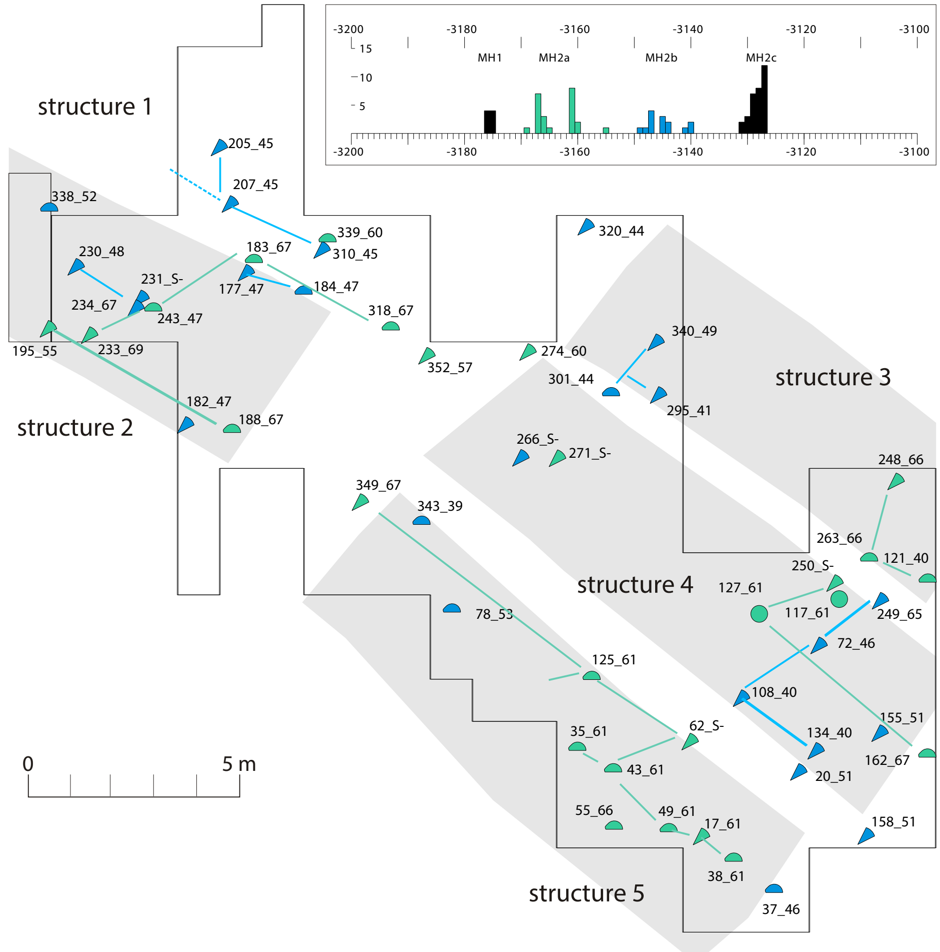

Figure 6. Nußdorf-Strandbad, plan of the dated piles and building structures of the Middle Horgen 2a (MH2a). The timber numbers of the piles are supplemented with the last two digits of the wane dating (e.g. 217_76: timber number 217, dated to 3176 BC; sapwood boundary dating only indicated by "S-" without year). Top right: cumulative chart of impact dates (wane dates only). Green: number of young trees (<50 annual rings; see Nelle and Billamboz 2020, 133–40).

deepened and extended under the additional load of the settlement deposits. On the lakeward side of the settlement, tipped piles and sloping layers near the boundary of the shallow zone indicate subsidence in the underlying lake marl. Taken together, this may have acted as a sediment trap and ensured that, in some circumscribed areas, preservation of the Horgen cultural layer was up to 50 cm thick (Köninger 2020, 34).

The deposit consists of organic detritus, which is split by two distinct fire layers in the landward sondage profile A (Figure 4). Two additional fire events are peripherally recorded in profile A and recognisable by charred wooden remains. It is uncertain whether the entire settlement was affected by a conflagration or just individual houses (Köninger 2020, 33). In any case, the stratigraphic evidence reflects several phases of construction, which is also supported by dendrochronological examination of the oak timbers (Nelle and Billamboz 2020, 136–39). However, individual layer sections must have been deposited within a narrow time frame, as indicated by matching sherds for section 4.2–4.6 (detritus – fire layer – detritus) and a branch obliquely cutting across the 30 cm thick detritus deposit 4.11u at the base of the layer (Köninger 2020, 33). The sequence of the feature indicates no long-term interruptions of settlement and disruption to the settlement sequence due to increasing water levels can be largely excluded on the basis of the palaeolimnological investigations.

The dendrochronological examination of the recovered oak timbers indicated two settlement phases in close succession, with the second settlement phase consisting of three construction phases (Nelle and Billamboz 2020, 136–38). The first settlement phase (MH1; MH=Middle Horgen), confirmed by seven timbers, dates to W3176–3175 (all dates BC; W=wane/Waldkante), the three building phases of the second settlement phases date to W3169–3160 (MH2a), W3149–3140 (MH2b) and W3131–3127 (MH2c). The dated oak piles allow reconstruction of 3–4 m wide and approximately 11 m long two-aisled buildings that stood close together, arranged in two rows (Figure 6). A total of five building ground plans were recorded.

The links between the Horgen layer and the dendro-dates are sparse. Two stratified timbers with dendro-dates of S3125 (S=sapwood dating) and W3128 from the

Figure 7. Phasing of the Horgen culture at lake Constance and the Horgen culture and Goldberg III group in Upper Swabia. Ceramic complexes and dendro data. Ag Alleshausen-Grundwiesen; Ol3 Olzreute-Enzisholz 3; Sr Wolpertswende-Schreckensee, TwI Alleshausen-TäschenwiesenI; DC dendrochronology. Data lake Constance: Billamboz and Maier 2009; Bleicher 2009; Bollacher 2001; de Capitani 2002; Kolb 1993; Köninger 2009; Nelle and Billamboz 2020; Schlichtherle 2004; 2009. Data Upper Swabia: Bleicher 2009; Schlichtherle 1999; Wolf *et al*. 2016.

		Ceramics	TCe	Stone	Chert	Bone	Antler	Daub	Total
sondages	number	2669	30	82	136	2235	13	891	6056
	weight (g)	108692	638	15391	1037	6047	436	26823	159064
collections	number	2522	62	63	250	13	-	-	2910
	weight (g)	87492	950	112119	1500	100	-	-	202161

Table1. Nußdorf-Strandbad, finds from sondages 1981–1993 and collections. Number and weight broken down by find categories. TCe: textile-decorated ceramics.

Figure 8. Nußdorf-Strandbad, sherds tempered with calcareous grit and haematite. Scale bar: 5 cm.

Figure 10. Nußdorf-Strandbad, vessel with biconical profile and stamped band along the rim.

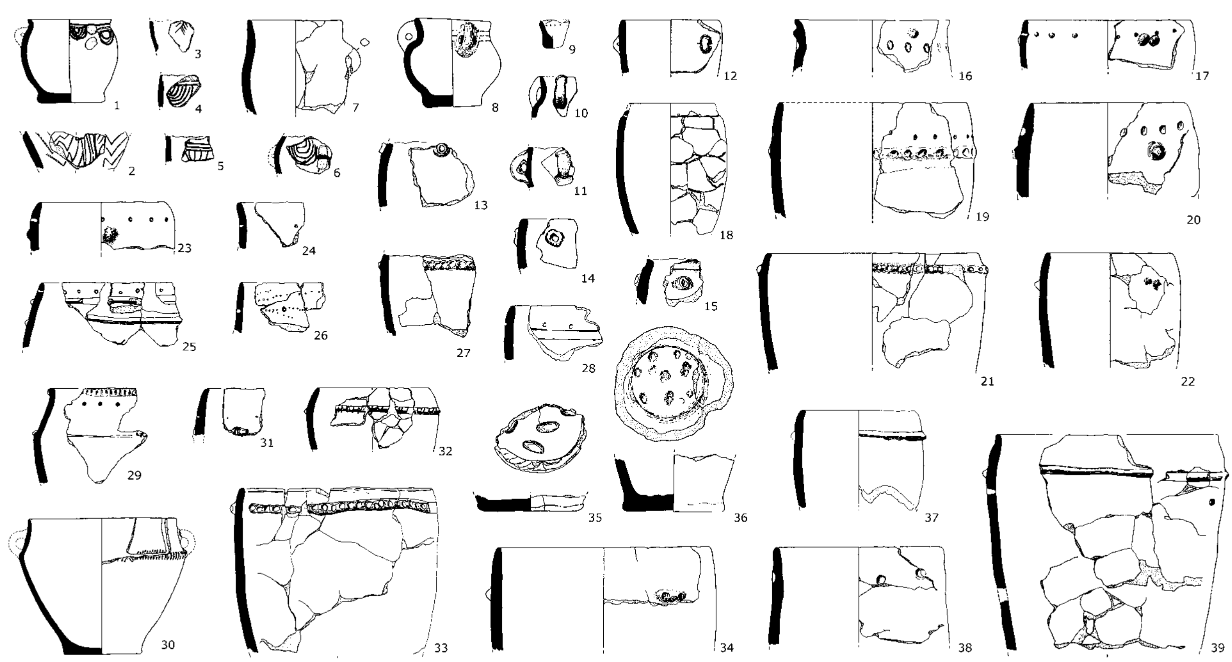

Figure 9. Nußdorf-Strandbad, pottery. Shape and decorative spectrum (drawings LAD, J. Köninger and H. Schlichtherle).

		L	Gr	Can	Can-Pri	RSt	Pri/Pe	B	B-Can	B-Pri/Pe	B-Fi	Fi-Pri	Fi-Can/Pri	Fi	FN	Total
Dec total	No	15	3	19	19	2	188	115	1	48	7	2	2	48	2	471
	%	3.2	0.6	4.0	4.0	0.4	39.9	24.4	0.2	10.2	1.5	0.4	0.4	10.2	0.4	100
RS dec total	No	5	1	13	11	2	159	48	0	41	5	1	2	36	1	325
	%	1.5	0.3	4.0	3.4	0.6	48.9	14.8	0	12.6	1.5	0.3	0.6	11.1	0.3	100
Nu81-93 dec total	No	1	0	12	6	1	81	71	1	20	1	2	1	18	0	215
	%	0.5	0	5.6	2.8	0.5	37.7	33.0	0.5	9.3	0.5	0.9	0.5	8.4	0	100
Nu81-93 RS dec	No	1	0	10	5	1	64	30	0	17	1	1	0	12	0	142
	%	0.7	0	7.0	3.5	0.7	45.1	21.1	0	12.0	0.7	0.7	0	8.5	0	100
Nu81-93 dec layer 4	No	1	0	6	1	2	27	29	0	8	0	1	0	10	0	85
	%	1.3	0	7.1	1.2	2.4	31.8	34.1	0	9.4	0	1.2	0	11.8	0	100

Table 2. Nußdorf-Strandbad, pottery vessels. Number and percentage of ornamental types. Total assemblage including collections (total) and assemblage from the sondages (Nu81–93) are listed separately. RS rim sherd; dec decorated; L incised line; Gr groove; Can fluting/cannelure; Pri pricking; RSt rectangular stamp; Pe perforation; B band; Fi finger impressions; FN fingernail impressions.

lakeward area of the culture layer were found in the upper part of the layer and in the lake marl above it, respectively. Therefore, for the lakeward parts of the culture layer, we can envisage that the Horgen stratigraphic complex was deposited before 3128 BC or, taking into account the life cycle of the timbers, a little later (Köninger 2020, 35). Five dendro-dated piles which puncture the Horgen layer suggest a similar dating framework (Köninger 2020, 35). The finds themselves can be attributed to the Middle Horgen (Köninger 2020, 35–38). Figure 7 provides an overview of the phasing of the Horgen culture at lake Constance and in Upper Swabia (Köninger 2020, 35–38).

The find materials — ceramics

The Horgen find assemblage consists of the finds from the sondages and rescue excavations of the State Office (c. 6000 finds) and from private collections (c. 2900 finds). It is thus one of the most extensive find assemblages of the Horgen culture on lake Constance. Apart from bone, ceramics are the dominant type of find in terms of number of pieces and weight (Table 1) and the most informative type of find regarding non-local elements. The pottery is predominantly typical of the Horgen style, the surfaces are mostly hand-smoothened and grey to light beige in colour. Quartz and chert were predominantly used as tempering agents, but additions of sand and grog were also common. Small stones up to a centimetre in diameter and organic materials were rare.

A handful of sherds were tempered differently, with calcareous grit and haematite (Figure 8), but the red-staining haematite is rather to be understood as a natural component of the raw clay (Köninger 2020, 42). The existence of multiple fracture lines indicates that the pots were probably mostly constructed using coiling techniques. The bases are sometimes connected to the lower walls, sometimes the lower wall is placed on the base plate, and more rarely the bases are inserted into the already formed walls.

In terms of shape, pots with tapering rims prevail, straight rims are more unusual, curved and funnel-shaped rims are rarer still (Köninger 2020, 43 tab. 9). In contrast, the pot with a biconical shoulder (*Knickwand*) (Figure 9.29; Figure 10) and a bowl of nearly identical profile (Figure 9.30) are atypical. An amphora-like handled vessel and a handled pot/beaker, as well as other handles and lugs (Figure 9.6–8.10–12), are extraneous to the Horgen range of vessel forms.

The ceramic ornamentation is extraordinarily rich, going far beyond the fluting, rows of holes, incised and grooved decoration usually found under the rim (Table 2). It includes fingertip-impressed decorations, typical for the lake Constance area and Upper Swabia, in varied combinations, alongside diffusely arranged fine dotted incisions. First and foremost, however, the ornamental

		B-indet	DB	NB	SB	B-seg	StB	B total	Dec total
Dec total	No	6	99	7	44	18	1	175	471
	%	1.3	21.0	1.5	9.3	3.8	0.2	37.2	100
RS dec total	No	4	49	3	25	14	1	96	325
	%	1.2	15.1	0.9	7.7	4.3	0.3	29.5	100
Nu81-93 dec total	No	5	52	4	22	8	1	92	215
	%	2.3	24.2	1.9	10.2	3.7	0.5	42.8	100
Nu81-93 RS dec	No	3	23	2	12	8	1	49	142
	%	2.1	16.2	1.4	8.5	5.6	0.7	34.5	100
Nu81-93 dec layer 4	No	1	17	2	7	3	1	31	85
	%	1.2	20.0	2.4	8.2	3.5	1.2	36.5	100

Table 3. Nußdorf-Strandbad, band ornamentation on pottery vessels. Number and percentage of ornamental types. Total assemblage including collections (total) and assemblage from the sondages (Nu81–93) are listed separately. RS rim sherd; dec decorated; B-indet indeterminate bands; DB dotted bands; NB notched bands; SB smooth bands; B-seg band segments (short bands); StB stamped bands.

spectrum is surprising due to the high proportion (between 30 and 40 % of the ornaments depending on the counting method) of vessels decorated with richly varied sculpted bands (*Leistenware*) (Table 3). Most of these bands are dotted (*Tupfenleiste*) or smooth (*glatte Leiste*), but there are also notched ones (*Kerbleiste*) and short segments (*Kurzleiste/Leistensegment*), as well as a stamped band (*Stempelleiste*) and one vessel with multiple bands (*Mehrfachleiste*) (Figure 11). There are also a rich variety of knobs (Figure 9), in particular so-called ring (indented) knobs (*Ringknubbe/gedellte Knubbe/Ringlinse*) (Figure 9.13–15), vertical lugs/ribs (*Vertikalknubbe/Rippen*) and gynaecomorphic double lugs (*Doppelknubbe*) (Figure 9.17.22).

Finally, ornamentation is applied to the vessel body using incision techniques (*Ritzziertechnik*; Figure 9.1–6, Figure 12). Concentrically arranged hanging semi-circular patterns (Figure 9.1.4–6) are interpreted as sun symbols. So-called genealogical motifs include fir branches or fishbone-like incised lines and bundles of lines with zigzags connecting both sides (Figure 9.2–3). According to H. Schlichtherle (2016), fir branch patterns are genealogical motifs used since the Early Neolithic to symbolise ancestral lines. The zigzag lines are thought to represent a superimposed anthropomorphic figure shown in the act of giving birth.

Internally "decorated" bases are another specific feature of the Nußdorf ceramics, 54 of a total of 193 base sherds (c. 28 %) have impressions of fingertips on the inside (Figure 9.35–36, Figure 13). The fingertip impressions can be distinct from each other and form a dotted pattern, or can be overlapping and sometimes drawn out. They were evidently intentionally applied and not "accidently" created during the making of the pots. The distribution of the internally stippled bases reaches as far as the Paris Basin, but concentrates around lake Constance and in the western part of Switzerland (Figure 14). At lake Constance, lake Zurich and in western Switzerland, their dating range is uniformly in the thirty-second and thirty-first centuries BC, with most finds dating to the thirty-second century. In contrast, according to ^{14}C dates, the stippled bases of the Groupe Gord date much younger (Köninger 2020, 54–55).

Further ceramic features include textile tools, mainly spindle whorls, of which there are 95 pieces in various forms. Only five of them are decorated (Figure 15). Except for "decorated" bases and incised motif ornamentation, most of the non-local ceramic elements were identified as input from the Danubian region (see below).

Spatial distribution of non-local elements

Only some of the non-local ceramic elements in Nußdorf are limited to individual buildings, despite the multiple taphonomic filters of the old excavations and collecting activities extending over decades. Thus, the ceramics from the two lakeside buildings 2 and 5 clearly show more varied influences from the Danubian area (Figure 16) than, for example, building 4, which is located landwards of them. Here, simple rows of finger-impressions and perforated rims of different shapes, all common in Horgen, are frequent. The ceramic decorations seem to differ in emphasis from building to building, with Danubian influences and possible Wartberg elements (see below) playing a role, especially in building 5. In any case, Danubian-influenced pottery is documented for all house sites and not limited to only a few, as in Zurich-Parkhaus Opéra 3 (Weber 2016, 49).

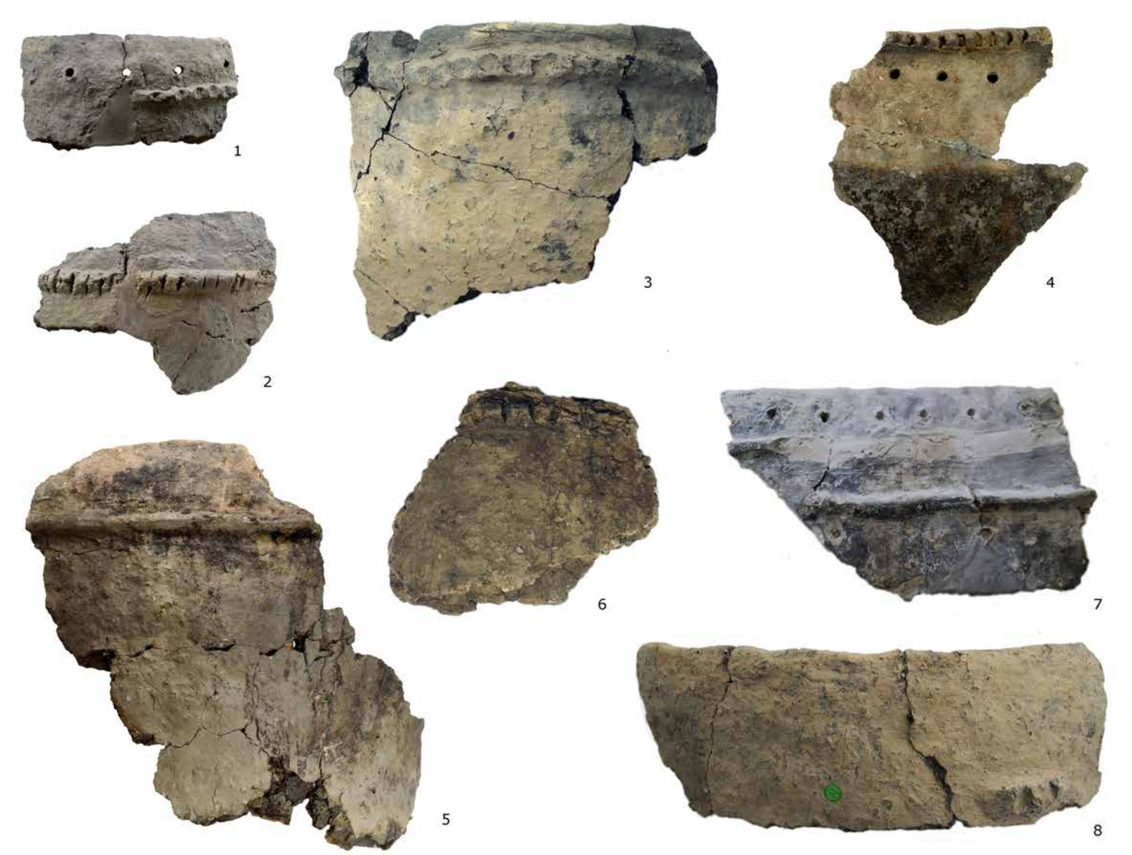

Figure 11. Nußdorf-Strandbad, vessels with applied plastic bands. Smooth bands (5 and 7), segmented bands (8 and 1), stamped band (4), spotted or stippled band (3), notched bands (2 and 6), multiple bands (7). Various scales (photos LAD, M. Erne).

Figure 12. (right) Nußdorf-Strandbad. Pottery with incised decoration (photo LAD, M. Erne).

Figure 13. (above) Nußdorf-Strandbad. Base with internal dotted decoration (photo LAD, M. Erne).

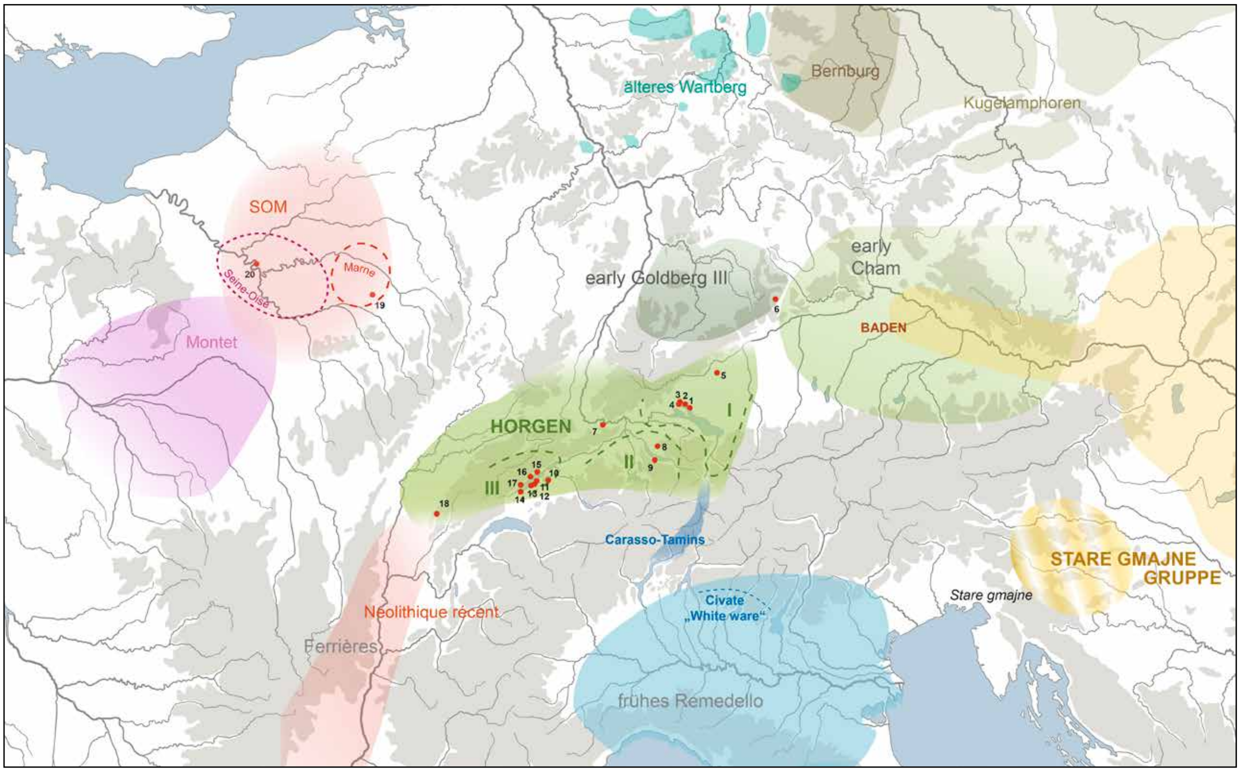

Figure 14. Cultural groups in the thirty-second century BC and sites with internally dotted bases. 19 and 20 belong to the younger Groupe Gord (after Köninger 2020, 54–55 fig. 66). Base map after Schlichtherle, LAD, supplemented. Regional groups of the Horgen culture: I lake Constance and Upper Swabia including the northern part of the Alpine Rhine valley; II central Switzerland; III western Switzerland and eastern France. Sites: 1 Nußdorf-Strandbad; 2 Sipplingen-Osthafen; 3 Ludwigshafen-Seehalde; 4 Bodman-Weiler I; 5 Bad Buchau-Dullenried; 6 Goldburghausen "Goldberg"; 7 Mumpf-Kapf; 8 Pfäffikon-Burg; 9 Horgen-Scheller (courtesy R. Ebersbach); 10 Muntelier-Platzbünden; 11 Portalban les Grèves; 12 Gletterens les Grèves; 13 Chevroux; 14 Yvonand IV; 15 Saint-Blaise "Bains des Dames"; 16 Auvernier-les Graviers; 17 Concise-la Lance; 18 Chalain 3; 19 Écury-le-Repos; 20 Paris Bercy.

Figure 15. Nußdorf-Strandbad, textile tools. Fired clay spindle whorls of different sizes and states of preservation.

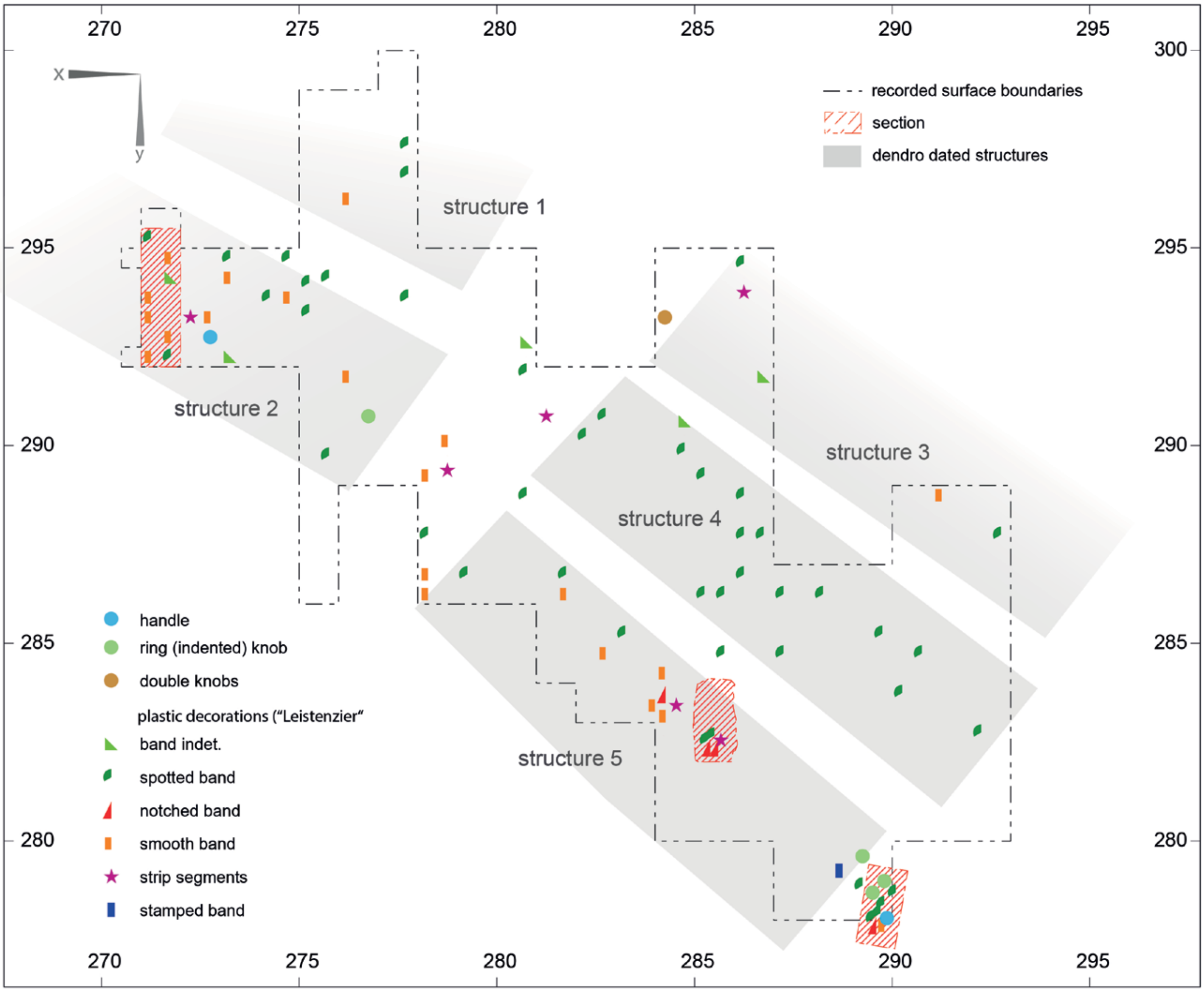

Figure 16. Nußdorf-Strandbad, distribution of pottery with different decorative features. For knobs, handles and plastic decorations, each symbol represents one find.

The wider context: Horgen applied decorations

The origin of the Horgen applied plastic decorations and other non-local elements

Applied plastic decorations do not belong to the classical spectrum of Horgen ceramic ornamentation in southern Germany or central and eastern Switzerland. They appear at lake Constance for the first time during the earliest Horgen culture at Arbon Bleiche 3, together with Baden-Boleráz pottery (de Capitani 2002, 209–16, 268–70 figs 362.6, 364.6–8). During the middle Horgen culture, they go on to become one of the influential elements of ceramic ornamentation, at least in the find assemblage of Nußdorf-Strandbad.

Traditionally, applied decorations, especially notched and stippled bands, belong to the ceramic repertoire of the Late Neolithic cultural groups (Späteolithikum *sensu* Lüning 1996) located east and north-east of lake Constance. There, they are found frequently and are sometimes rich in variety, for example in the Cham group, or as the case may be, the Baden culture in Bavaria (see below), the Burgerroth/Altenberg group in Franconia (Matuschik 1999; also Link 2016, 124) or the Wartberg group in Hesse (Schwellnus 1979). From there, most likely via the Cham/Baden culture, the applied decoration techniques could have spread to Upper Swabia and lake Constance by the middle Horgen culture. Linked to these cultural groups are the biconical profiles, the ring knobs, the double lugs and vertical knobs, as well as the numerous spindle whorls.

In the case of the Middle Horgen, problems are still caused by the fact that potential mediating cultural groups from a comparable time horizon — such as the Early Cham culture or a possible independent Baden horizon in Bavaria — are only weakly attested by find

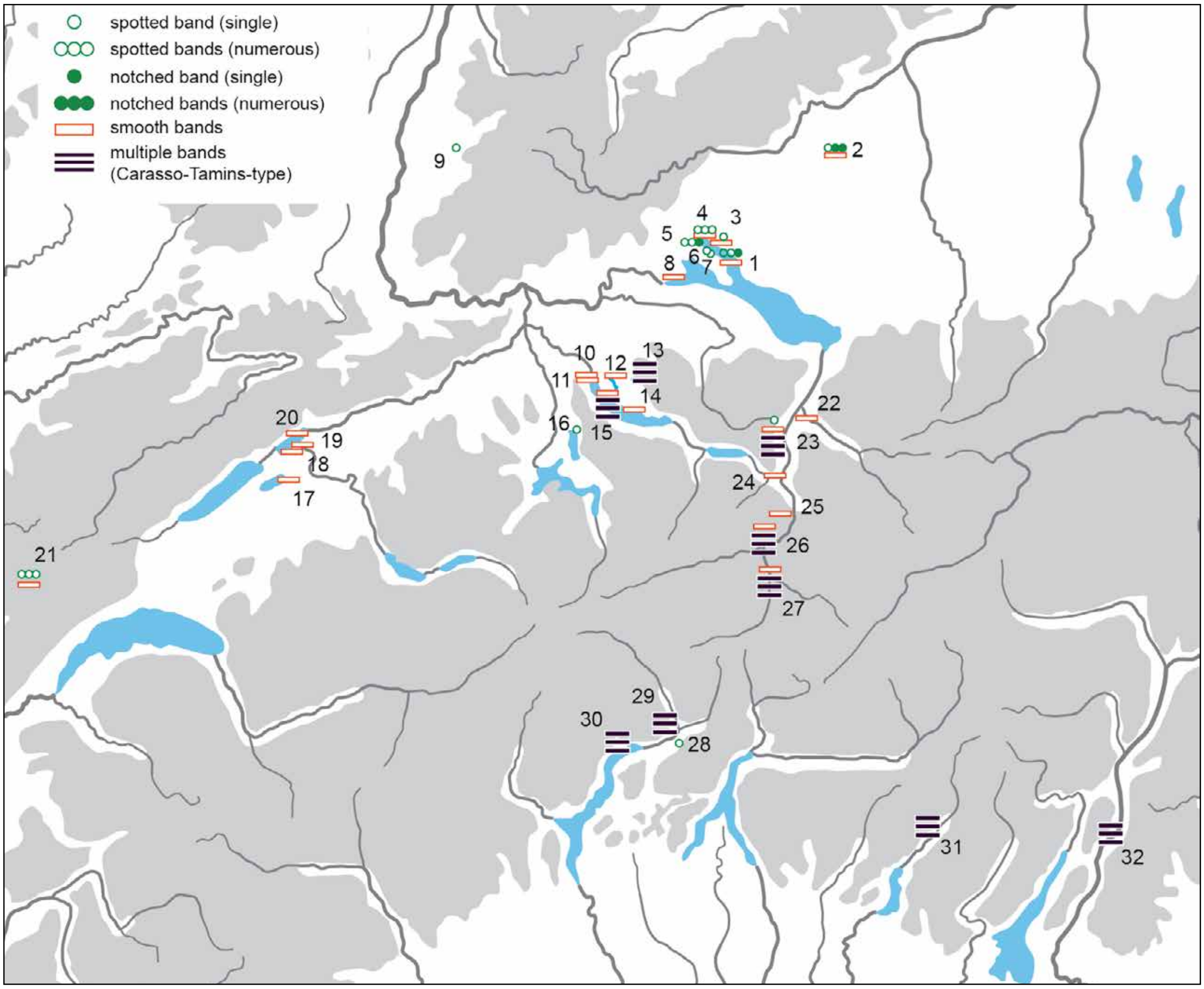

Figure 17. Sites of Horgen pottery with applied plastic bands and multiple bands in the southern foothills of the Alps (for further literature see Köninger 2020, 50 fig. 58). 1 Nußdorf-Strandbad; 2 Bad Buchau-Dullenried; 3 Sipplingen-Osthafen; 4 Ludwigshafen-Seehalde; 5 Bodman-Weiler I; 6 Wallhausen-Ziegelhütte; 7 Dingelsdorf indet.; 8 Wangen-Hinterhorn; 9 Schallstadt-auf der Leimgrub; 10 Zürich-Parkhaus Opéra 3; 11 Zurich-KanSan 4; 12 Greifensee-Furren; 13 Pfäffikon-Burg; 14 Uetikon-Schifflände; 15 Feldmeilen-Vorderfeld; 16 Hünenberg-Chämleten; 17 Muntelier-Platzbünden; 18 Lüscherz-Bingeli; 19 Sutz-Lattrigen; 20 Twann OH; 21 Lac Chalain 3. cVIII; 22 Borscht-Schellenberg; 23 Eschen-Lutzengüetle; 24 Wartau-Ochsenberg; 25 Untervaz-Haselboden; 26 Tamins-Crestis; 27 Cazis-Petrushügel; 28 Bellinzona "Castel Grande"; 29 Bellinzona "Carasso-Lusanico"; 30 Ascona "San Michele"; 31 Breno, Valcamonica; 32 Isera-La Toretta 5.

material and ^{14}C dates, and thus remain badly understood (see below section "Cham, Horgen and Goldberg III"; Gohlisch 2005, 145–55; Köninger *et al.* 2001, 648–49; Matuschik 1990, 434; 2001, 675–76, 716; Ottaway 1999; 2001, 17–18; Raetzel-Fabian 2001a, 110–12, 440; Raßhofer 2017, 77–110, 103 fig. 31).

The introduction of applied plastic decoration from the Alpine Rhine valley (Bollacher 2001, 217), on the other hand, is highly unlikely. Applied decoration styles are not found there and, apart from a few exceptions in the northern Alpine Rhine valley (Itten 1970, pl. 45.1–4), smooth bands dominate.

Distribution and dating of Horgen applied plastic decorations

As far as dendro-data allow an assessment, all the ceramic complexes with applied decorations mentioned above date to the thirty-second century BC (Köninger 2020, 48–51). The different types of plastic decorations show four different regions of distribution (Figure 17):

1. In the lake Constance area, with Upper Swabia bordering to the north, plastic decorations are represented in many variations and large numbers. In addition to smooth, notched and segmented bands, there are mainly single

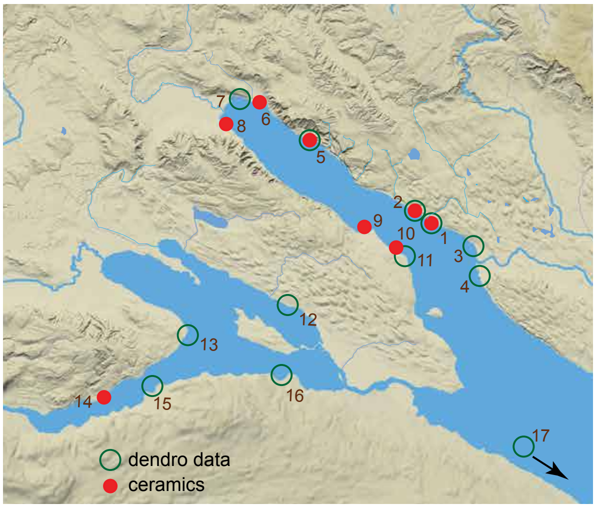

Figure 18. Thirty-second century BC lakeshore settlements on lake Constance (base map generated from LiDAR data provided by Landesamt für Denkmalpflege Baden-Württemberg). 1 Nußdorf-Strandbad; 2 Überlingen-Osthafen; 3 Maurach-Ziegelhütte; 4 Unteruhldingen-Stollenwiesen; 5 Sipplingen-Osthafen; 6 Ludwigshafen-Seehalde; 7 Ludwigshafen-Holzplatz; 8 Bodman-Weiler I; 9 Wallhausen-Ziegelhütte; 10 Dingelsdorf-Seewiesen; 11 Dingelsdorf, station unknown; 12 Allensbach-Strandbad; 13 Hornstaad-Hörnle V; 14 Wangen-Hinterhorn; 15 Steckborn-Turgi; 16 Ermatingen-Westerfeld; 17 Arbon-Bleiche 1.

stippled bands around the vessel's circumference. The numerous notched plastic decorations along the rim in the Dullenried assemblage are striking.

2. In central and eastern Switzerland, plastic decorations occur only sporadically; here they are predominantly smooth bands. Dotted and multiple bands are only occasionally present.
3. In the Alpine Rhine valley and in canton Ticino — between Liechtenstein and Ascona — multiple bands are common. It is unclear to what extent smaller sherds with smooth bands belong to vessels with multiple bands. There are only few stippled bands.
4. In western Switzerland and eastern France, Horgen plastic decorations are rare and limited to individual sites. Apart from a few smooth bands from lake Murten and lake Biel, the Horgen ware from Lac Chalain, decorated with stippled bands, is an exception.

The Alpine Rhine valley is thus divided into two parts. The north, up to about Liechtenstein, can be linked with the lake Constance region on the basis of the circumferential finger-impressed bands and plastic decorations of Eschen-Lutzengüetle (Itten 1970), while the area to the south with its smooth multiple bands belongs to the Alpine region.

Horgen lakeside settlements of the thirty-second century BC at lake Constance

Based on dendro-data and the presence of vessels with plastic decoration similar to the Nußdorf ceramics, 17 shore settlements of the thirty-second century BC can be identified among the numerous Horgen sites of lake Constance (Figure 18). They are mainly located on the shores of lake Überlingen, where they are mostly attested by ceramics with applied plastic decoration. On the other parts of the lake, settlements of the thirty-second century BC are predominantly attested by dendro-dates, a sure sign that the spatial distribution has been masked by taphonomic factors. This fits with the fact that they are predominantly standard settlement sites, such as Wangen-Hinterhorn, Allensbach-Strandbad or Arbon Bleiche. It is also striking that the repeatedly documented shore sections of Nußdorf-Überlingen, Bodman-Ludwigshafen and Maurach-Unteruhldingen connect the lake Constance area to the north via the streams Stockacher and Seefelder Aach.

Comparison of Horgen assemblages

Typologically comparable pottery assemblages from the lake Constance area and from Upper Swabia are rare and relatively small. The closest parallels from lake Constance are the ceramics from Sipplingen-Osthafen, ensemble SiJ (Kolb 1993, layer 13A) and ensemble SiK (Kolb 1993, layer 13B) (ensemble denomination after Matuschik and Müller 2023, 58–60, 163–72) and the finds from the wetland settlement of Bad Buchau-Dullenried (Bollacher 2001) in the Federseeried, excavated in the 1920s. A representative assemblage from lake Zurich is the recently excavated site Zurich-Parkhaus Opéra 3 (Harb and Bleicher 2016).

Sipplingen-Osthafen ensemble SiJ, lake Constance

The ceramic assemblage of this ensemble (3150–3148 BC) includes 28 usable rim, decorated wall, and base pieces (Figure 19). The pot forms are rather profiled with inverted, straight or funnel-shaped rims. The bases are more or less stepped (Figure 19.19–28). Perforated rims, stippled rim lips, circumferential finger impressions and fluting are present, as well as smooth and stippled plastic bands. Rim and base forms largely correspond to the spectrum known from layer 4 at Nußdorf. With the exception of the cord-decorated sherds of a profiled pot (Figure 19.3) and the rim sherd of a small biconical bowl, extensively decorated with shallow incisions (Figure 19.4), the decorative spectrum is also found in Nußdorf. Spindle whorls, on the other hand, are missing, as are internally stippled bases. These are found in the overlying layer 13B (ensemble SiK), which is dated to 3085–3060 BC. Among the 19 sherds catalogued from

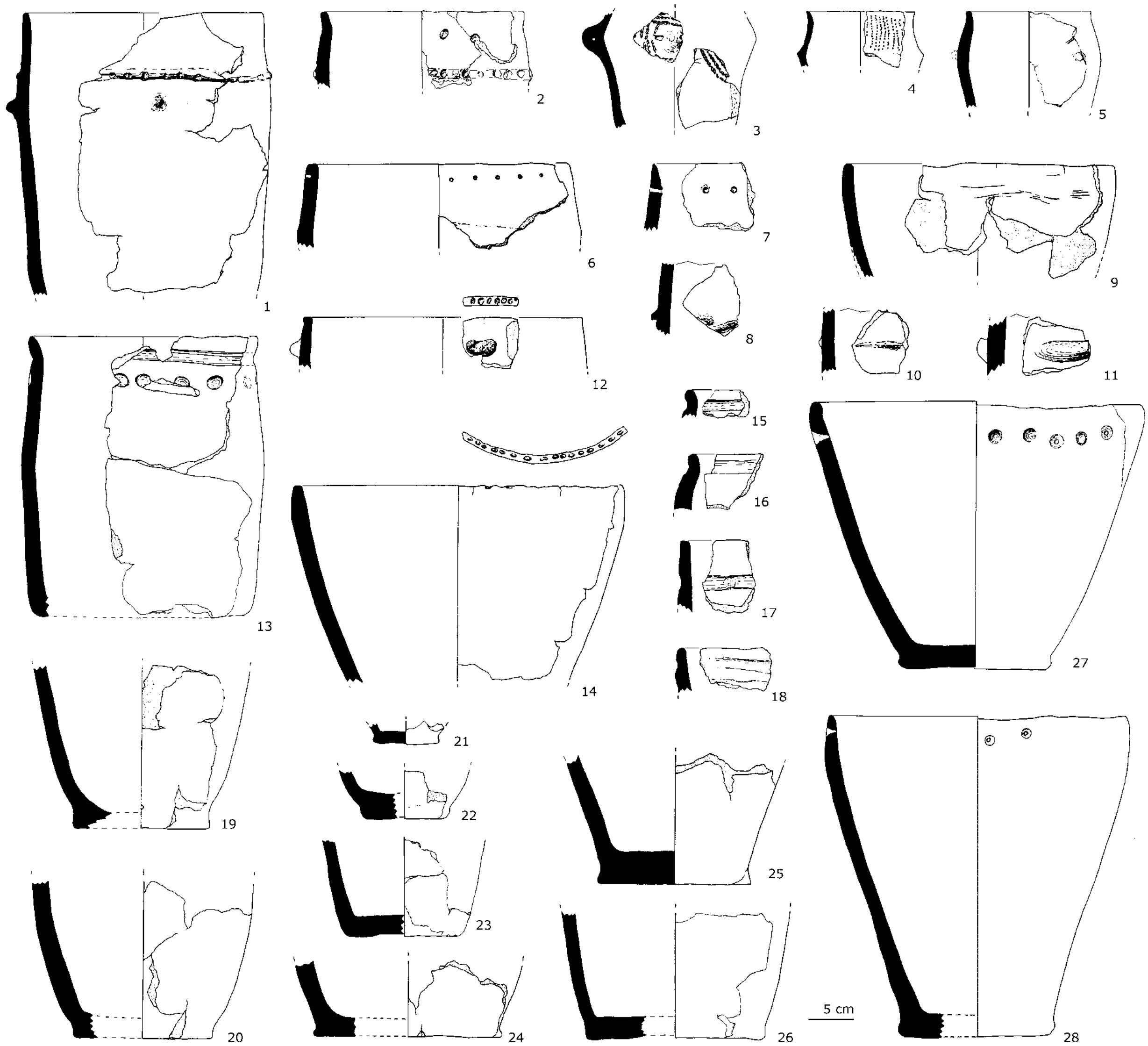

Figure 19. Sipplingen-Osthafen, ensemble SiJ. Complete pottery vessel inventory (after Kolb 1993, layer 13A).

ensemble SiK, however, there are none with applied plastic decoration (Kolb 1993, 207; the pot decorated with notched bands, pl. 22.162, comes from layer 13 — see catalogue Kolb 1993, 10; in the plate caption it is erroneously assigned to layer 13B).

Bad Buchau-Dullenried, Upper Swabia

The find assemblage, excavated in the 1920s (Figure 20), is dendrochronologically undated. ^{14}C dates from the 2000/2001 post-excavation study fall between 3332 and 3035 calBC (Schlichtherle 2004, 21). The multi-phased construction of the settlement possibly indicates a certain temporal depth for the find material (Schlichtherle 2004, 19). 122 vessel sherds and three spindle whorls were available for evaluation (Bollacher 2001). The range of shapes basically consists exclusively of pots with predominantly straight to inverted mouths. Curved or stepped rim forms are only documented four and two times respectively and are thus the exception (Bollacher 2001, 205). Three vessels reported as beakers (Bollacher 2001) (e.g. Figure 20.7) can also be seen as small pots.

The decoration spectrum is dominated by occasional fluting and a few perforated rims (incisions and actual perforations combined), single circumferential rows of finger impressions (Figure 20.22.23.26–27) and horizontal borders (Figure 20.1–3.9.11–12). Segmented plastic bands, also known as short bands (*Kurzleisten*), are relatively common (Figure 20.1), but are rarely found in Nußdorf.

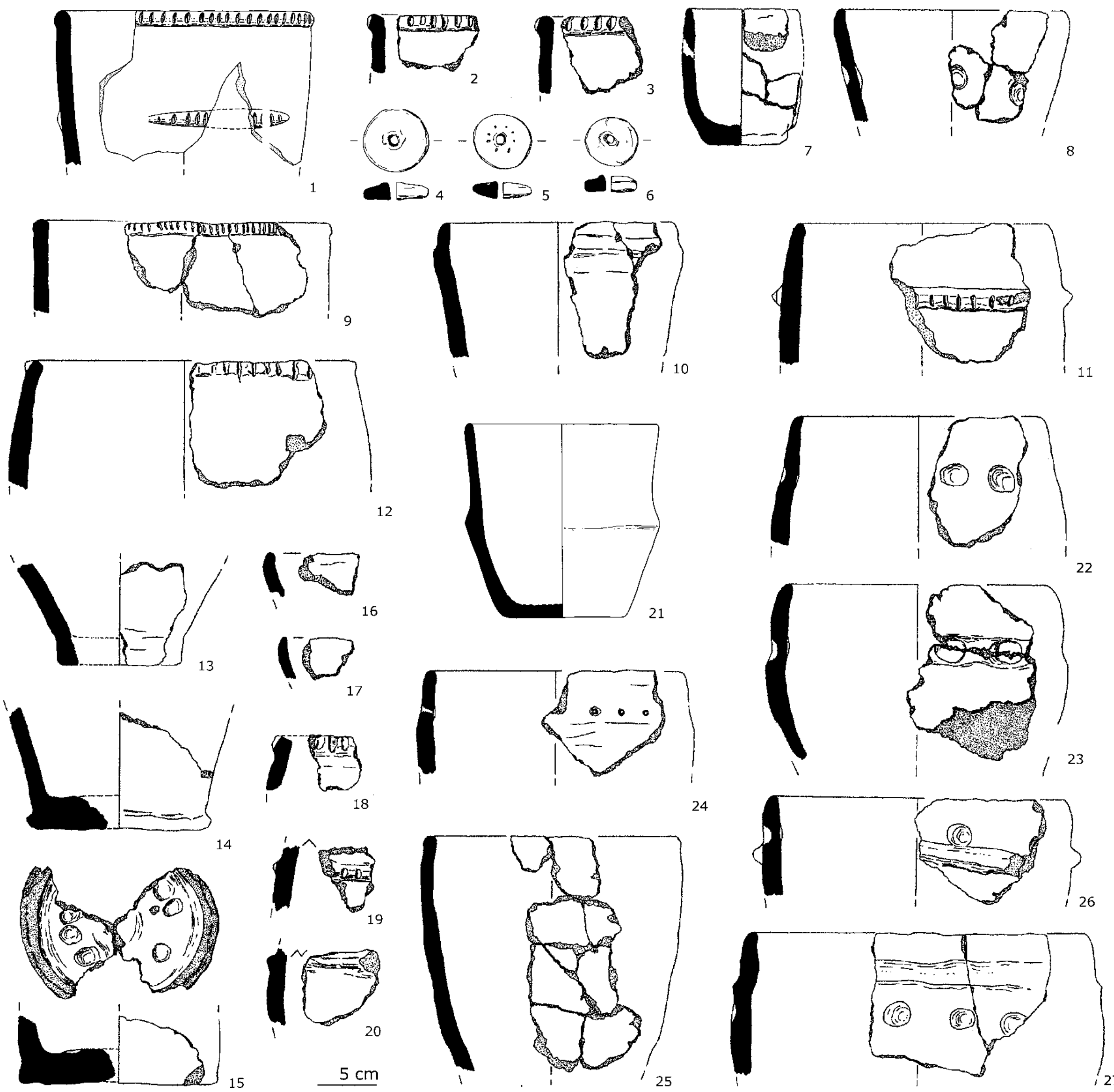

Figure 20. Bad Buchau-Dullenried. Selection of pottery vessels and textile tools (after Bollacher 2001).

It is also noticeable that the bands are often marginal (Figure 20.1–3.9.12) (Bollacher 2001, 206–07). Smooth bands are rare (Figure 20.20.26). The pot with a circumferential bulge (Figure 20.21) suggests a biconical vessel profile of the kind that later becomes popular in the context of the Goldberg III group of Upper Swabia (Schlichtherle 1999, 35–48; see below). In addition, some bases are stippled on the inside (Figure 20.15). This means that the Dullenried pottery is easily comparable with that from layer 4 of Nußdorf-Strandbad.

A cleft-hafted antler sleeve, spindle whorls as well as elbow-shaped wooden hafts with parallel cleft hafts fit easily into the inventory of the Middle Horgen culture (Bollacher 2001, 224–25, 284 fig. 63). It is noticeable that marginal notched bands and so-called short or segmented bands occur much more frequently in Dullenried than in Nußdorf. In the context of the Cham culture of Bavaria, marginal bands are attributed to the arcade rims of the Altheim culture (Matuschik 2001, 676) and are thus regarded as an indication of an older period. Together with the fact that short bands in Nußdorf also occur in the landward side of the settlement area, i.e. potentially before 3169 BC, this could mean that Dullenried has to be dated somewhat earlier than the bulk of the Nußdorf pottery.

Taken together, the two inventories from Nußdorf and Dullenried in the lake Constance/Upper Swabia region are trendsetting and at the same time characterise the ceramic facies of the “Nußdorf-Dullenried type”, which can be dated to the thirty-second century BC (Köninger 2009, 109; Schlichtherle 2004, 18).

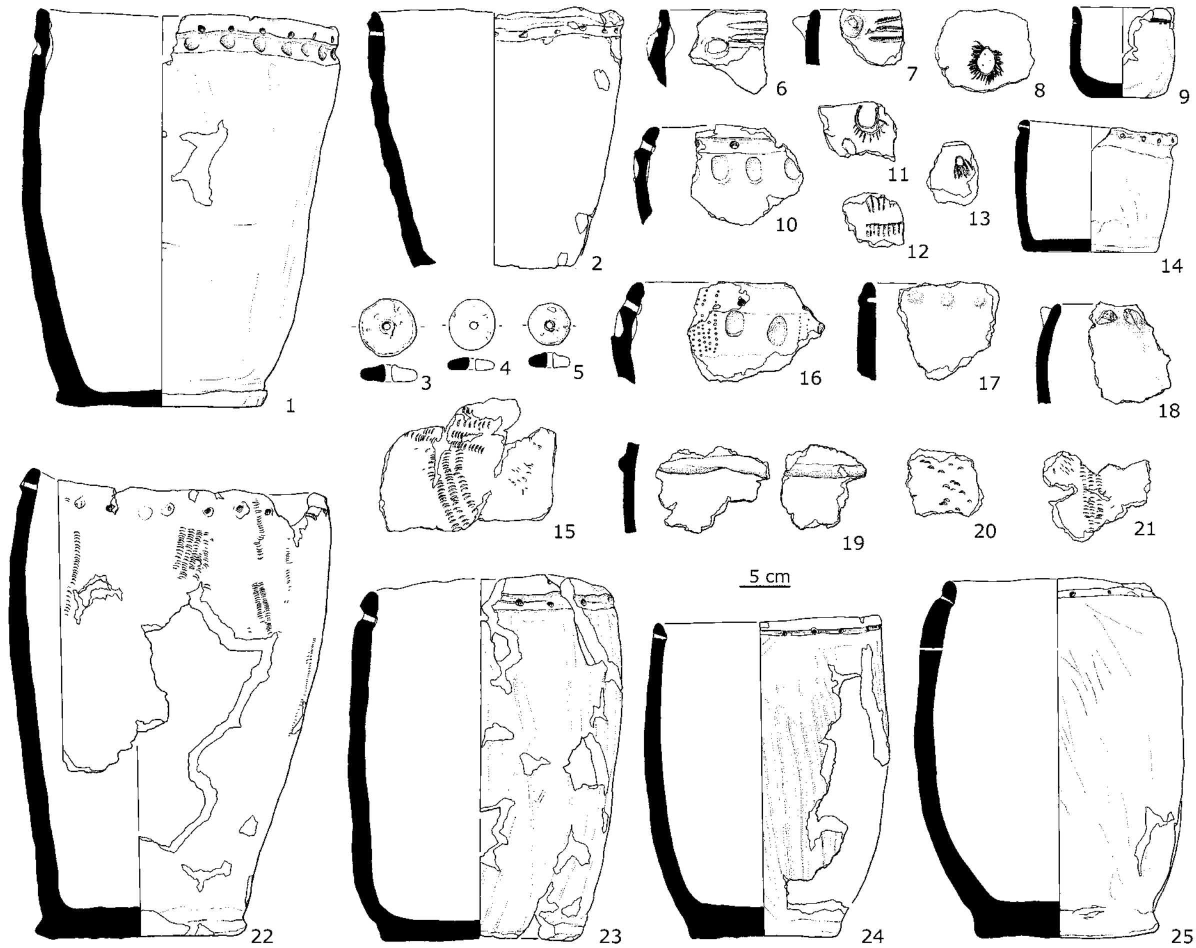

Figure 21. Zürich-Parkhaus Opéra 3. Selection of pottery vessels and textile tools (after Harb and Bleicher 2016).

Zürich-Parkhaus Opéra 3, lake Zürich

The rescue excavations carried out from April 2010 to the end of January 2011 during the construction of an underground car park in front of the opera house in the centre of Zurich (Bleicher and Harb 2015, 9) yielded one of the most extensive find assemblages of the thirty-second century BC for eastern Horgen in layer 13, an assemblage now known as Opéra 3 (Figure 21). The linked dendro-dates between 3176 and 3153 BC (around 3165 BC) fall within the time frame of Nußdorf-Strandbad (Bleicher and Harb 2015; 2017; Harb and Bleicher 2016).

The pottery spectrum is predominantly distinguished by slightly profiled, globular vessels, which are mostly decorated below the rim with grooves or fluting and rows of holes. A rim sherd decorated with plastic bosses (*Lochbuckel*) is remarkable (Figure 21.17). As far as can be determined, rims are predominantly inverted or straight; internally stippled bases are absent (Weber 2016, 32–33).

Considering that 3000 m^2 were excavated at Zurich-Parkhaus Opéra 3, yielding 26,767 sherds, the number of decorative elements common to the Nußdorf-Strandbad pottery is incredibly small. Five sherds decorated with smooth bands (Figure 21.19) (Weber 2016, 38) and four with circumferential fingernail impressions on the vessel wall (Figure 21.1.10.16) are worth mentioning. Fingernail impressions (Figure 21.15.21–22) on the vessel wall, gynaecomorphic double knobs (Figure 21.18), a ring (indented) knob and sun or bow motifs (Figure 21.8.11.13) are also present in only limited numbers (Weber 2016, 34–57). Measured against the total quantity of finds, the number of 31 spindle whorls is relatively low (Harb 2016, 202–03).

The selected pottery complexes show striking differences. In the lake Zurich area, perforated rims, fluting and grooved/scored bands (Weber 2016, 39–41) are dominant, while Danubian or north-eastern influences occur only sporadically, as in the other Horgen find assemblages from lake Zurich (e.g. de Capitani 1993, 63 pl. 7.1; Hardmeyer 1994, 83–84; Stöckli 2009, 253 pl. 17B.17; Weber 2016, 43). In addition to the regionally widespread decoration of simple circumferential finger impressions, the Horgen ceramics of the Nußdorf-Dullenried type include

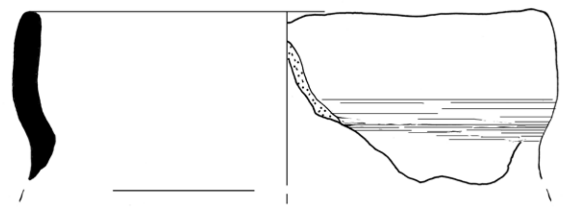

Figure 22. Nußdorf-Strandbad. Vessel with "thickened neck".

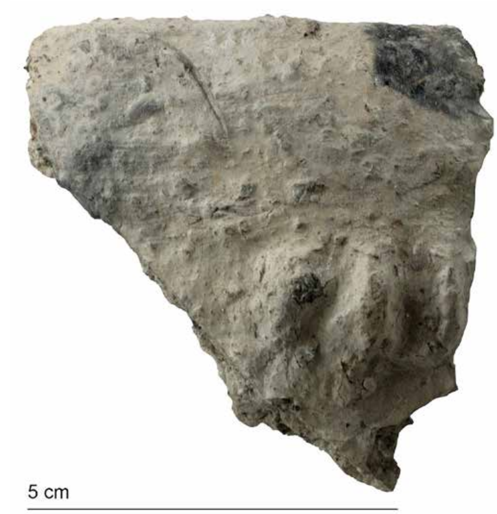

Figure 23. Nußdorf-Strandbad. Sherd with elongated vertical knobs ("ribs") (photo LAD, M. Erne).

Danubian influences, such as applied plastic decorations, vessels with handles or ring knobs. These were to become much more frequent later. Substantial Danubian influences in pottery apparently did not reach beyond the region of lake Constance/Upper Swabia.

Non-local influences — translocality at lake Constance in the thirty-second century BC

Indications of external influences (Bleicher *et al.* 2017, 253–62) in the Nußdorf find assemblage, as in the find material from the other shore settlements on lake Constance, can mainly be deduced from the pottery. The find material will have found its way into the lake Constance pile dwellings either as actual barter or trade goods, as ideas or conventions for their production by people, or through communication.

Long-distance trade routes and communication axes apparently ran along the major river systems (Köninger 2007, 50; Köninger and Schlichtherle 1999, 43–53; 2009, 390; Köninger and Schöbel 2010, 420–21; Mainberger 2016, 349–60; Mottes *et al.* 2002, 119–35), which may have been used less as actual waterways but rather as orientation aids (Mainberger 2016, 350 with dissenting hypothesis). Shallow headwaters and fast-flowing to torrential waters such as the Alpine Rhine would have been navigable with rafts or dugout canoes, if at all, then only to a limited extent, for example when water levels were favourable.

Lake Constance is in a central position in terms of transport geography, as it is indirectly or directly connected to the major central European river systems of the Rhine and the Danube. The Alpine Rhine opens the lake Constance basin to the south towards the central Alpine watershed, to the north it is connected to the Danube via the Schussen and the Federsee basin, and to the west and south-west it opens up via the High Rhine and the Aare. The extent to which the High Rhine area influenced developments further west cannot be determined beyond doubt, although this can be considered in individual cases (see below).

The west

Contacts to the regions west of lake Constance are sparse. Among the pottery, apart from a few stepped rims and the single piece of a pot with thickened neck (*Blähhals*) (Figure 22) (Stöckli 2009, pl. 38A.16), it is mainly the internally stippled bases that are known in some numbers from the Horgen shore settlements of western Switzerland on lakes Neuchâtel and Chalain in eastern France (see Figure 17.17–21). Surprisingly, similarities to eastern France are clearest in the Combe d'Ain, where at Lac de Chalain Station 3, Layer VIII yielded a larger number of internally stippled bases and band-decorated wares (Giligny *et al.* 1995, 314–40). The layer is likely to date between 3182 and 3158 BC on the basis of sapwood boundary dating of stratified timbers (Stöckli 2009, 184). In northern France, there are at least two other sites with internally stippled bases in the context of the Late Neolithic "Groupe Gord", which, however, are likely to be younger than the bulk of the Horgen bases of this type (Salanova *et al.* 2011, 78–79 fig. 1, tab. 1, 85–88 fig. 8).

The east/north-east

A few sherds of pottery are tempered with calcareous grit and haematite. They probably come from the area of the central Swabian Alb, directly to the north of Upper Swabia, where white limestone and nodules of bean iron ore with red haematite occur naturally (Köninger 2007, 23–24).

The majority of the non-local decorative and typological elements in the Nußdorf pottery spectrum are to be found further to the north and east, and predominantly in the Danube region. These include handled vessels, subcutaneously pierced handle lugs and ring knobs (also called "ring lenses" [*Ringlinsen*], Matuschik 1999, 84), the richly varied plastic decorations — dotted, notched, smooth and segmented bands (Matuschik 1999, 84–85; also listed under short bands and stippled or notched knobs) — so-called skimmed or smeared rims (*abgestrichene Ränder*, where a spatula or similar tool has been used

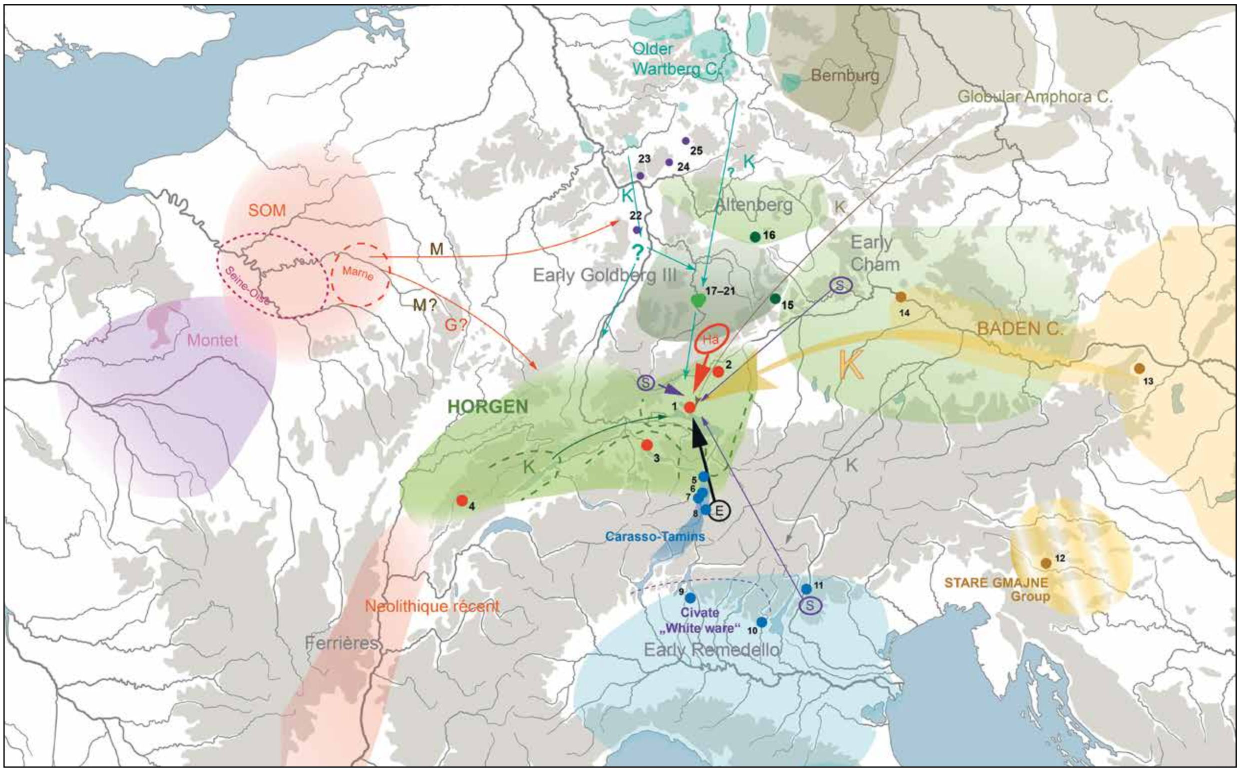

Figure 24. Foreign influences in the central Horgen area on lake Constance and sites mentioned in the text. Arrow sizes reflect intensity of contact (map based on Schlichtherle LAD, supplemented; for further literature see Köninger 2020, 78–79). Sites: 1 Nußdorf-Strandbad; 2 Bad Buchau-Dullenried; 3 Zürich-Parkhaus Opéra 3; 4 Chalain 3, cVIII; 5 Ochsenberg-Wartau; 6 Untervaz-Haselboden; 7 Tamins "Crestis"; 8 Cazis "Petrushügel"; 9 Civate "Bucco della sabbia"; 10 Monte Covolo; 11 Isera-La Toretta; 12 Stare gmajne; 13 Baden "Königshöhle"; 14 Parkstetten; 15 Goldberg; 16 Burgerroth; 17 Stuttgart-Hofen; 18 Stuttgart-Münster "Schnarrenberg"; 19 Stuttgart-Stammheim "Neubaugebiet Süd"; 20 Stuttgart-Stammheim "Sieben Morgen"; 21 Stuttgart-Mühlhausen "Viesenhäuser Hof"; 22 Eyersheimer Mühle; 23 Wiesbaden "Hebekies"; 24 Bad Homburg "Klinikum"; 25 Inheiden "Auf der Mauer". Abbreviations: E noble serpentine (*Edelserpentin*); G antler; Hä haematite and lime-grit temper; K ceramics; M megalith; S flint; SOM Seine-Oise-Marne culture. Regions: I lake Constance/Upper Swabia; II lake Zurich/central Switzerland; III western Switzerland.

to join the everted portion of the rim to the vessel wall), biconical vessels (see below) and numerous spindle whorls (Köninger *et al.* 2001, 648), for which H. Schlichtherle (1990, 223), following R.A. Maier (1959), already suspected influences from the south-eastern European Baden culture. Individual pieces of Baden ceramics can be found as far as the Nördlinger Ries, following the Danube (Matuschik 2001, 682, 718–19 figs 11–12) and their inspiration is thought to be responsible for the applied plastic decorations found in the Cham culture (Matuschik 2001, 676–84).

A handled biconical bowl with rectangular stamps (so-called *Formstiche* according to Burger's 1988 definition, as seen on the carination of the vessel Figure 9.30) and the biconical pot with a rim stamped in the same way (Figure 9.29) also find comparanda in the Cham culture (Gohlisch 2005, 91 fig. 52,19; Matuschik 1990, pl. 55.3), but also in the Wartberg group of Hesse (Schwellnus 1979, pl. 36.15) and the Globular Amphora culture (Beier 1988, 202 pl. 21.4).

Long oval vertical lugs or ribs (Figure 23) are found at the "Alter Berg" near Burgerroth in Lower Franconia (Spennemann 1984, 122 fig. 70.41), as well as among the Cham culture finds at Moosham-Flickermühle (Matuschik 1990, pl. 247.5; 1999, 88 fig. 17.9.10). Finally, rib-like vertical bands are also known on Baden amphorae from Bavaria (Raßhofer 2020, 210, 213), so it is possible that the ribs are a genuinely Baden decorative element. Evidence of lithic material of eastern provenance, in contrast, is the exception. The find of a flint knife is worth mentioning (Kieselbach 2020, 96–99).

The Danubian-oriented contact structure (Figure 24) outlined so far in the Nußdorf pottery can also be found in smaller pottery assemblages of the Nußdorf-Dullenried type and on individual pieces. Noteworthy are the above-mentioned sherds with applied plastic decoration from Ludwigshafen-Seehalde (Figure 25 A), Bodman-Weiler I (Figure 25 B), Dingelsdorf (Figure 25 C), Überlingen-Osthafen

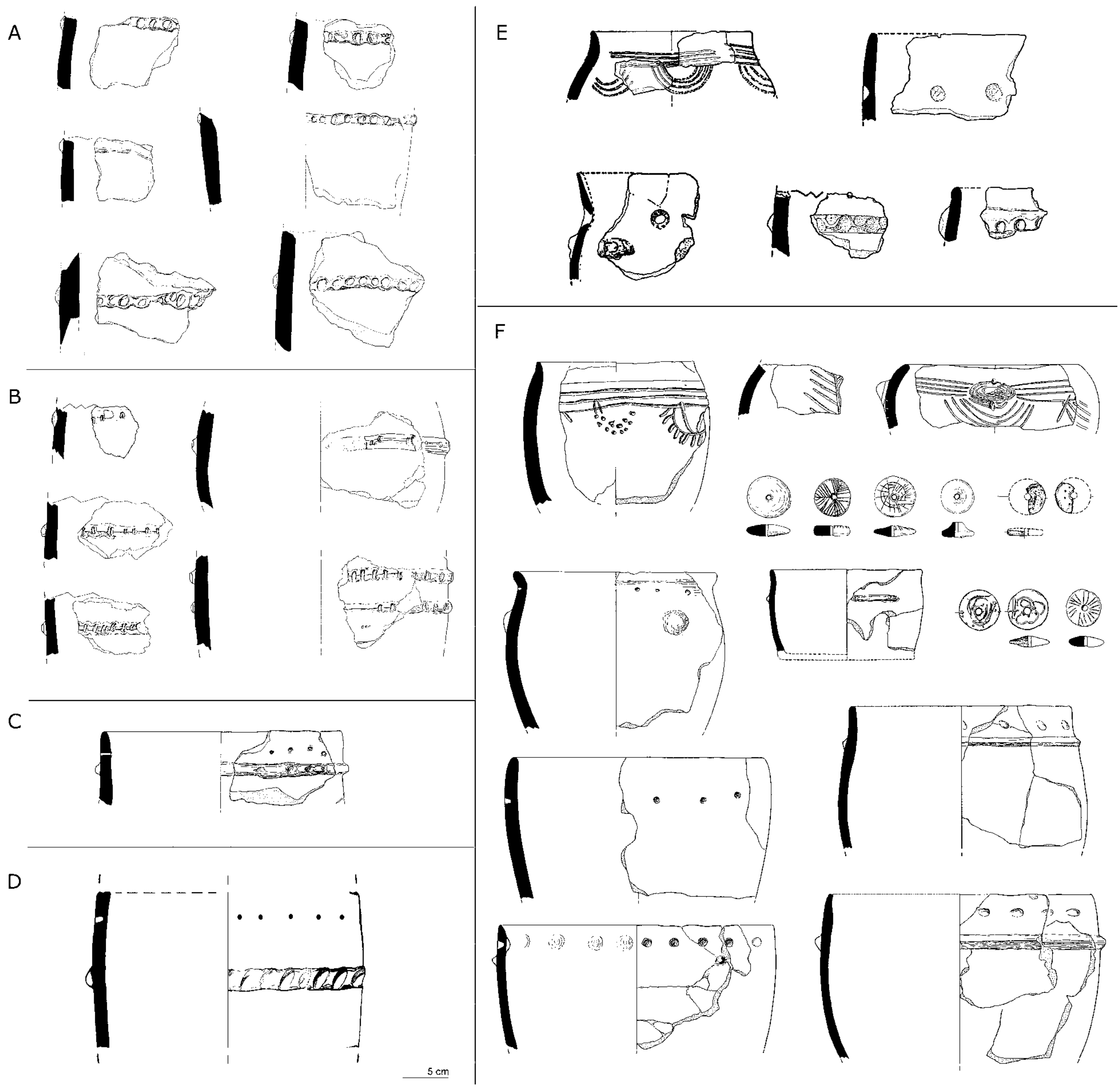

Figure 25. Pottery of Nußdorf-Dullenried type from lake Constance pile dwellings. A Ludwigshafen-Seehalde, layer 5; B Bodman-Weiler I, layer 7; C Dingelsdorf (site indet.; old find); D Überlingen-Osthafen (most likely attribution, old find); E Wallhausen-Ziegelhütte, layer 20 (sherds with plastic decorations, others from the surface of the lake bed); F Wangen-Hinterhorn (old finds). After Köninger 2020, 49 figs 56–57, 85–87 figs 108–10.

(Figure 25 D), Wallhausen-Ziegelhütte layer 20 (Figure 25 E) and Wangen-Hinterhorn (Figure 25 F). A sherd from Sipplingen ensemble SiJ, decorated extensively and slightly pierced on the surface (Figure 19.4), as well as cord-decorated vessel sherds from Ludwigshafen-Seehalde layer 5 (Figure 26) and Sipplingen-Osthafen ensemble SiJ (Figure 19.3), also point to the north and the east.

The decorated bowl with horizontal cord impressions from Ludwigshafen-Seehalde (Figure 26) finds good parallels at Kopfham-Galgenberg (Ottaway 1999, 108 fig. X3.12b — instead of cord impressions, there are incised lines), but comparable pieces can also be found in the context of the Globular Amphora culture in Poland (Köninger 2007, 47–48). Parallels to the biconical bowl extensively decorated with vertical incisions from Sipplingen ensemble SiJ (layer 13A) (Figure 19.4) are represented in the Cham culture (see Matuschik 1990, pl. 21.7, 133.27) and also occur among the finds of the Wartberg group (see Schwellnus 1978, 36, 47, pl. 27.15, 36.9). Only the vessel

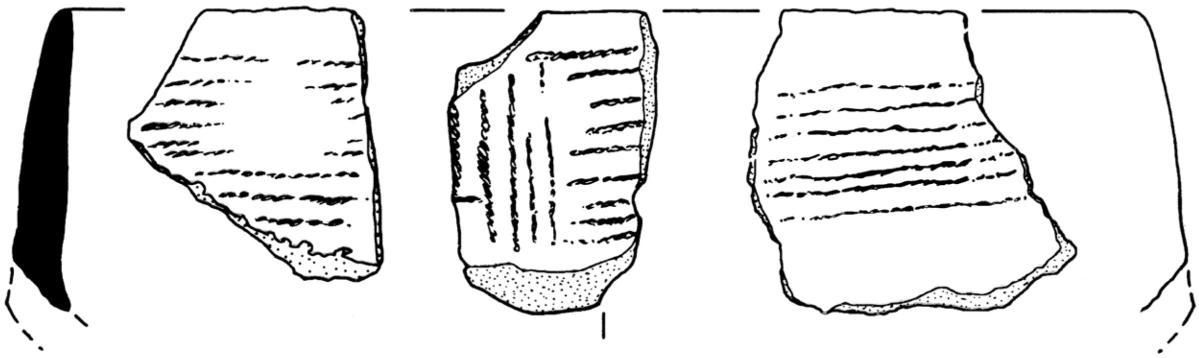

Figure 26. Ludwigshafen-Seehalde, layer 5. Cord-decorated biconical bowl.

with perforated lugs and cord impressions (Figure 19.3) from Sipplingen-Osthafen ensemble SiJ (layer 13A) can be assigned to the Globular Amphora culture (see Szmyt 2003, 107); in any case, no acceptable parallels can be found in the context of the Cham culture (Kolb 1993, 376).

The south

The relatively high number of "noble" serpentine (*Edelserpentin*) axes indicate a link to the south. The deposits of noble serpentine closest to lake Constance are in the Grison Alps (Köninger and Schlichtherle 1999, 43–53). Possible production sites of the axe blades can be found at Cazis-Petrushügel in the immediate vicinity of the deposits around the Piz Platta and Tamins-Crestis, Untervaz-Haselboden and Ochsenberg-Wartau downstream in the Alpine Rhine valley (see Figure 24.5–7). The hilltop settlements belong to the Alpine group of the Horgen culture, whose distribution reaches as far as canton Ticino and thus crosses the main Alpine watershed.

The provenance of the few Jurassic flints in the Nußdorf inventory is thought to be west of lake Garda near Monti Lessini (Kieselbach 2020, 98), and thus from the southern foothills of the Alps. It is uncertain whether the perforated rim with horizontal multiple bands from Nußdorf-Strandbad (Figure 9.25, Figure 11.7) also points in this direction. The corresponding pottery of the Tamins-Carasso type also has multiple plastic decorations, but the spacing between the bands is much greater and the rims are not usually perforated (Primas 1979, 13–27). The smooth multiple bands from the Cham context, which can also be associated with perforated rims, actually make a better match (Gohlisch 1999, 58–59 figs 3–4; Matuschik 1990, pl. 253.1a).

Cham, Horgen and Goldberg III

As already mentioned, most of the non-local elements on the Nußdorf ceramics are found in the context of the Cham culture, which is widespread in the Bavarian Alpine foothills along the Danube and in the Franconian Jura (Matuschik 1999, 87). In general, the cultural groups of Altenberg/Wartberg/Bernburg, which are located further north, are linked to the Cham culture by numerous similarities, including perforated rims (Matuschik 1990, 493), so that these decorative and formal elements may also partly indicate contacts with these cultural groups (see above).

The problem is that these comparative Cham culture finds almost all come from later Cham assemblages (on the internal division of the Cham culture see Matuschik 1992; 1999, 83–92; 2001, 675–82), which according to ^{14}C dates is most likely dated to the twenty-ninth/twenty-eighth century BC, at least after 3000 BC (Gohlisch 2005, 131–35, 146, 155 fig. 89; Stöckli 2009, 147–52). They are therefore clearly younger than the Nußdorf ceramics. According to ^{14}C dates, the earliest possible beginning of the Early Cham culture lies in the thirty-first century BC or not much later than 3000 BC (Gohlisch 2005, 145). One reason to postulate an earlier onset of the Cham culture perhaps in the thirty-second century BC (Matuschik 2001, 675) are the dendro-dated Nußdorf finds themselves. In this respect — pots without plots?

Find assemblages which can be dated with some degree of certainty to the thirty-second century BC do exist in Lower Bavaria, but their cultural affiliation is disputed. If one follows G. Raßhofer (2017, 107), it is a matter of judgement whether one considers the Lower Bavarian find assemblages with Baden pottery to indicate an independent Baden settlement phase (Engelhardt 2011, 153), or whether one assigns them to an Early Cham group (Matuschik 2001, 683–84). Both Early Cham, Classic Baden in Lower Bavaria (Raßhofer 2017, 77) and an older phase of Cham following Gohlisch (2005, 146) are only sparsely attested by finds (Figure 27), so the possibilities for comparison are limited.

Were these influences visible on the pottery instead to be ascribed in a general way to the Wartberg/Bernburg or Globular Amphora cultural groups further north or east, which according to ^{14}C dates (Raetzel-Fabian 2002, 5 fig. 2; Szmyt 2003, 112 tab. 2) are more likely to be contemporary with Middle Horgen, the problem would merely be

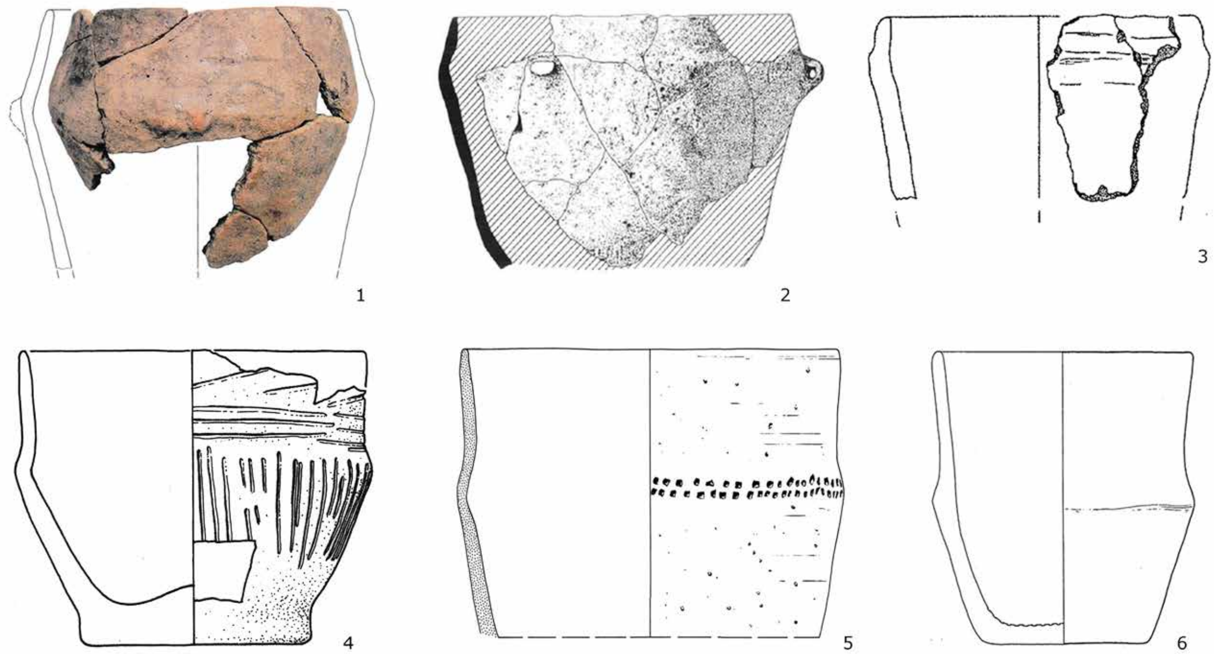

Figure 27. Comparative finds from Bavaria, Upper Swabia and lake Constance. 1 Altenmarkt, Baden/Early Cham? (after Raßhofer 2017); 2 Galgenberg, Early/Older? Cham (after Ottaway 1999); 3 Bad-Buchau-Dullenried, Middle Horgen (after Bollacher 2001); 4 Sipplingen-Osthafen, Middle? Horgen (old find); 5 Hienheim, Early/Older? Cham (after Modderman 1971); 6 Bad-Buchau-Dullenried, Middle Horgen (see Figure 20.21).

displaced, since only the Cham and Goldberg III cultural groups could act as possible mediators, unless one were to envisage transmission via the Upper Rhine (see Figure 24). On the one hand, however, there are only a few sites (Figure 24.17–20) between the Wetterau and the area around the confluence of the Neckar and the Rhine which could prove this (Raetzel-Fabian 1990, 161–76), and on the other hand, their find material is difficult to classify precisely, both chronologically and culturally.

The heterogeneous find assemblage from the old excavations at Eyersheim mill (Figure 24.8) (Bantelmann 1984, 16–36 pl. 1–7) with stab-and-drag ornamented pottery, cord decorations, biconical profiles and two antler sleeves could cover a longer time period, roughly between the thirty-third and thirtieth/twenty-ninth centuries BC. The pottery from Bad Homburg "Klinikum" (Figure 24.10) (Meyer 2010, 28), decorated with textile impressions and presented descriptively in preliminary report form, is more likely to date to the thirtieth/twenty-ninth centuries BC. This also applies to the finds from Inheiden "Auf der Mauer" with collared bottles, biconical bowls and cups and biconical vessels (Figure 24.20) (Sailer 1998, 243 fig. 40). Typologically comparable pieces to the finds from Wiesbaden "Hebenkies" (Figure 24.18), namely to the sherds with elongated perforated knobs (Bantelmann *et al.* 1980, 226 fig. 23.3–10), can be found among the finds from the "Alter Berg" near Burgerroth (Spennemann 1984, 122 fig. 70.5), which have been ^{14}C-dated to the middle of the third millennium BC (Link 2016, 123). In contrast, the ^{14}C date of 4610±50 BP (3410±50 calBC) obtained at Hebenkies (Bantelmann *et al.* 1980, 233) would in any case fall before 3200 BC.

The long-distance connection via the Upper Rhine and Middle Rhine to the mountain ranges of central Germany is, therefore, definitely an option that should be kept open, also in view of the partly contradictory dating approaches, even though it is currently only weakly documented and cannot contribute anything substantial to the problem of Early Cham or Early Goldberg III, given that a good part of the non-local elements in the Nußdorf material is clearly of Danubian character.

The resulting hypothesis could therefore be that there must have been an early phase of the Goldberg III group or Cham culture in the thirty-second century BC, whose find material is, however, currently difficult to characterise. In the case of the Older Cham, this could be indicated by the statistically less probable sections in the 2σ range of the ^{14}C data series (Matuschik 1999, 83 fig. 12); for Early Cham or Classic Baden in Lower Bavaria, this hypothesis, supported by the four ^{14}C dates from Parkstetten (Raßhofer 2017, 103 fig. 31), is already more probable. The hypothetically assumed thirty-second century Early Cham culture in Bavaria is thus a little more than just an unsatisfactory construct resulting from the aforementioned dilemma, but is in the process

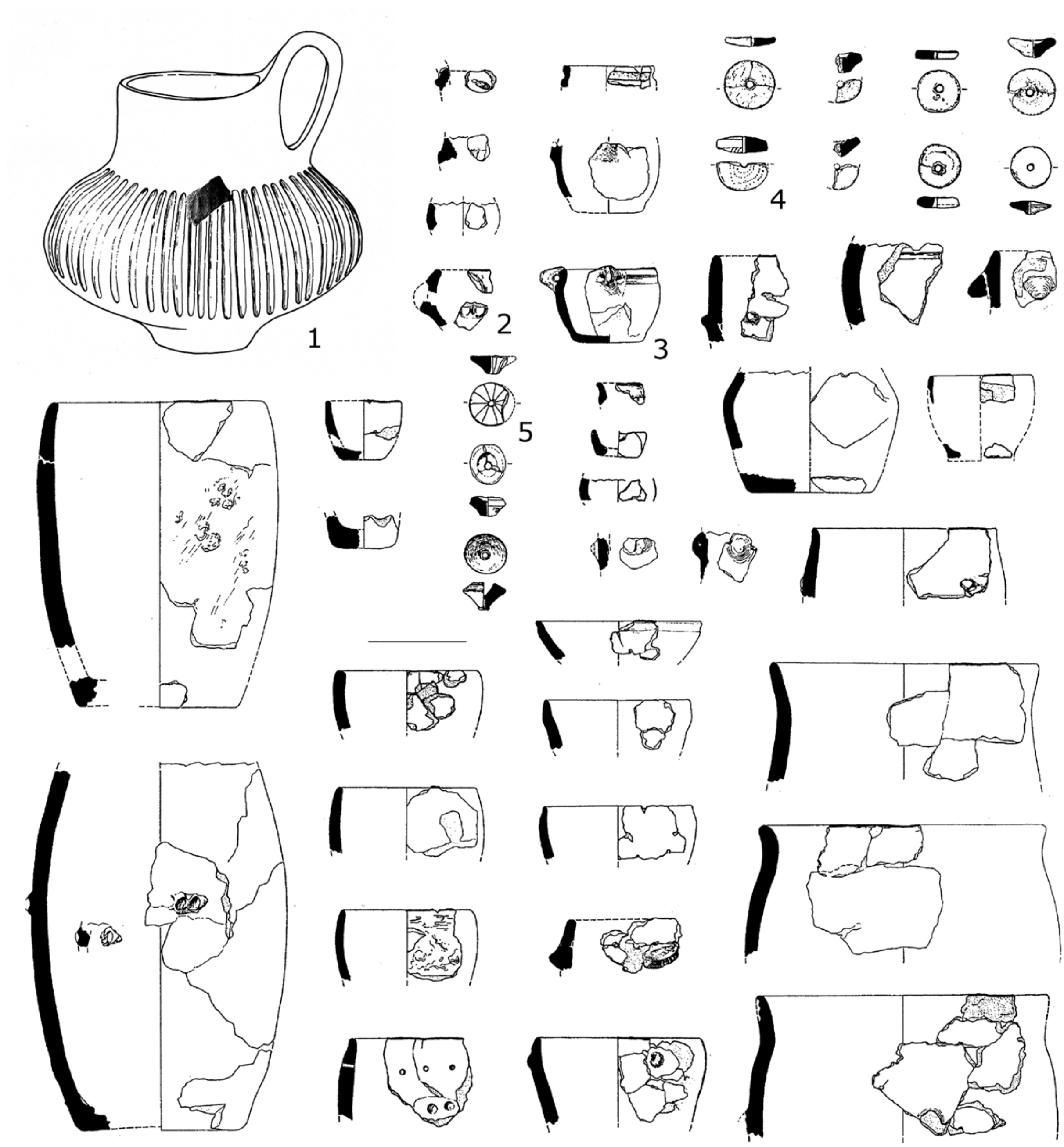

Figure 28. Bad Buchau-Torwiesen II. Ceramic spectrum (after Schlichtherle 2004, 18 fig. 7).

of being substantiated by ^{14}C dates and find material (see Figure 27).

For the early phase of the Goldberg III group, the starting point is more favourable. While the dendro-dates of the Goldberg III group of Upper Swabia, neighbouring the lake Constance area, lie between 2906 and 2856 BC (Wolf *et al.* 2016, 79–80), contours of an Early Goldberg III are beginning to emerge for the central Neckar region thanks to ^{14}C dates falling well before 3000 BC and the associated find material from the sites and pithouses of Mühlhausen "Viesenhäuser Hof", Hofen, Stammheim "Sieben Morgen" and "Neubaugebiet Süd" to the north-east of Stuttgart (Matuschik and Schlichtherle 2009, 35, 48–49; Schlichtherle and Joachim 2008, 42–43). At these sites, biconical bowls (Schlichtherle and Joachim 2008, 41 fig. 20.1.4), wall sherds of collared bottles (Matuschik and Schlichtherle 2009, 48–49, 52–53, pl. 5.68.78), and applied plastic decorations (Matuschik and Schlichtherle 2009. pl. 5.69.70.73.74.76), as well as antler sleeves with strikingly elaborate extended lobes (Matuschik and Schlichtherle 2009 pl. 1.5, 4.57), underline the mediating role of the middle Neckar region between north and south even for the thirty-second century BC.

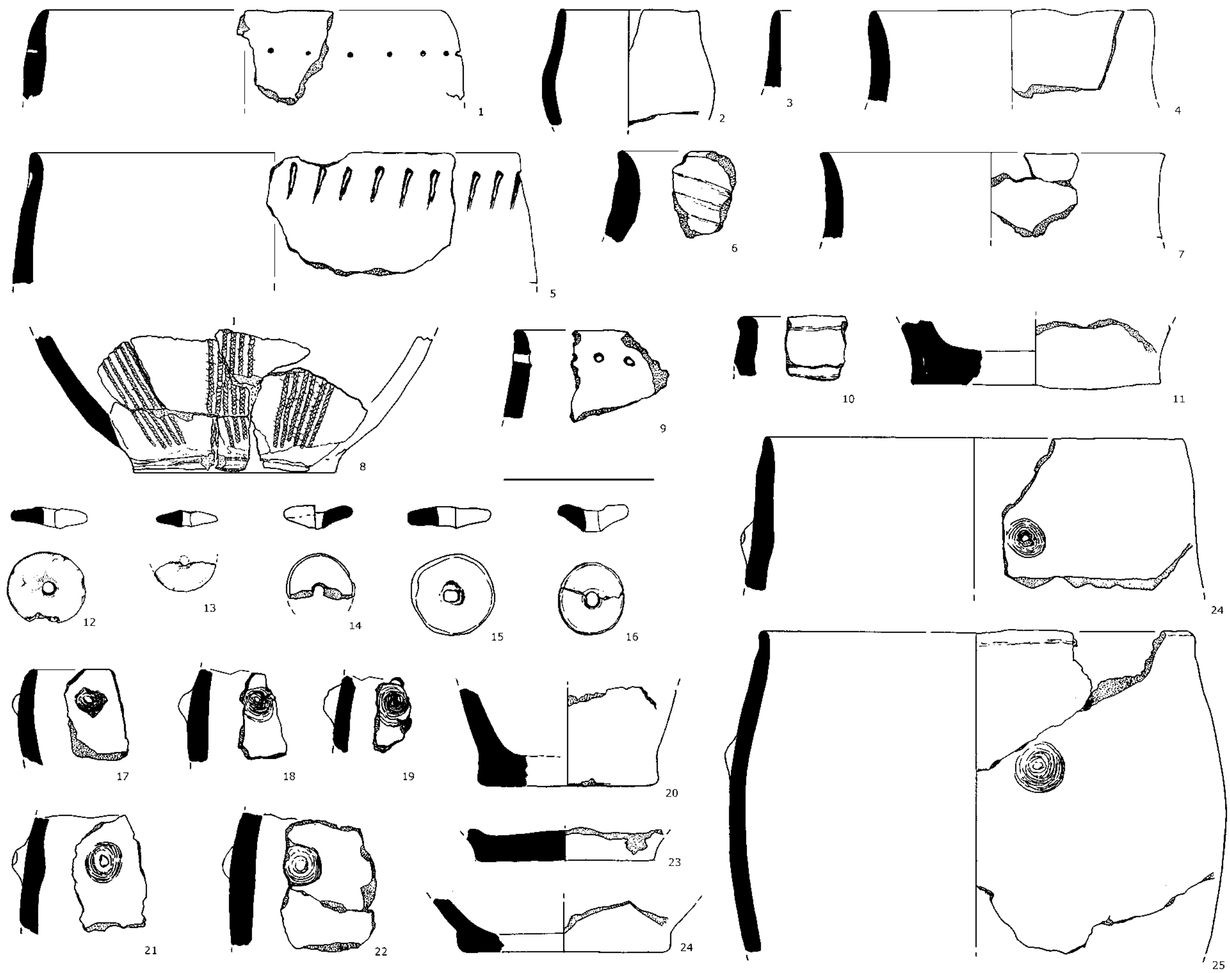

Figure 29. Wallhausen-Ziegelhütte, layer 2a. Ceramic spectrum with lower part of a bowl decorated with cord imprints (8), spindle whorls (12–16) and ring-shaped knobs (21, 25) (after Köninger 2009, 104–05 fig. 33).

Discussion: Danubian influences in the Horgen culture at lake Constance and in Upper Swabia

Danubian influences are here primarily understood as ornamental and typological elements of ceramic style in the sense of J. Lüning (1996). Accordingly, they can often serve as parameters when it comes to changes in the social or economic structure of settler communities. Such Danubian links have repeatedly been identified in the south-western German–Swiss Alpine foothills since the Early Neolithic (Köninger *et al.* 2001, 653) and have also repeatedly been attested in the context of the Horgen culture for the region of lake Constance/Upper Swabia (see Figure 30). The sequence can be summarised as follows:

An early Danubian impulse can be seen in the Late Neolithic in the earliest Horgen culture at lake Constance already in the thirty-fourth century BC, attested by Baden-Boleráz-type pottery. This can be supported by well-stratified material from Arbon-Bleiche 3 (de Capitani 2002), as well as by the old finds from lake Constance pile dwellings on the German shore (Köninger *et al.* 2001, 643–49, 664 fig. 2). The small find ensemble from Bad Buchau-Bachwiesen III in Upper Swabia may also belong here (see Figure 7, bottom right) (Schlichtherle 2009, 70–75).

In the ensuing thirty-third century BC, elements of Baden or Baden-Boleráz are evident in the bog settlement of Bad Buchau-Torwiesen II in the Federsee area in the shape of a sherd with fluted decoration (Figure 28.1), a saddled handle (*gesattelter Henkel*) (Figure 28.2), a cup with its handle protruding above the rim (*überrandständiger Henkel*) (Figure 28.3) and a short band (Figure 28.6). In addition, there are numerous spindle whorls (Figure 28.4.5) (Schlichtherle 2011, 23–24). At lake Constance, on the other hand, such clear Baden elements are lacking in the pottery of the thirty-third century BC, although it must be pointed out that the material base is poor. For Sipplingen, the stippled knob from ensemble SiH (layer 12) (Kolb 1993, pl. 11.3), which could also be regarded as a band segment, and a smooth band (Kolb 1993, pl. 12.92) could be regarded as weak indications of Danubian influences. This is clearer for the ceramics from layer 2a of Wallhausen-Ziegelhütte, which yielded Danubian ring knobs (Figure 29.21.25) and spindle whorls (Figure 29.12–16) (Köninger 2009, 104–05, 107–08, pl. 1–3). Furthermore, the sherds of a vessel base with braided cord decoration (Figure 29.8) point to the north-east, to the Luboń group of the Polish Funnel Beaker culture (Köninger 2009, 108).

In the thirty-second century BC, strong Danubian influences are recorded both at lake Constance and in Upper Swabia with pottery of the Nußdorf-Dullenried type (see above).

The material base for the thirty-first century is weak. With Sipplingen ensemble SiK (layer 13B), the small sherd of a biconical pot with shallow incisions (Figure 30) (Kolb 1993, pl. 22.160) can perhaps be regarded as an isolated indication of Danubian influences — on the basis of ^{14}C dates it is rather unlikely to see this as a contact find to the "Burgerroth/Altenberg group" (Link 2016, 123).

In the early thirtieth century BC, the Horgen culture of the lake Constance area seems to have oriented itself more towards the west, as indicated by a butterfly bead (Kolb 1993, 253 pl. 58.568 layer 14), a rim with knob garlands (*Knubbenkranz*) (Kolb 1993 195, 378; see also Figure 7 ensemble SiM) or a stepped rim from Sipplingen ensemble SiM (layer 14). Isolated smooth bands from layer 14 (Kolb 1993, pl. 31.243.245) could therefore also be attributed to western contacts. Once again, however, this result is based on sparse data and potentially subject to revision.

Finally, for the late thirtieth and the first half of the twenty-ninth century BC, a last phase of Danubian influence is indicated by the well-stratified biconical bowls of the Goldberg III type in several lakeshore settlements at lake Constance (Köninger 2007, 47–50 fig. 51) (Figure 7 ensemble Sipplingen SiN). In addition, there is an isolated sherd with vertical and horizontal bands from Haltnau-Oberhof and a multi-peaked knob from the Late Horgen context in Bodman-Weiler II (Köninger 2007, 25–26 fig. 25, 47–48 fig. 48), both at lake Constance.

The assemblage from Meersburg-Ramsbach (Figure 31) on the northern shore of lake Constance also deserves to be highlighted, as it contains wares with applied plastic decoration in combination with biconical bowls and a handled vessel suggesting influences from the Goldberg III group, which was established in Upper Swabia by the twenty-ninth century BC at the latest. In the thirty-second and thirtieth/twenty-ninth centuries BC, pottery tempered with haematite and calcareous grit also reached lake Constance; its origin can be assumed to be in the central Swabian Jura.

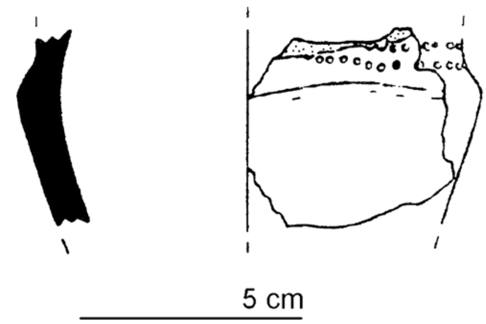

Figure 30. Sipplingen-Osthafen, Ensemble SiK. Biconical pot with shallow incisions.

Thus, from the thirty-fourth century BC onwards, Danubian influences are recognisable at lake Constance in the context of the Horgen culture in three time windows. According to M. Kolb (Kolb 1993, 380–81), a more westward-oriented phase is perhaps indicated by Sipplingen ensemble SiM (layer 14; see Figure 7) for the early thirtieth century BC. It remains unclear whether the ceramic finds indicate a continuous influx of people or ideas from the Danube region, which can only be established archaeologically at certain points, or whether they were in fact individual, temporary processes which, as in the case of Bad Buchau-Torwiesen II, hardly went beyond the Federsee area in the thirty-third century BC. It is striking that in the thirty-fourth century BC, Baden-Boleráz type pottery is present at lake Constance, but absent in Upper Swabia. In this case, one would think that the lack of evidence is more likely to be due to taphonomy and does not reflect actual processes.

No matter how continuous the influx of Danubian influences may have been, it is a phenomenon that can be traced over several centuries, beginning as early as the Early Neolithic and having a lasting influence on the Horgen culture in the region of lake Constance and Upper Swabia. It is difficult to say with any certainty what was behind these influences, which can be identified first and foremost in the pottery. Indications can be gleaned from the different types of these foreign wares. Four aspects can be identified that could be subsumed under the term influence.

Firstly, it is likely that people from the central Swabian Alb actually reached lake Constance. Secondly, people from outside may also have joined the settlements at lake Constance, where they produced their pottery in the traditional way (de Capitani 2002, 216; Hosch and Jacomet 2004, 157). Thirdly, and this is not so clear-cut, "non-local" pottery could have been imitated by local people (de Capitani 2002, 216), or the new arrivals could have produced their traditional

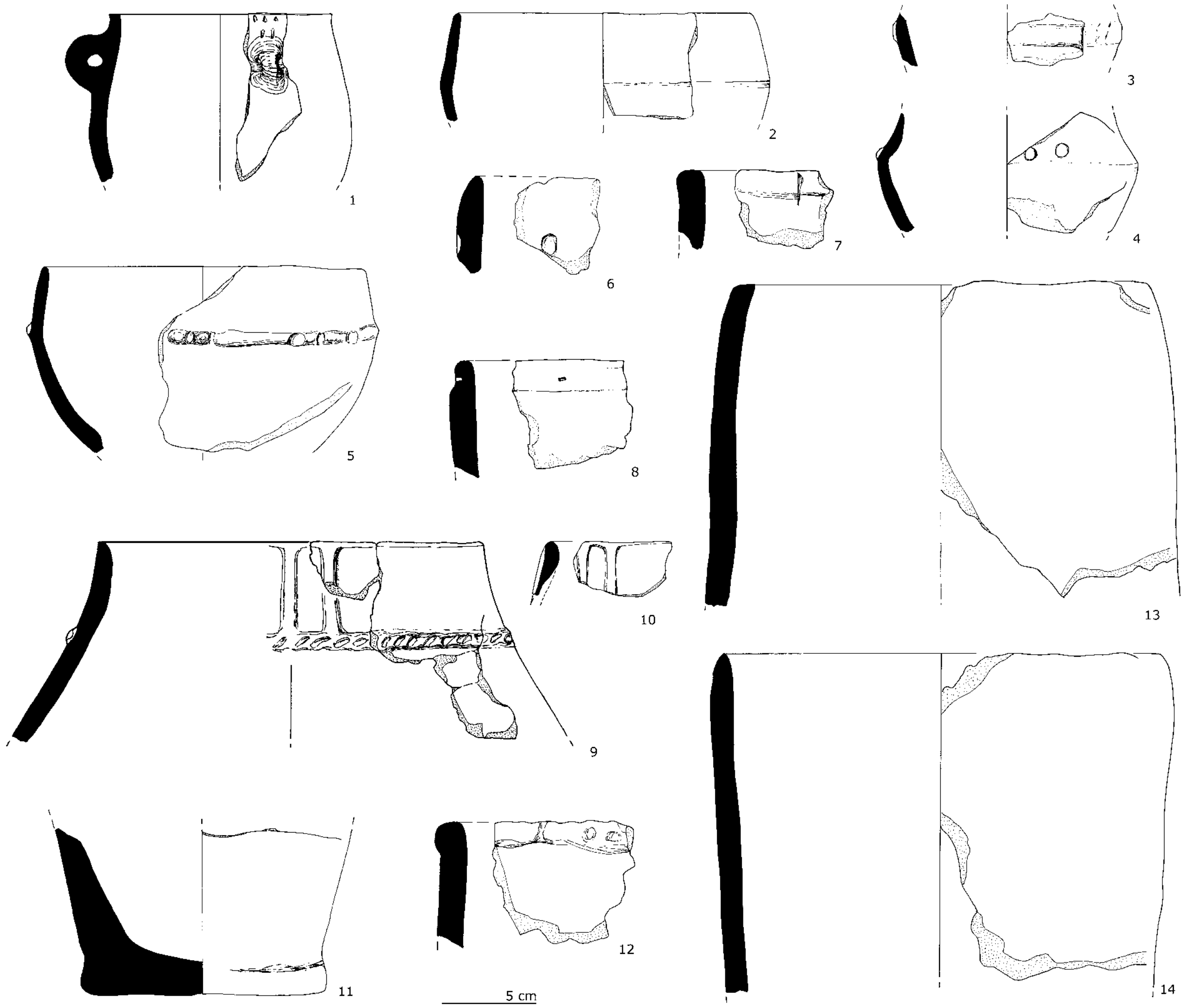

Figure 31. Meersburg-Ramsbach, feature 2 and the lake floor. Ceramic spectrum of the thirtieth/twenty-ninth centuries BC. Sherds 3, 4, 8, 9, 11, 13 and 14 come from the uppermost cultural layer of feature 2 (after Köninger 2007, 41–43 fig. 44).

pottery with local technology. The final possibility is particularly fascinating. Here, pots of local shapes were decorated in a non-local manner. This is especially true of the Horgen wares from Nußdorf, but also applies to those from Meesburg-Ramsbach. In one or two cases, it cannot be ruled out that mobile individuals actually reached the lake Constance area by following the Danube upstream.

The diffusion processes envisaged by Schlichtherle (Köninger *et al.* 2001, 653) could therefore also have come about in part through migration (Heitz and Stapfer 2016, 151; 2017). At least for the last stage between the Swabian Alb and lake Constance, this is likely. Whatever the provenance of the Horgen applied plastic ornamentations and handled vessels is, it is clear that these "non-local wares" do not stand alone (Lüning 1996, 236), but that processes of upheaval, development, reorientation or demographic change went hand in hand with ceramic change. Therefore, this will hardly have been solely a change in ceramic style.

It can be assumed that the associated contacts were also linked to economic innovations (Figure 32). It is hardly a coincidence that economic changes can be observed with the appearance of foreign elements from the Danube. With the change in cereal and weed spectra, spelt wheat species — especially durum wheat — become dominant (Herbig 2009, 38; Kohler-Schneider and Caneppele 2009, 67), flax and opium poppy play an increasingly important role in the cultivated crop spectrum and a small-seeded fibre flax appears for the first time (Herbig 2009, 40–41; Karg 2020, 141–52; Karg *et al.* 2018, 33–38; Kohler-Schneider and Caneppele 2009, 67). The emerging use of draught animals (Deschler-Erb and Marti-Grädel 2004, 245–54; Hosch and Jacomet 2004, 135–57; Leuzinger 2007; Steppan 2007, 58–60) and at the same time — at least on the western shores of lake Constance — the increasing formation of colluvia (Vogt 2014) suggests that from the Late Neolithic

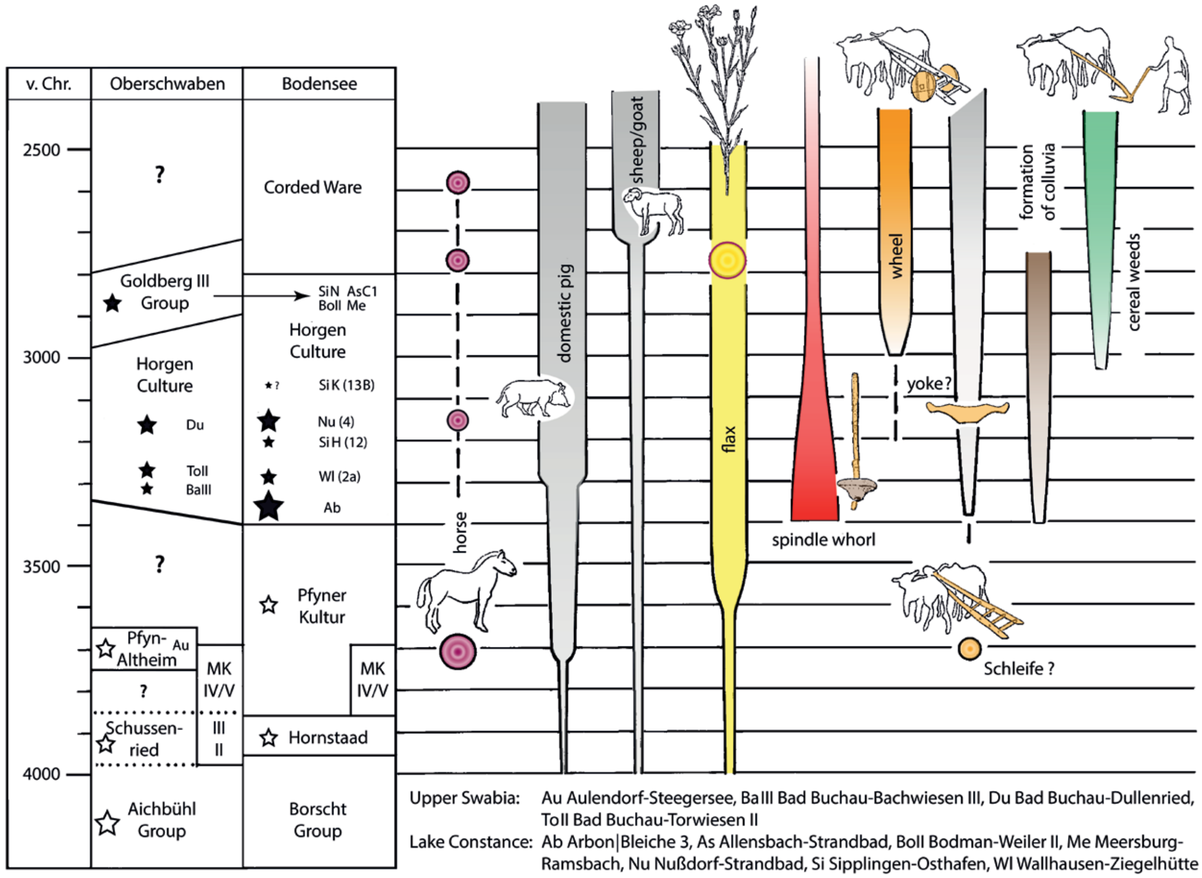

Figure 32. Cultural succession and innovation in the lake Constance/Upper Swabia area and foreign elements from the Danube in the pottery inventories. Open star: Younger Neolithic; filled star: Final Neolithic. Symbol size reflects frequency. MK: Michelsberg culture (after de Capitani 2002; Köninger 2009; Köninger *et al.* 2001; Schlichtherle 2004; 2009. Graphic: H. Schlichtherle, supplemented).

(Spätneolithikum *sensu* Lüning 1996) onwards, arable land was cultivated intensively over a longer period of time. This ultimately signals the beginning of arable farming in the true sense of the word (Köninger *et al.* 2001, 651–53) — although the botanical indications do not seem to be quite so clear-cut (Herbig 2009, 58). At the same time, pollen and macro-remains for the lake Constance/Upper Swabia/lake Zurich area signal the continuing opening up of the landscape (Herbig 2009; Köninger *et al.* 2001, 651–53) and the emergence of grasslands (Herbig 2009). The development of the crop spectra in the lake Constance/Upper Swabia area and at lake Zurich run largely parallel in the Late Neolithic (Herbig 2009, 38–39). In contrast to the lake Constance/ Upper Swabia area, however, the accompanying innovations are not strongly expressed in the ceramic spectra of lake Zurich.

The high number of spindle whorls indicates the intensification of textile production, accompanied by an intensification in flax cultivation (Herbig 2009, 31, 38) and presumably also by the emerging use of sheep's wool (Grabundžija 2020, 59–61; Grabundžija and Schlichtherle 2021, 640). The wheel and wagon may have arrived here in the course of Danubian technology transfers from the Carpathian Basin and the Lower Danube, traced using pottery (Köninger *et al.* 2001, 651). This is conceivable despite striking differences in wheel and wagon technology (Schlichtherle 2002; 2016). The eastward-oriented translocality of the Nußdorf pottery style was thus only the visible expression of profound transformation processes that began in the thirty-fourth century BC.

Translation: Jamie R. McIntosh

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The time of the cord rollers

Textile-roughened pottery of the early third millennium BC and cultural transmission networks from a south-western German perspective

Philipp Gleich

Abstract

Researching supra-regional contact networks shortly before the spread of the Corded Ware is an important step towards a better understanding of the cultural changes during the early third millennium BC in central Europe. A widespread feature connecting different pottery styles during that time are textile-roughened surfaces. The starting point of this study is an analysis of pottery from south-western Germany and Switzerland. In agreement with older examinations, the use of cord-wrapped roulettes is considered a valid explanation for most of these finds. In order to follow Late Neolithic textile-roughened pottery in space and time, a literature survey of its distribution and absolute chronology is undertaken. The use of different textile tools for the treatment of pottery surfaces appears between the Upper Rhine and the northern Carpathians within the first centuries of the third millennium BC, indicating a wide-ranging contact network. The question of a continuation of this practice after the emergence of the Corded Ware culture is still open for most areas. Radiocarbon dates from the Baltic states indicate similar or even higher ages of the oldest textile-roughened pottery within that area. Potential connections between the central and eastern European clusters of occurrences are not yet clear.

Keywords: textile-roughened pottery, Goldberg III pottery, Late Neolithic, supra-regional networks, chronology

General problem: the question of transmission networks in central Europe before the spread of the Corded Ware

The spread of single burial customs and an increasing standardisation of pottery styles in central Europe are considered important symptoms of the spread of the archaeological phenomenon of the so-called "Corded Ware culture". Several explanation models for these processes have been suggested. They either emphasise a spread through migration processes from the eastern European steppe zone or transmission processes within cultural networks in central Europe (Furholt 2017; 2019; Haak *et al.* 2015; Heyd 2017; Kristiansen *et al.* 2017; Kroon *et al.* 2019).

To make progress in this debate and to gain more insights into the overall developments during the early third millennium BC, a deeper understanding of pre-Corded Ware

In D. Hofmann, D. Mischka and S. Scharl (eds) 2025. *The eve of destruction? Local groups and large-scale networks during the late fourth and early third millennium BC in central Europe*, 95–122. Leiden: Sidestone Press.

German term	English translation (P. Gleich)	Literature (examples)
Binsenkeramik	rush pottery	Schneider 1924
textilverzierte Keramik	pottery with textile decoration	Dirks 2000
mattengerauhte Keramik	mat-roughened pottery	Dehn and Sangmeister 1954; Müller-Karpe 1951
Keramik mit Textilabdrücken	pottery with textile impressions	Schlabow 1960; 1971
abrollgerauhte Keramik / abgerollte Abdruckzier / Keramik mit Schnurabrollungen	pottery with roulette roughening / roulette-impressed decoration / pottery with rolled cord decoration	Matuschik 1999; Schlichtherle 2018; Schrickel 1969; Spennemann 1984

Table 1. German terms for textile-roughened pottery and their English translations.

English term	German term	Explanation
textile roughening	Textilrauung	general term for a roughening with textiles of as yet unknown character (detailed examination missing)
corded roulette roughening	Abrollrauung mittels Schnurwicklung	use of a roulette with a simple cord (twisted or turned) wrapped around it
braided roulette roughening	Abrollrauung mittels Flechtröllchen	use of a more complex roulette produced by some kind of braiding technique

Table 2. Terms used to describe textile-roughened pottery in this article.

cultural networks is crucial. On which spatial scale did cultural transmission operate within these networks, and which cultural practices were affected? Did an increasing supra-regional standardisation only begin with the spread of the "Corded Ware culture"?

Supra-regional connections visible in pottery styles have already been recognised by many scholars who studied pre-Corded Ware remains in central Europe (e.g. Iversen 2015; Matuschik 1992; Pape 1978; Szmyt 2003; Woidich 2014). However, the theoretical framework of the archaeological culture concept with its focus on modern political units still hampers the consideration of prehistoric cultural developments at a continental or semi-continental scale.

The aim of this article is to shed light on a distinct feature in the context of these problems: textile-roughened pottery surfaces. This technological trait is part of many different pottery styles (Figure 4) that are considered "type fossils" of "archaeological cultures". Based on an empirical study of south-western German and Swiss material and a comparative literature survey, the following questions will be asked: How were these special surfaces made? Where do they occur? When do they occur? What do they tell us regarding the spatial scale and character of transmission networks in the early third millennium BC?

Since the archaeological culture concept is critically assessed here, archaeological cultures will be treated as pottery styles rather than shorthands for identity groups. The timeframe under consideration is fuzzy. Thus, the working term "early third millennium BC" will be used to refer to the period from around 3000 BC to the beginning of the Corded Ware, i.e. up to 2700 or 2600 BC in some parts of central Europe. This period is part of the Late Neolithic (3500–2800 BC) and the Final Neolithic (2800-2200 BC) in the periodisation system of Lüning (1996). A diachronic consideration of textile-roughened pottery with a focus on the Bronze Age has been published by S. Schaefer-Di Maida (2017).

Late Neolithic textile-roughened pottery in German research: terms and explanations

The research history and terminology of Late Neolithic textile-roughened pottery surfaces in Germany has recently been treated in detail by H. Schlichtherle (2018). Table 1 presents an overview of common German terms and English translations.

In the middle of the twentieth century the term "mat-roughened pottery" became popular, meaning that these surfaces were created by impressing mat-like textiles. After conducting archaeological experiments, W. Schrickel introduced the idea that roulettes wrapped with a cord or sometimes a leather band were used on Late Neolithic pottery from the Wartberg in Hesse (Schrickel 1969, 67–71). In the following decades, corded roulette roughening or other rolling techniques were identified at many sites of the early third millennium BC in Germany (see below). Recently, a large series of rolling experiments was conducted by Schlichtherle, who already identified the use of cord-wrapped roulettes for pottery finds from south-western Germany (Schlichtherle 2018). His publication was the foundation for examining textile-roughened surfaces from the south-western German state of Baden-Württemberg and Switzerland described in the following section. Considering these recent studies, Table 2 summarises the terms used in this article to name rough pottery surfaces with textile impressions.

A case study: roughening techniques in Baden-Württemberg and Switzerland

A sample of 155 pottery reconstructed vessel units from Baden-Württemberg and 41 reconstructed vessel units from Switzerland was analysed by the author.

Chronology and stylistic contexts

In Baden-Württemberg, pottery assemblages of the early third millennium BC containing textile-roughened pottery are attributed to the Goldberg III style (Driehaus 1960; Schlichtherle 1999). In Upper Swabia, which is located between lake Constance and the Swabian Alb, six wetland settlements of the early third millennium BC have been examined by the cultural heritage service of Baden-Württemberg (Landesamt für Denkmalpflege Baden-Württemberg) since 1979 (Figure 1). Despite the limited size of the trial trenches, the small pottery assemblages from these sites are important. The good preservation of the vessel surfaces allows detailed observations of impressions (Figure 2.1–2, Figure 3).

Using dendrochronology, N. Bleicher was able to place most of these sites within the twenty-ninth century BC (Bleicher 2009, 166–67). Textile roughening is missing at Seekirch-Stockwiesen and Alleshausen-Täschenwiesen, which are the oldest sites with pottery of the Goldberg III style and dated around 2900 BC (Figure 1). Since textile roughening is present at Alleshausen-Grundwiesen, a site dated to the middle of the twenty-ninth century by wiggle-matching (Bleicher 2009, 132), the introduction of this technique must be assumed to have taken place during the first half of the twenty-ninth century BC. The sites Olzreute-Enzishollz and Wolpertswende-Schreckensee have both yielded textile-roughened pottery. However, they were both occupied several times during the twenty-ninth century, and the time of the occurrence of textile roughening cannot be determined precisely. Seekirch-Achwiesen can so far only be placed within the rather broad timespan 2860 to 2490 calBC by radiocarbon dating (Schlichtherle 2004, 44–45). This is problematic, since this site has revealed a high number of well-preserved textile-roughened vessels (Figure 3). It cannot currently be decided if textile roughening was still practiced in Upper Swabia after the Corded Ware had already appeared in neighbouring regions (around 2720 BC at lake Constance and around 2750 BC at lake Zürich, see Suter 2017, 277–87). Although pollen diagrams indicate continuous human impact on the landscape in Upper Swabia during the third millennium BC (Liese-Kleiber 1993, 45), no settlements are known until the Early Bronze Age. Thus, it is not clear whether Corded Ware was introduced in Upper Swabia.

Textile-roughened pottery also occurs on the eponymous Goldberg, a hilltop site in the Nördlinger Ries (Figure 2.3–4). Since stratigraphic information is sparse, these finds can only be roughly placed within the early third millennium BC using typology (Schröter 1975). The finds known from most Swiss sites are not stratified and could either be associated with the Late Horgen style and date before the Corded Ware or they could be contemporary with the early occurrence of Corded Ware. The only association between Corded Ware pottery and textile-roughened sherds has been reported for Diessenhofen-Unterhof (Baeriswyl and Trachsel 1995, 34–36). However, due to the absence of absolute dates, the genesis of the reported cultural layer within the medieval castle seems unclear and thus the association is uncertain.

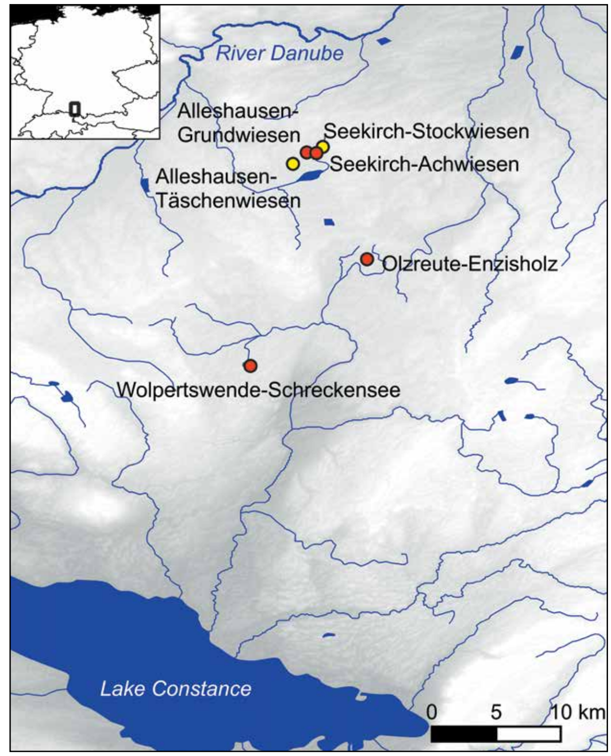

Figure 1. Wetland settlements in Upper Swabia with pottery of the Goldberg III style. Red dots: evidence of textile-roughened pottery; yellow dot: no evidence of textile-roughened pottery. Geodatasets used: NASA Shuttle Radar Topography Mission (SRTM) (2013). Distributed by OpenTopography (DOI: 10.5069/G9445JDF); bodies of water based on European Environment Agency (https://www.eea.europa.eu/data-and-maps/data/wise-large-rivers-and-large-lakes).

Characteristics of the textile-roughened vessels

Textile structures could be clearly identified on the majority of the roughened pottery surfaces from Baden-Württemberg and Switzerland. Other roughening techniques like brushstroke or the rolling of antler only occur on single sherds (Figure 5).

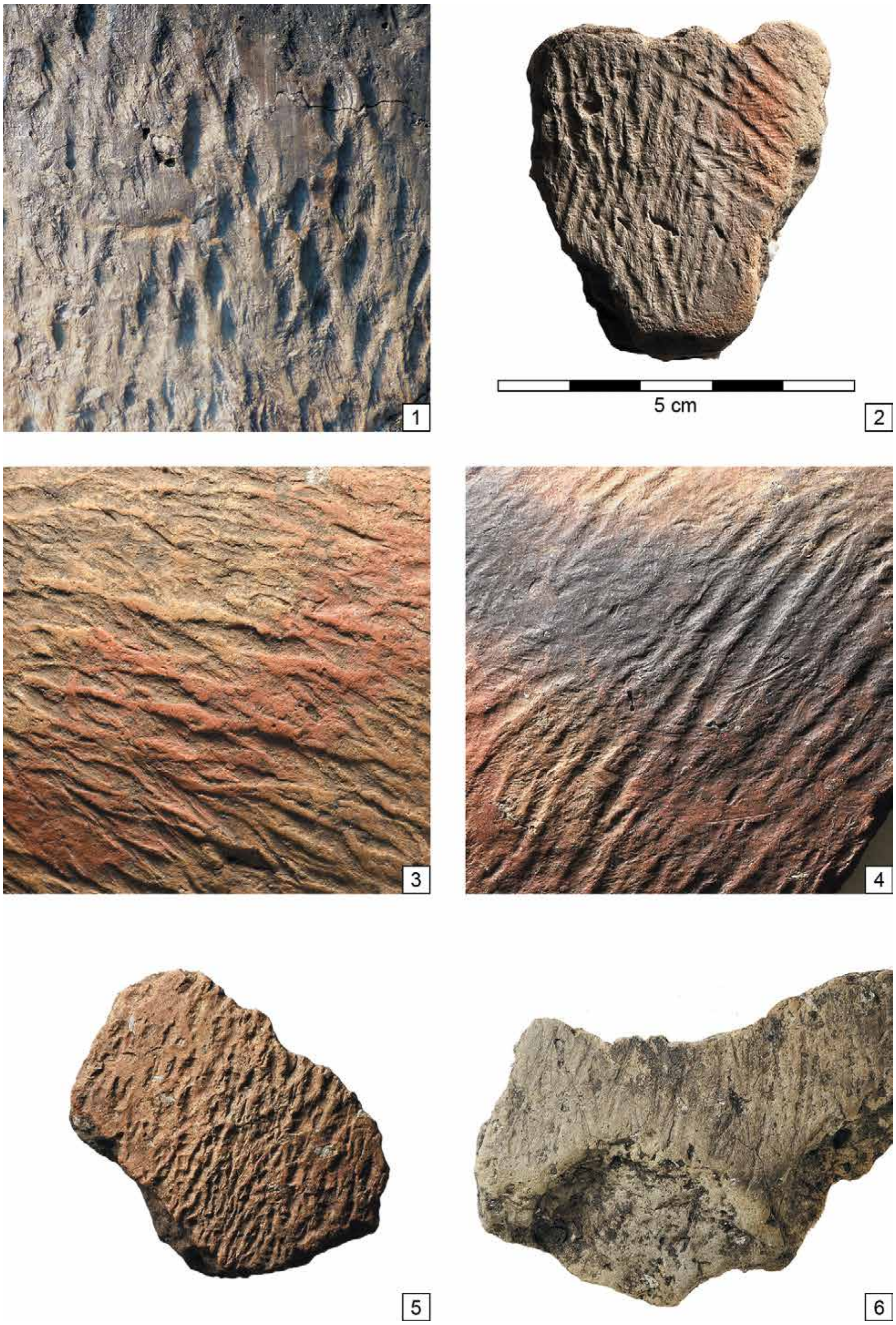

Figure 2. Examples of textile-roughened pottery surfaces from Baden-Württemberg. 1 Seekirch-Achwiesen, 2 Olzreute-Enzisholz, 3–4 Riesbürg/Goldburghausen-Goldberg. Scale: 1:1. (1,2,6: ©Landesamt für Denkmalpflege im Regierungspräsidium Stuttgart/photos: Philipp Gleich. 3,4,5: ©Landesmuseum Württemberg Stuttgart/photos: Philipp Gleich).

Parallel bundles of impressed lines could be identified on most of the textile-roughened sherds. The narrowest lines are 1 mm wide, the broadest up to 4 mm (Figure 2.1). Diagonal microstructures are visible in the interior of these lines. These diagonal structures indicate that cords were an important component of the tools used. The fibre structures reveal a varying width, sometimes below 0.1 mm. Most probably, the cords were made from plant fibres. Substantial textile finds from Seekirch-Achwiesen suggest that bast and flax fibres were important resources for cord production at that time (Feldtkeller 2004), but a use of simple plant blades or stalks is also possible for some pieces.

Two types of cords could be distinguished from the impressions: twisted cords made from two or more orderly twisted strands (Figure 2.1; Figure 3.1) account for about 10 % of the 196 examined samples from Baden-Württemberg and Switzerland. In the other cases rather

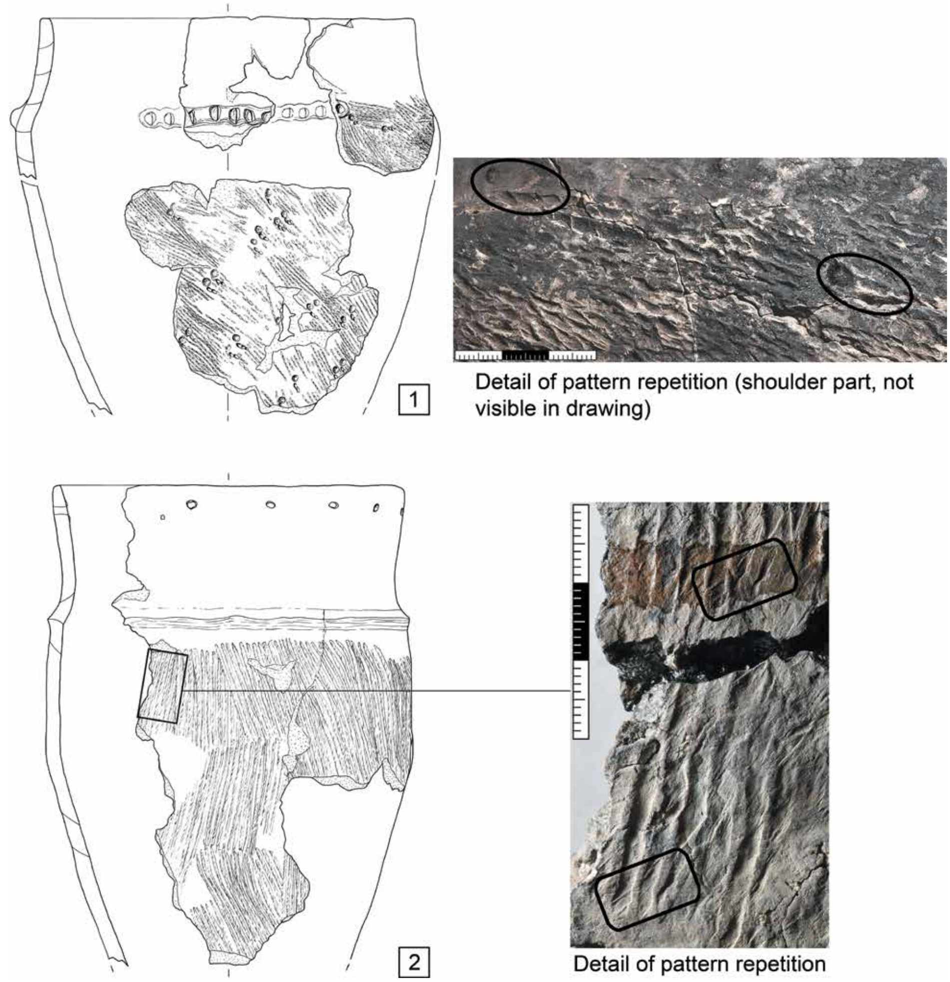

Figure 3. Textile-roughened pots from Seekirch-Achwiesen with identified rolling pattern repetition. Rim diameter of the pots c. 32 cm. (©Landesamt für Denkmalpflege im Regierungspräsidium Stuttgart/drawings and photos: Philipp Gleich).

loosely turned fibre strands reminiscent of raw yarn or blades/stalks of plants were used (Figure 2.2–4; Figure 3.2).

Usually, the cord lines occur in curved or straight bundles with a width of some centimetres that can be followed over the surface until they are cut or overlain by other bundles (Figure 3). These bundles were also described for similar pottery of the Cham style by I. Matuschik (1999, 72) and for the Globular Amphora style by K. Grebe (1962, 31) and indicate the use of a rolling technique. Applying strict research criteria, the use of a rolling tool can only be confirmed if pattern repetition can be identified. This will be illustrated by two examples from Seekirch-Achwiesen.

The first pot was already described by Schlichtherle (2018, 164–65 fig. 8). It is covered by impression bundles of twisted cord on its lower part (Figure 3.1). The single bundles are 2.5 cm wide and consist of eight parallel cord impressions. A knot repeatedly occurs at the edge of the bundles at a distance of 7.8 cm. This indicates that the cord was wrapped around a roulette of 2.5 cm diameter eight times. Thus, a rather small, one-handed roulette was used. The knot impression often appears in clusters indicating a zigzag rolling movement over the vessel body. This movement was performed in a more horizontal way on the carination/shoulder and in a more oblique way towards the base of the vessel.

In the second case (Figure 3.2), a turned cord was used. The pattern repetition could be observed at 4.5 cm, indicating the use of a roulette with a diameter of 1.1 cm. The photo illustrates that the pattern repetition “jumps” one line further during the rolling process, a phenomenon described by Schlichtherle (2018, 160 fig. 4.5). The roughened zone starts below a cordon decoration at the shoulder of the pot. The bundles of linear impressions appear rather vertical on this example and densely overlap, so that the width of the cord winding can only be estimated at around 4 cm. The change of the angle between the rolling bundles also indicates a zigzag rolling. The lower part of the pot was covered by several horizontal zones with vertical zigzag-rolling patterns. The width of the horizontal zones is around 15 cm and could be rolled over with a single handspan.

The use of simple roulettes, such as sticks with a cord loosely wrapped around them, is typical for the examined material. This is indicated by gaps of differing widths

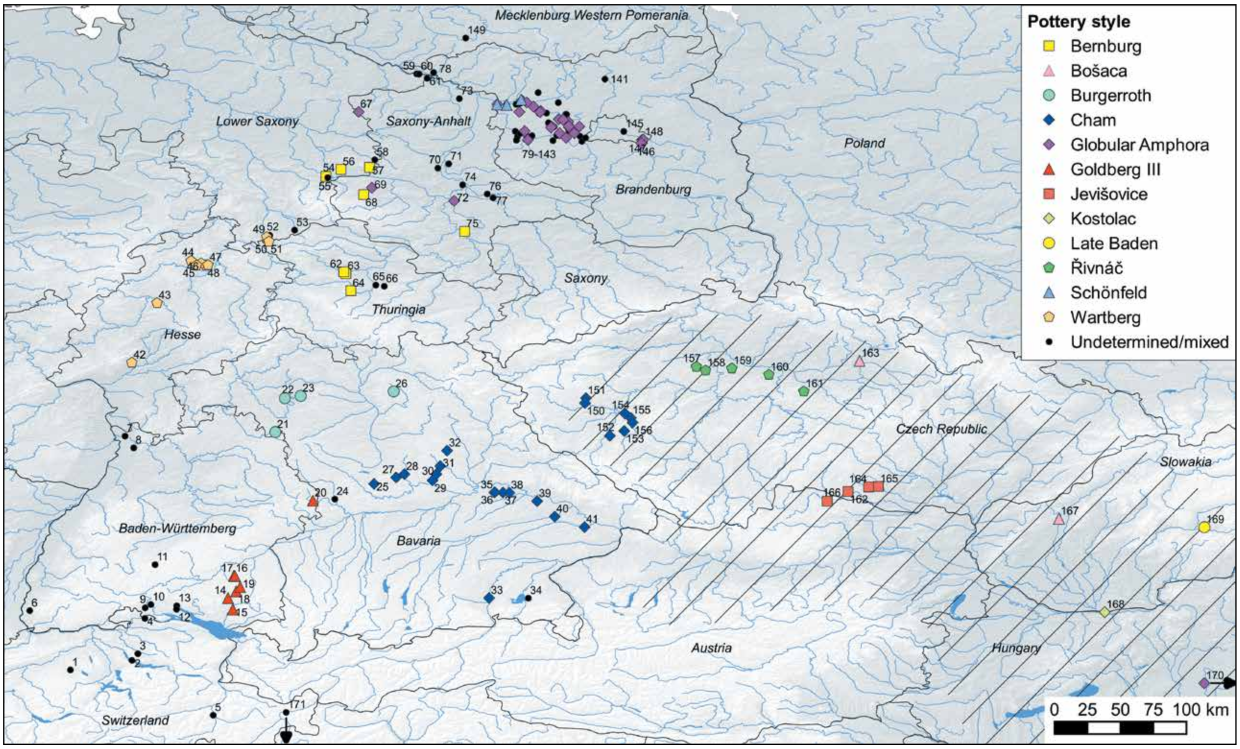

Figure 4. Central European sites of the early third millennium BC with finds of textile-roughened or "honeycomb"-patterned pottery. Hatched area: only selected sites mapped. For references and details see Appendix 1. Geodatasets used: NASA Shuttle Radar Topography Mission (SRTM) (2013). Distributed by OpenTopography (https://doi.org/10.5069/G9445JDF); bodies of water based on European Environment Agency (https://www.eea.europa.eu/data-and-maps/data/wise-large-rivers-and-large-lakes); political borders based on Natural Earth Data (https://www.naturalearthdata.com/downloads/10m-cultural-vectors/10m-admin-1-states-provinces/).

between the single cord impression lines (Figure 2). Braided roulettes leave more regular patterns on the surface. This can be seen on archaeological examples from Abora I in Estonia (see below). Positive evidence for this practice could not be identified in the material from Baden-Württemberg and Switzerland.

The percentage of textile-roughened vessels can only be estimated since the degree of fragmentation is rather high. Like in other regions, the feature almost exclusively appears on the outer surfaces of pots. Pots account for 85 % of the vessels at the Upper Swabian sites. At Alleshausen-Grundwiesen around 25 % of the pots have textile-roughened surfaces, at Seekirch-Achwiesen around 40 %. At Wolpertswende-Schreckensee similar proportions can be expected. At Olzreute-Enzisholz only four out of 8000 sherds have textile roughening. It is not yet clear if there is a constant increase in the percentage of textile-roughened pottery over the twenty-ninth century BC in Upper Swabia. Considering the general dynamics of pottery-making practices during that time, diverging proportions of textile-roughened vessels and different traditions of pottery surface treatment must be assumed even in roughly contemporaneous assemblages.

Occurrences, find contexts and chronology in other parts of Germany and central Europe

Map overview and finds contexts in Germany

In addition to the analysed finds from Baden-Württemberg and Switzerland, a literature survey was conducted. Sites with textile-roughened pottery were mapped for Germany and Switzerland (Figure 4; Appendix 1). For the neighbouring countries of eastern central Europe only a small number of selected sites could be recorded and mapped (Figure 4, shaded areas). The map is also heavily influenced by the state of publication. For instance, E. Kirsch (1993) conducted a thorough survey of archives and private collections in the 1980s in the German state of Brandenburg. For the western surroundings of Berlin he reported the densest site agglomeration within Germany so far (Figure 4.79–143; Kirsch 1993, map 10). Other areas lack similar projects and thus appear rather empty.

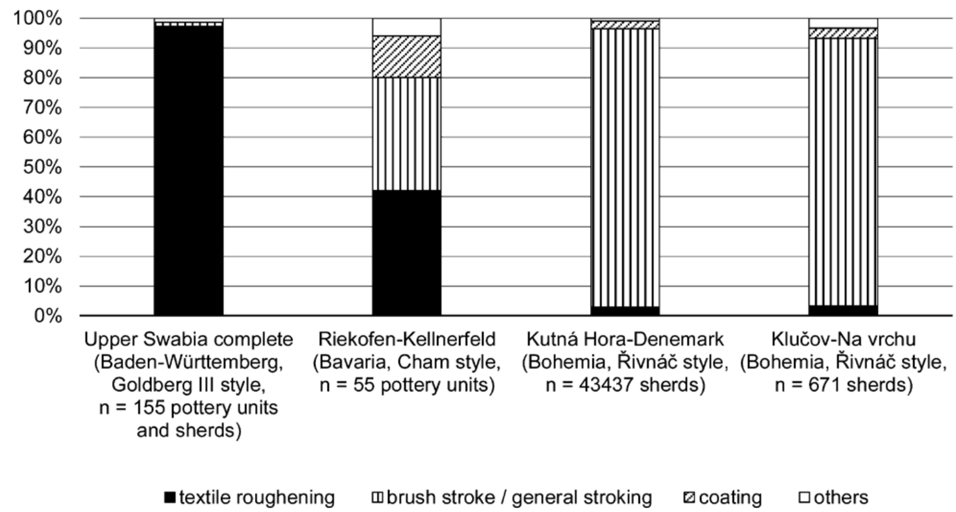

Figure 5. Proportions of different pottery roughening techniques for selected sites and areas. Upper Swabia: examinations by the author. Riekofen-Kellnerfeld: Matuschik 1999, 72. Kutná Hora-Denemark: Zápotocký and Zápotocká 2008, 165 tab. 9. Klučov-Na vrchu: Zápotocký and Kudrnáč 2008, 75.

In addition, radiocarbon dates were collected. While some of the dates are directly related to textile-roughened pottery or pit features containing it (Figures 6–8, yellow marks), others are only generally connected to site occupation (Figures 6–8; Appendix 2).

Most roughened vessels were found within settlement features like pits, cultural layers or ditches. Of the 141 sites recorded for Germany, only eleven (8 %) are burial places or potential burial places (Appendix 1).

The phenomenon is mainly concentrated in southern, central and north-eastern Germany. It seems absent in the distribution area of the Late Funnel Beaker styles of Scandinavia and northern/north-western Germany. The apparent boundary across the northern German plain can hardly be explained by geographical features, but is likely a cultural phenomenon. The westernmost distribution areas are Hesse and Baden-Württemberg, where find spots reach the Upper Rhine valley. No occurrences are known from France. The rather isolated finds on the Swiss plateau mark the south-western boundary. Noteable occurrences are Cazis-Petrushügel in Grisons in the southern Alpine Rhine Valley (Primas 1985, 95 fig. 67,T47–T52) and the Rocca di Rivoli near Verona, marking the only find spot in Italy (Primas 1982, 578 fig. 1.1). These sites indicate that the practice was occasionally transmitted over the Alps, probably from north to south.

Bavaria, western Bohemia, and Upper Austria (pottery styles: Cham, Burgerroth)

The pottery found in settlements along the Danube and its tributaries in southern Bavaria is attributed to the Cham style. According to the periodisation suggested by Matuschik (1999), textile-roughened surfaces are typical for the late phase of this style. Considering radiocarbon dates, this phase can be roughly placed between 2900 and 2600 calBC (Engelhardt 2002; Matuschik 1999, 83–86). One slightly older radiocarbon date has been reported from a settlement pit at Aiterhofen-Ödmühle, which contained textile-roughened pottery (Figure 6). At this potentially earlier site the textile-roughening technique is infrequent. Thus, an initial phase of textile roughening from around 3000 calBC onward is possible.

In his study of the Late Cham site Riekofen-Kellnerfeld, Matuschik concludes that corded roulette roughening was very important, but not the only technique used to produce textile-roughened surfaces (Matuschik 1996, 106–10; 1999, 72–73). Other techniques like brushstroke or coating are also important there (Figure 5). The textile-roughening technique can also be found in the Czech Republic, where it occurs on pottery of the western Bohemian Cham style together with other techniques like brushstroke and brush impressions (Prostředník 2001, 165). Although precise quantitative data are not available for these sites, textile roughening seems to be very frequent at sites like Bzí-Veliká Skála and Šťahlavice-Lopata (e.g. Jílková 1957, 27 fig. 9.9, 34 fig. 15.4). The Cham style is also present in Upper Austria. A sherd from Steyregg-Pulgarn has potentially been roughened with a twisted cord (Maurer 2013, 122–23). However, brushing and coating is more frequent at this site (Maurer 2013, 122 note 393).

Northern Bavarian pottery of this time is attributed to the Burgerroth style, named after the most important site. Corded rouletting was the main roughening technique applied at Burgerroth (Spennemann 1984, 106). The rolling technique has recently been confirmed by the identification of a pattern repetition (Link 2018, 191 fig. 12).

The chronological relationship of the Late Cham and Burgerroth styles to the Corded Ware style is not clear yet. Due to plateaus in the calibration curve, this question can not be decided by radiocarbon dates alone (Figure 6). Corded Ware pottery occurs in small numbers at several sites of the Cham style (Furholt 2008, 20), and also in the upper layers of the ditch at Riekofen-Kellnerfeld (Matuschik 1999, 91 fig. 20), but the significance of this is under debate. While Matuschik

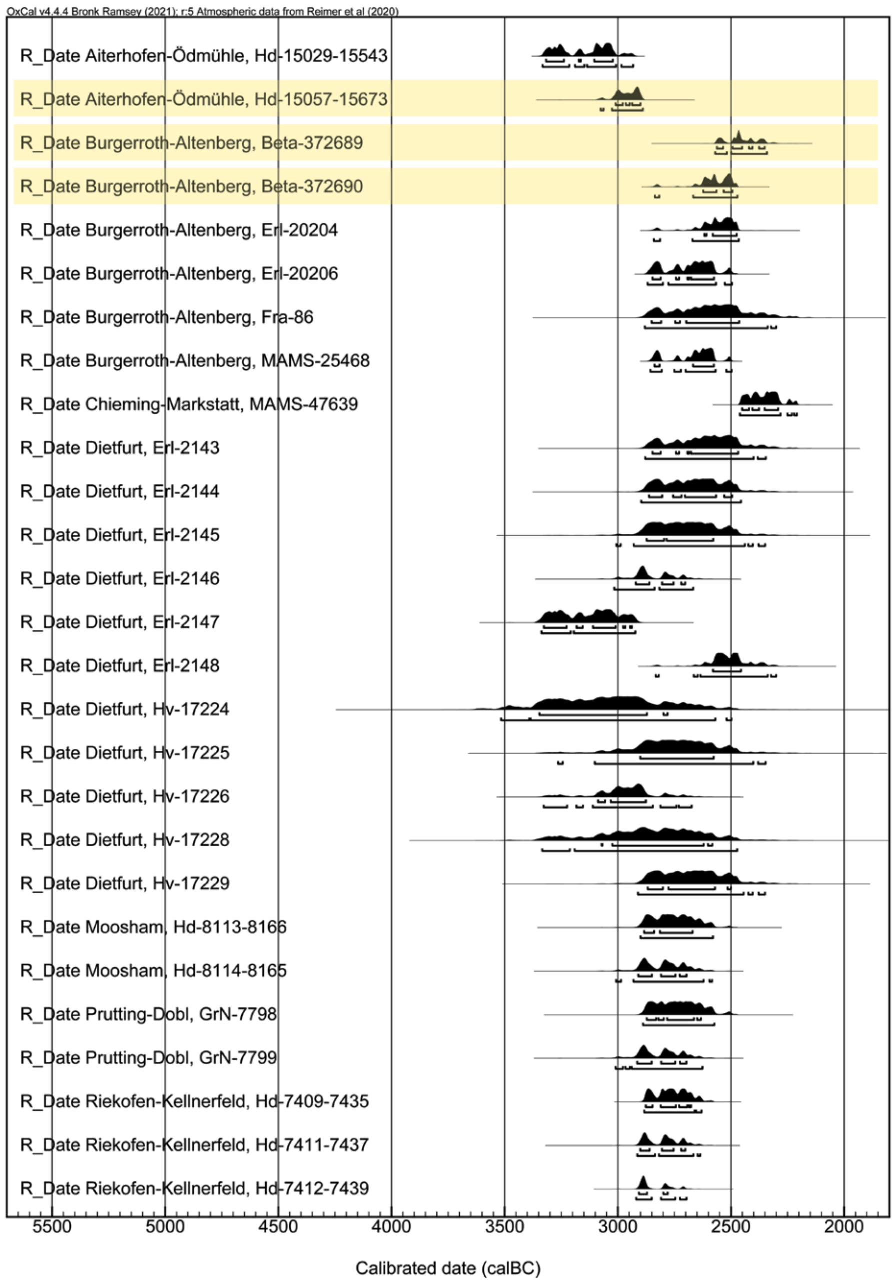

Figure 6. Southern Germany. Radiocarbon dates from Late Neolithic sites with evidence of textile-roughened pottery. Dates obtained directly from textile-roughened vessels or from pit features containing textile-roughened pottery are marked in yellow. For references and details see Appendix 2. Plotted using OxCal v4.4.4 (Bronk Ramsey 2009; https://c14.arch.ox.ac.uk/oxcal/OxCal.html).

(1999, 82–84) expects a longer chronological overlap of the Late Cham and Early Corded Ware styles, W. Stöckli (2009, 158–59) is sceptical. At Burgerroth, textile-roughened pottery was found together with Corded Ware in the fill of a pit house. Radiocarbon dates from this feature fall around 2600 calBC (Link 2016). An even younger radiocarbon date was reported from Chieming-Markstatt in southern Bavaria, where textile-roughened pottery was found in the fill of a pit house and in a cultural layer covering the pit house (Pechtl and Möslein 2020). However, as the sample comes from the layer above the pit house, its association with the textile-roughened pottery is not fully clear.

Three radiocarbon dates from Vlkov-Babiny, western Bohemia, cover the first and the second half of the third millennium BC (John 2009a, 37). This site has yielded Late Cham pottery. Brushstroke ("slámování") and "honeycomb" roughening ("voštinování") appear together at this site (John 2009b, 17). Judging from the published photos, this "honeycomb" roughening has strong similarities with the pieces termed "textile roughening" here (e.g. John and Bouda 2009, 95 nr. 416; see discussion below). Although their stratigraphic position is not published in detail, the radiocarbon dates from Vlkov could point to a longer use of such roughening techniques until Corded Ware was present in western Bohemia.

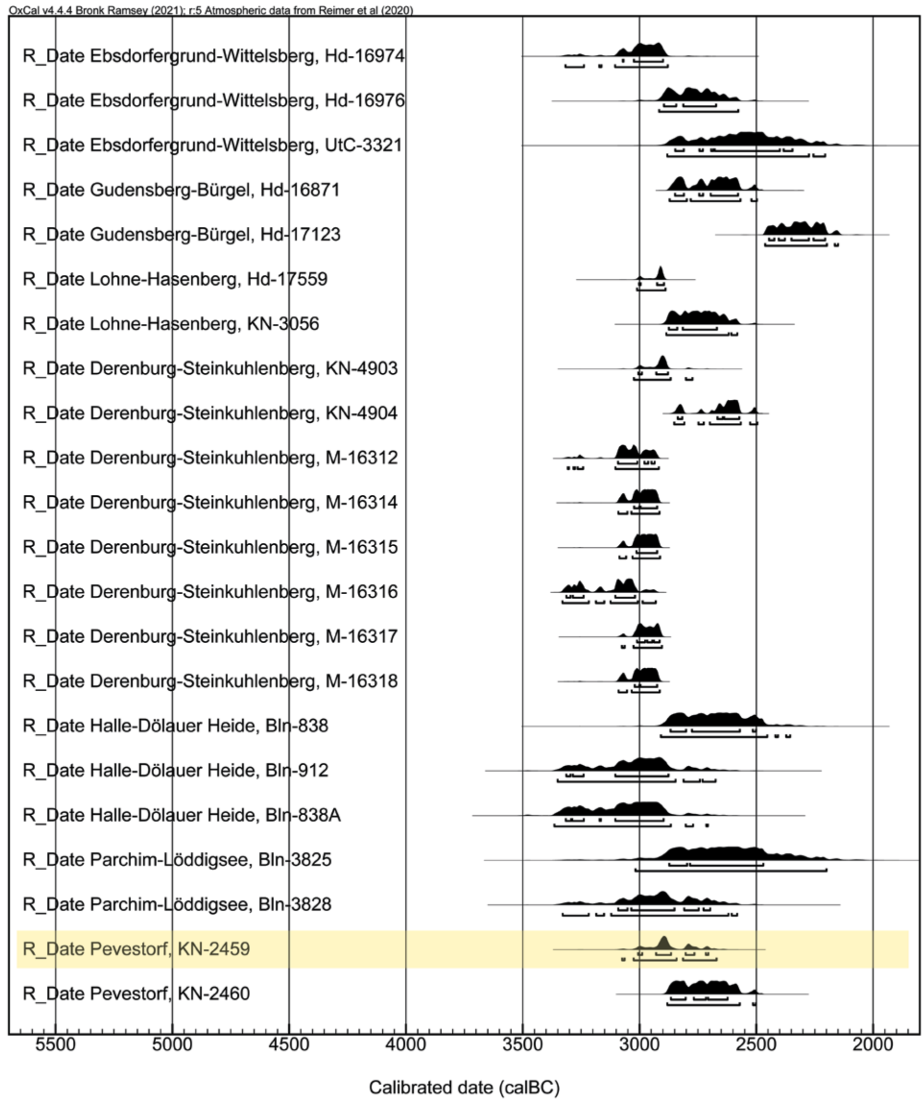

Figure 7. Central and north-eastern Germany. Radiocarbon dates from Late Neolithic sites with evidence of textile-roughened pottery. For references and details see caption of Figure 6.

Hesse, Thuringia, and southern Lower Saxony (pottery styles: Wartberg, Bernburg)

The Hessian settlement sites of the Wartberg style with occurrences of textile roughening are concentrated around the town of Fritzlar (Figure 4.44–48). The exact proportions of other roughening techniques cannot be extracted from the existing literature. The most detailed examination is available for the Wartberg itself. Schrickel (1969) reports over 2000 textile-roughened sherds for that site, which were mainly produced by corded roulette roughening. Besides that, other techniques like the rolling of antler or a roulette wrapped with a leather band are mentioned (Schrickel 1969, 67–68). As D. Raetzel-Fabian (2002, 7–8) has demonstrated, sites with textile-roughened pottery belong to a late development of the Wartberg style that roughly dates between 3000 and 2700 calBC. An overlap with the Corded Ware style is possible.

Some sites in southern Lower Saxony and in the Thuringian Basin have also yielded textile-roughened pottery. The pottery from these sites is often attributed to the Bernburg style, but also has similarities with other styles like Wartberg, Burgerroth and Globular Amphora. Cord rolling and corded rouletting techniques have also been suggested for Lower Saxony and Thuringia (Bücke 1986, 55–56; Dirks 2000, 75).

Saxony-Anhalt, eastern Lower Saxony and western Brandenburg (pottery styles: Globular Amphora, Bernburg, Schönfeld)

Within these areas textile roughening is connected to the pottery styles Bernburg, Globular Amphora and Schönfeld. These styles often appear in mixed assemblages at the same site. Thus, a stylistic classification of the roughened pottery is not always possible (Figure 4).

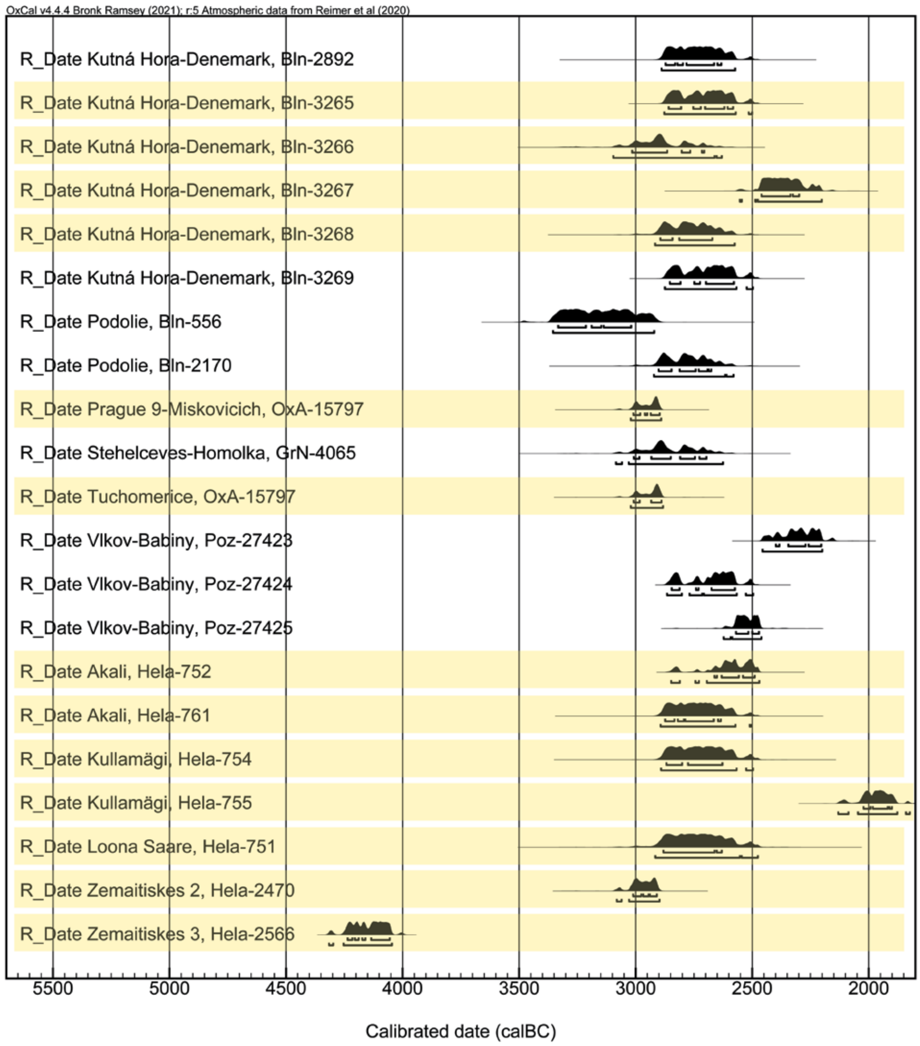

Figure 8. Eastern central Europe and Baltic states. Radiocarbon dates from Late Neolithic sites with evidence of textile-roughened pottery. For references and details see caption of Figure 6.

Textile roughening is frequent on Bernburg style pottery in the fortified settlement of Halle-Langer Berg in Saxony-Anhalt. H. Behrens and E. Schröter (1980, 51) explain the roughening by the direct rolling of twisted cords. The published photos do not only reveal impressed lines of twisted cords but also gaps of different widths between the single cord lines (Behrens and Schröter 1980, 171 pl. 8). In comparison to the pieces from Baden-Württemberg (Figure 2.1; Figure 3.1), it is highly probable that a corded roulette technique with twisted cord was at least one of the roughening techniques used in Halle. H.-J. Beier (1988, 28) considers cord rolling techniques important for the Globular Amphora vessels of Saxony-Anhalt. Drawings indicate the use of twisted cords, potentially wrapped around roulettes, at many sites of the Globular Amphora style in Germany (Becker 2002, pl. 4.2.4.13; Beier 1988, pl. 20.6, 53.10, 54.31; Kirsch 1993, fig. 145, fig. 177.1080).

It is still difficult to establish an absolute time frame for textile-roughened pottery in the Bernburg and Globular Amphora pottery styles. Considering radiocarbon dates, J. Müller suggested a maximum duration of 3100 until 2700 calBC for the Bernburg style with a potential overlap with the Corded Ware (J. Müller 2001, 170–73). R. Schwarz (2018) disagrees with this model. Based on Bayesian modelling of radiocarbon dates from several sites in Saxony-Anhalt, he suggests a duration of 3075–2800 calBC for the Bernburg style and no overlap with the Corded Ware (Schwarz 2018, 36–37). In his model, the practice of textile roughening is part of the youngest development of the Bernburg style (phase 3), which he places within a modelled timespan between 2925 and 2800 calBC (Schwarz 2018, 29). This estimate comes close to the dendrochronological dates from Upper Swabia. However, the number of published radiocarbon dates connected to contexts with textile-roughened pottery in central and north-eastern Germany is still low. The best association occurs in grave K16 at the burial site Pevestorf 19. The fill of the grave contained textile-roughened sherds that were probably grave goods.

The date (KN-2459) falls between 3000 and 2700 calBC, with the highest probability in the twenty-ninth century calBC (Figure 7).

The radiocarbon dates from Halle-Dölauer Heide have too broad error margins to contribute to more detailed chronological discussions (Figure 7). The dates from Derenburg-Steinkuhlenberg belong to a rather early horizon between 3100 and 2900 BC (Figure 7). Interestingly, this site has only revealed a small number of textile-roughened sherds in the fill of a settlement burial, which is not absolutely dated itself (Hille 2020, 93 nr. 72). Like in Bavaria, this could indicate an earliest possible occurrence of the practice around 3000 BC and a main phase of popularity from the twenty-ninth century BC for textile roughening in the Bernburg style of Saxony-Anhalt. G. Wetzel's (1979, 43) mentions of textile-roughened pottery associated with the Schönfeld style were critically discussed by J. Beran (1990, 30–31), who noted that textile roughening only occurs in closed assemblages of the Fischbeck style, the initial phase of the Schönfeld style. This phase could predate the Corded Ware, yet its absolute date is not fully clear (J. Müller 2001, 247). To my knowledge, there are no clear associations of textile-roughened pottery and Corded Ware in closed and absolutely dated contexts in central and north-eastern Germany.

Further to the east: textile roughening and related techniques

Eastern central Europe (pottery styles: Řivnáč, Jevišovice, Late Baden)

Textile-roughened pottery vessels are present in the Řivnáč style in eastern Bohemia. Stehelčeves-Homolka (Ehrich and Pleslová-Štiková 1968, 72) and Kutná Hora-Denemark (Zápotocký and Zápotocká 2008, 164–65) yielded multiple vessels of this kind. For Kutná Hora-Denemark the quantitative relation of different roughening techniques is published in detail, indicating that textile roughening is rare in comparison to brushstroke (Figure 5). Radiocarbon dates from Kutná Hora-Denemark fall into the first third of the third millennium BC. Slightly earlier radiocarbon dates from the very beginning of the third millennium BC come from settlement features containing textile-roughened pottery at Tuchoměřice and Prague 9-Miškovice (Figure 8; Ernée *et al.* 2007; Sankot and Zápotocký 2011).

Brushstroke is the most frequent roughening technique of the Jevišovice pottery style of Lower Austria and Moravia. No textile roughening is reported from Melk-Wachberg, a site considered early within the Austrian development of the Jevišovice style (Ruttkay 2001). However, Raabs-Oberndorf has yielded textile-roughened vessels. The drawings could indicate the use of twisted cords there (Ruttkay 2000, 569 fig. 245). Only brushstroke is reported from the Moravian site Brno-Starý Lískovec (Medunová-Benešová and Vitula 1994, 18–19). From the eponymous site of Jevišovice-Starý Zámek (Medunová-Benešová 1972, pl. 51.12.17, 106.5, 110.6.8) and Grešlové Mýto-Nad Mírovcem (Medunová-Benešová 1973, pl. 4.1, 8.1) rather few textile-roughened vessels are known. However, there is a whole series of vessels from Vysočany-Palliardiho hradisko, which is considered a late Jevišovice site (Medunová-Benešová 1977, pl. II). The relative and absolute chronology of the Jevišovice style is still under debate (Peška 2011, 315–17; Schmitsberger 2006). It can be assumed that most sites with textile-roughened vessels date to the early third millennium BC and are rather late in the relative development of the style. The radiocarbon dates from Brno-Starý Lískovec indicate that there are also sites without textile-roughened pottery during the late phase around 2900–2700 calBC (Görsdorf 1994).

V. Struhár, M. Soják and M. Cheben (2015, 247–48) have recently published a review of the so-called "honeycomb" patterns that occur on vessel surfaces of the Late Baden and Bronze Age pottery styles in Slovakia and Hungary. The Slovakian term for these surfaces is "voštinovaný", the Czech term "voštinování". These surfaces typically bear patchy groups of oval depressions. Although detailed technological examinations have not come to my attention, it must be assumed that rolling — potentially using a cord-wrapped or braided roulette — often played a role in the creation of these surfaces. M. Zápotocký and M. Zápotocká (2008, 165 tab. 9) translate the term with the German "mattenabdruckverziert", meaning "decorated by mat impressions".

Although these surfaces are an important feature of Bronze Age pottery styles of the Carpathian area, especially of the Hatvan style (Nešporová 1969), Struhár and colleagues (2015, 247–48) have pointed to their occurrence in several Late Baden hilltop settlements in Slovakia. In some cases, it is not fully clear if the honeycomb pottery actually belongs to Late Eneolithic or Early Bronze Age occupation events (Novotná and Soják 2013, 24; Struhár *et al.* 2015, 247). Important evidence for a Late Eneolithic occurrence comes from the hilltop settlement of Lieskovec-Hrádok in Slovakia. Following R. Malček (2013, 125), all the pottery found there belongs to a short timespan within the Late Baden style. The "honeycomb" pattern appears in rather low numbers alongside brushstroke in the pottery assemblage (Malček 2013, 37 fig. 24.V503, 74 fig. 48. V49, pl. XLVI.15, XLVII.15.19). Further examples of "honeycomb" patterns are known from sites of the Bošaca style in Plotiště nad Labem in eastern Bohemia (Vokolek and Zápotocký 1990, 34 fig. 5.20, 36 fig. 6.15.16) and from Podolie in western Slovakia, where this technique only accounts for 1 % of the roughening techniques (Šuteková 2008, 285). V. Němejcová-Pavúková (1968, 413 fig. 40.7.8) reported comparable finds from Iža in southern Slovakia, which is attributed to the Kostolac style. She noted that the "honeycomb" pattern also occurs within the wider distribution area of the Kostolac style in northern Hungary (Němejcová-Pavúková 1968, 414–15).

These considerations show that brushstroke dominates in the Late Baden pottery styles north of the Carpathians, and that potential textile-roughened pottery is rather rare in this area. However, an example from east of the Carpathians is reported from a Moldavian burial containing pottery of the Globular Amphora style. V. Mihailescu-Bîrliba (2005, 95) uses the old German term "Binsenkeramik" ("rush pottery", see Table 1) to describe the pottery surfaces that were produced by some kind of textile roughening. Interestingly, textile roughening does not occur in the central and eastern parts of the overall distribution area of the Globular Amphora style (pers. comm. Marzena Szmyt). According to Wiślański (1966, 10), it is a typical feature of the western Globular Amphora style within the borders of modern-day Germany.

Finland and the Baltic states

Alongside central and eastern central Europe, there is a second cluster of textile-roughened pottery in north-eastern Europe (Schaefer-Di Maida 2017, 33 fig. 4). In his seminal work, M. Lavento (2001) presented an overview of the "textile pottery" in this area, where it often appears in mixed assemblages containing finds of the prehistoric Metal Ages and the Neolithic. Although the practice of textile roughening is important during the Bronze and Iron Ages in Finland and the Baltic states, Lavento (2000; 2001, 88–108 with detailed discussion) demonstrated that the beginning of this practice lies in the Neolithic. Evidence for this early beginning comes from the Estonian settlement sites Riigiküla XIV and Lemmetsa I. Both yielded textile-roughened pottery as well as Combed Ware and Corded Ware. Later occupation is absent (Lavento 2000, 111–12). B. Dumpe (2005; 2006) conducted a detailed experiment-based analysis of Neolithic textile-roughened pottery from the Abora I settlement at lake Lubān in Estonia. She showed that the pottery surfaces were mainly treated by directly rolling a double- or triple-twisted cord over the vessel (not wrapped around a roulette). For some examples, she demonstrated the use of more complex braided roulettes (Dumpe 2006, 83–84). Although no clear evidence for either technique has been found in Baden-Württemberg or Switzerland, it is possible that they occur in other areas of central Europe. Especially the vessel surfaces from the Moravian Jevišovice site Vysočany-Palliardiho hradisko (Medunová-Benešová 1977, pl. II) show similarities to the dense and regular depression patterns on vessels from Abora I (Dumpe 2006, 75 fig. 4).

Radiocarbon dates on organic residue on textile-roughened vessels found at the Estonian sites of Akali, Kullamägi and Loona fall into the early third millennium calBC (Kriiska *et al.* 2005, 6 tab. 1). Thus, they have the same radiocarbon age as the majority of dates obtained for central European contexts of textile-roughened pottery (Figure 8). For the Lithuanian site of Žemaitiške 3, which revealed pottery of the Narva style and textile-roughened pottery, a much older radiocarbon date between 4230–4060 calBC was published (Piličiauskas 2012, 49). Although this date could be affected by a freshwater reservoir effect (Piličiauskas *et al.* 2011, 639–40), an earlier beginning of textile roughening in north-eastern Europe is possible. For a detailed discussion as to which Neolithic pottery styles the early textile-roughened pottery is related to, Lavento's (2000; 2001) work is a good starting point. A chronological association with Narva pottery, the Combed Ware style, as well as the Corded Ware style is discussed for Finland and the Baltic states (Lavento 2000; Piličiauskas 2012; Piličiauskas *et al.* 2011). A. Kriiska's excavation results for the Estonian site of Riigiküla XIV indicate that the practice of textile impression is present in Corded Ware assemblages in Estonia (Kriiska 2000, 66).

A further search for textile-roughened surfaces would exceed the scope of this paper. However, the phenomenon also occurs in the Upper and Middle Volga areas of Russia, where this long-lasting practice might begin in the Pitted-Combed Ware style of the Late Neolithic (Lavento 2000, 115–16).

Discussion

The bigger picture of the occurrence of textile-roughened pottery in the European Neolithic is still fragmented and blurred. Open questions concerning the techniques, absolute chronology and associations with pottery styles demand further research. Nonetheless, the archaeological research of the last decades has brought to light observations of general importance for the understanding of transmission networks in the early third millennium BC.

The wide geographical distribution of Late Neolithic textile-roughened pottery

The central and eastern European occurrences can be traced from the Upper Rhine rift in the west to the river Siret in Moldavia and from the shore of the Baltic Sea in Mecklenburg Western Pomerania in the north to the area north of the Carpathians in the south (Figure 4). At present, a geographical connection between the central European areas of distribution and the eastern areas in Finland, the Baltic states and western Russia cannot be established. Thus, it cannot be decided if the practice of textile roughening was invented independently in these two areas or if this practice was transmitted between them. Considering the visual similarity of the pottery surfaces and the similar use of rolling techniques, a transmission process of some kind can be assumed. From a central European perspective, it is worth mentioning that textile roughening dominates over other roughening techniques especially in Germany, which is the westernmost part of the whole distribution area. The quantitative importance of textile roughening decreases in the Řivnáč, Jevišovice and Late Baden styles in eastern central Europe (Figure 5). This could indicate that potential transmission processes between east and west did not take place via overland connections but via the Baltic Sea.

The similarity and dissimilarity of practices

Especially for the German occurrences, most authors agree on the use of rolling techniques and on the use of cord-wrapped roulettes or sometimes other kinds of roulettes. The use of rolling techniques and even braided roulettes has been confirmed for Abora I in Estonia. It is not clear if this technique played a role in the production of textile-roughened surfaces in the west. A detailed analysis of the "honeycomb" patterns of eastern central Europe has not yet been carried out. Yet, the use of textile-rolling techniques in the widest sense may be assumed for at least some of these finds. Thus, it can be stated that the use of textiles, twisted or turned cords and rouletting techniques was most probably part of the textile-roughening techniques within their whole distribution area, although in most areas it was certainly not the only technique applied.

The temporal proximity of the absolutely dated occurrences

The temporal proximity of the radiocarbon dates in Figures 6–8 is remarkable. For central Europe, the earliest dates belong to the timespan of 3100–2900 calBC. These dates are rare and could indicate an initial phase. Most dates fall between 2900 calBC and 2600 calBC. Chronological differences between different areas of occurrence cannot be seen at the current state of research. It rather seems that textile-roughening practices, which have no predecessors in central Europe, spread within a barely measurable timeframe at the beginning of the third millennium BC. The Upper Swabian sites in Baden-Württemberg are so far the only ones dated by dendrochronology. Here, it is evident that textile roughening begins in the twenty-ninth century and thus clearly before the earliest regional occurrence of the Corded Ware style in Baden-Württemberg. A beginning of textile-roughened pottery before the introduction of the Corded Ware style is also highly probable for the other areas of occurrence in central Europe. It must be assumed that textile roughening continued to be practised into the time of the Corded Ware in some areas. However, the details of regional processes and potential overlaps are less clear. Closed find contexts containing Corded Ware and textile-roughened pottery are rare. The same is true for radiocarbon dates after 2700 calBC that are clearly related to textile-roughened pottery. The best evidence, to my knowledge, for both of these phenomena comes from the pit houses at the northern Bavarian site of Burgerroth (Link 2016). For the many "mixed" sites under debate, it could be helpful in the future to obtain direct radiocarbon dates from charred remains or lipids in textile-roughened and Corded Ware vessels.

Conclusion

In central Europe the textile-roughening technique is important as a diagnostic feature for the identification of sites dating to the transitional horizon into the time of the Corded Ware. Indeed, textile roughening seems to have spread within a short time just before the first Corded Ware vessels appear. The transmission processes behind this spread are unknown. Bipartite pots with a smooth upper part, lugs or cordons at the carination and a textile-roughened lower body are found in most pottery styles of the early third millennium BC in central Europe (see the examples in Figure 3). Most probably, the rough surfaces were appreciated on a supra-regional scale since they facilitated the handling and transportation of vessels. Sometimes, textile roughening appears on vessels bearing more distinct styles. From north-eastern Germany, globular amphorae with textile roughening on their round lower bodies are known (Kirsch 1993, fig 177,1080). A closer comparative examination could answer the question of regional peculiarities of the textile-roughening techniques themselves. The overall picture suggests that the practices of textile roughening were picked up by pottery making communities operating at a more regional or local scale. Obviously, these pottery making communities had grown together in a dynamic and wide-ranging transmission network before the Corded Ware appeared. This network allowed for the transmission of distinct practices within timespans that can barely be measured by radiocarbon dating. The discontinuous spatial distribution shows that individual communities stayed somewhat autonomous in choosing to adopt the practice or not. Textile roughening was especially popular among the Late Neolithic pottery making communities within the area of modern-day Germany.

It is not the goal of this article to explain this transmission network in terms of exchange and mobility practices. Yet, it is quite probable that it played a role in the spread of the Corded Ware. One argument is the spatial structure of this network. Its western and southern boundaries in central Europe come close to the boundaries of the distribution of Corded Ware pottery (Figure 4). The second argument are the contents transmitted within this network. The use of textiles, braided roulettes and especially twisted cords is at the core of textile roughening. Other features encompassing most of the mentioned pottery styles are geometric decorations made by twisted-cord impressions. Some cord decorations from Baden-Württemberg and Bavaria are directly comparable to cord decorations of the Globular Amphora style (Woidich 2014, 215–19). Cord decorations are also very common in the Řivnáč (Zápotocký and Zápotocká 2008, 206–07 fig. 92) and Jevišovice styles (Medunová-Benešová 1977, pl. XV) of eastern central Europe. This important phenomenon cannot be covered further in the scope of this paper. Cord decorations and textile roughening show that the use of cords for ornamenting pottery was an important and well-established feature in the growing supra-regional networks on the eve before and potentially also on the morning after the introduction of the Corded Ware.

Whether Early Corded Ware vessels were also circulated within these networks is an important question. The regular occurrence of Corded Ware sherds within settlements of the early third millennium BC throughout central Europe could indicate this (see the discussion in Furholt 2008).

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Appendix 1. Central European sites of the Late Neolithic with evidence of textile-roughened pottery (mapped in Figure 4).

Site nr.	Site name	Site type	Municipality	District	Province	Country	Pottery style	Reference
1	Egolzwil 2	Settlement			Luzern	Switzerland	Undetermined/ mixed	Unpublished
2	Feldmeilen-Vorderfeld	Stray finds/ unclear		Meilen	Zürich	Switzerland	Undetermined/ mixed	Unpublished
3	Maur-Schifflände	Stray finds/ unclear		Uster	Zürich	Switzerland	Undetermined/ mixed	De Capitani 1993
4	Diessenhofen-Unterhof	Potential settlement		Frauenfeld	Thurgau	Switzerland	Undetermined/ mixed	Baeriswyl and Trachsel 1995
5	Cazis-Petrushügel	Settlement		Viamala	Grisons	Switzerland	Undetermined/ mixed	Primas 1985
6	Mauchen-Fundstelle 25a	Stray finds/ unclear	Schliengen	Lörrach	Baden-Württemberg	Germany	Undetermined/ mixed	Grimmer-Dehn 1998
7	Ilvesheim-Atzelberg	Stray finds/ unclear		Rhein-Neckar-Kreis	Baden-Württemberg	Germany	Undetermined/ mixed	Hecht 2003
8	Heidelberg-Kirchheim	Stray finds/ unclear		Heidelberg	Baden-Württemberg	Germany	Undetermined/ mixed	König 2016
9	Duchtlingen-Hohenkrähen	Stray finds/ unclear	Hilzingen	Konstanz	Baden-Württemberg	Germany	Undetermined/ mixed	Matuschik 1996, list 3 nr. 1
10	Mühlhausen-Ehingen-Bei der Mauer	Stray finds/ unclear		Konstanz	Baden-Württemberg	Germany	Undetermined/ mixed	Matuschik and Schlichtherle 2009, nr. 3
11	Hausen am Tann-Lochenstein	Stray finds/ unclear		Zollernalbkreis	Baden-Württemberg	Germany	Undetermined/ mixed	Matuschik 1996, list 3 nr. 5
12	Bodman-Hals	Potential settlement	Bodman-Ludwigshafen	Konstanz	Baden-Württemberg	Germany	Undetermined/ mixed	Hopert *et. al*. 1998
13	Ludwigshafen-Seehalde	Stray finds/ unclear	Bodman-Ludwigshafen	Konstanz	Baden-Württemberg	Germany	Undetermined/ mixed	Köninger 2003
14	Wolpertswende-Schreckensee	Settlement		Ravensburg	Baden-Württemberg	Germany	Goldberg III	Rademacher 1987
15	Ravensburg-Veitsberg	Settlement		Ravensburg	Baden-Württemberg	Germany	Goldberg III	Matuschik 1996, list 3 nr. 11
16	Alleshausen-Grundwiesen	Settlement		Biberach	Baden-Württemberg	Germany	Goldberg III	Schlichtherle 1999
17	Seekirch-Achwiesen	Settlement		Biberach	Baden-Württemberg	Germany	Goldberg III	Matuschik 1996, list 3 nr. 13
18	Aulendorf-Steeger-See	Potential settlement		Ravensburg	Baden-Württemberg	Germany	Goldberg III	Unpublished
19	Olzreute-Enzisholz	Settlement	Bad Schussenried	Biberach	Baden-Württemberg	Germany	Goldberg III	Schlichtherle 1999
20	Goldburghausen-Goldberg	Settlement	Riesbürg	Ostalbkreis	Baden-Württemberg	Germany	Goldberg III	Schlichtherle 1999
21	Burgerroth-Alter Berg	Settlement	Aub	Würzburg	Bavaria	Germany	Burgerroth	Matuschik 1996, list 2 nr. 3
22	Prosselsheim	Settlement		Würzburg	Bavaria	Germany	Burgerroth	Matuschik 1996, list 2 nr. 7
23	Krautheim	Stray finds/ unclear	Volkach	Kitzingen	Bavaria	Germany	Burgerroth	Matuschik 1996, list 2 nr. 5
24	Fessenheim-Bürg	Stray finds/ unclear	Wechingen	Donau-Ries	Bavaria	Germany	Undetermined/ mixed	Burger 1988, cat. nr. 56
25	Weißenburg-Alte Bürg	Stray finds/ unclear		Weißenburg-Gunzenhausen	Bavaria	Germany	Cham	Burger 1988, cat. nr. 54
26	Voitmannsdorf	Settlement	Königsfeld	Bamberg	Bavaria	Germany	Burgerroth	Matuschik 1996, list 2 nr. 11
27	Landersdorf-Hinterer Berg	Settlement	Thalmässing	Roth	Bavaria	Germany	Cham	Burger 1988, cat. nr. 51
28	Obermässing	Stray finds/ unclear	Greding	Roth	Bavaria	Germany	Cham	Burger 1988, cat. nr. 52
29	Dietfurt an der Altmühl	Settlement		Neumarkt in der Oberpfalz	Bavaria	Germany	Cham	Gohlisch 2005

Site nr.	Site name	Site type	Municipality	District	Province	Country	Pottery style	Reference
30	Kemnathen	Potential settlement	Breitenbrunn	Neumarkt in der Oberpfalz	Bavaria	Germany	Cham	Matuschik 1996, list 1 nr. 16
31	Eichenhofen-Adelburg	Stray finds/ unclear	Seubersdorf	Neumarkt in der Oberpfalz	Bavaria	Germany	Cham	Burger 1988, cat. nr. 47
32	Winkl-Lauterach-Rötelberg	Potential settlement	Kastl	Amberg-Sulzbach	Bavaria	Germany	Cham	Burger 1988, cat. nr. 55
33	Prutting-Dobl	Settlement		Rosenheim	Bavaria	Germany	Cham	Burger 1988, cat. nr. 62
34	Chieming-Markstatt	Settlement		Traunstein	Bavaria	Germany	Undetermined/ mixed	Pechtl and Möslein 2020
35	Alteglofsheim-Sportzentrum	Settlement		Regensburg	Bavaria	Germany	Cham	Matuschik 1996, list 1 nr. 5
36	Köfering-Kelleräcker	Settlement		Regensburg	Bavaria	Germany	Cham	Matuschik 1996, list 1 nr. 17
37	Moosham-Flickermühle	Settlement	Mintraching	Regensburg	Bavaria	Germany	Cham	Burger 1988, cat. nr. 24
38	Riekofen-Kellnerfeld	Settlement		Regensburg	Bavaria	Germany	Cham	Burger 1988, cat. nr. 29
39	Aiterhofen-Ödmühle	Settlement		Straubing-Bogen	Bavaria	Germany	Cham	Burger 1988, cat. nr. 1
40	Ettling-Westerndorf	Settlement	Wallersdorf	Dingolfing-Landau	Bavaria	Germany	Cham	Burger 1988, cat. nr. 12
41	Aldersbach-Schloßberg	Potential settlement		Passau	Bavaria	Germany	Cham	Burger 1988, cat. nr. 2
42	Bad Homburg-Klinikum	Settlement		Hochtaunuskreis	Hesse	Germany	Wartberg	Meyer 2011
43	Ebsdorfergrund-Wittelsberg	Settlement	Ebsdorfergrund	Marburg-Biedenkopf	Hesse	Germany	Wartberg	Raetzel-Fabian 2000, cat. nr. 45
44	Altendorf-Eierfeld	Cemetery	Naumburg	Kassel	Hesse	Germany	Wartberg	Raetzel-Fabian 2000, cat. nr. 18
45	Lohne-Hasenberg	Settlement	Fritzlar	Schwalm-Eder-Kreis	Hesse	Germany	Wartberg	Raetzel-Fabian 2000, cat. nr. 55
46	Kirchberg-Wartberg	Settlement	Niedenstein	Schwalm-Eder-Kreis	Hesse	Germany	Wartberg	Raetzel-Fabian 2000, cat. nr. 52
47	Gudensberg-Bürgel	Settlement	Niedenstein	Schwalm-Eder-Kreis	Hesse	Germany	Wartberg	Raetzel-Fabian 2000, cat. nr. 48
48	Gudensberg-Güntersberg	Settlement		Schwalm-Eder-Kreis	Hesse	Germany	Wartberg	Raetzel-Fabian 2000, cat. nr. 49
49	Ballenhausen-Abri Mühltal I	Rock shelter	Friedland	Göttingen	Lower Saxony	Germany	Wartberg	Raetzel-Fabian 2000, cat. nr. 71
50	Reiffenhausen-Abri Schierenberg II	Rock shelter	Friedland	Göttingen	Lower Saxony	Germany	Wartberg	Raetzel-Fabian 2000, cat. nr. 76
51	Reiffenhausen-Abri Schierenberg II	Rock shelter	Friedland	Göttingen	Lower Saxony	Germany	Undetermined/ mixed	Grote 1994, 183–84
52	Reinhausen-Abri Reiseberg I	Rock shelter	Gleichen	Göttingen	Lower Saxony	Germany	Undetermined/ mixed	Grote 1994, 211–15 and pl. 124.6
53	Westerode-Rosental	Stray finds/ unclear	Duderstadt	Göttingen	Lower Saxony	Germany	Undetermined/ mixed	Dirks 2000, 158 nr. 30
54	Werlaburgdorf-Lietfeld	Settlement		Wolfenbüttel	Lower Saxony	Germany	Bernburg	Dirks 2000, cat. nr. 33
55	Werlaburgdorf-Kreuzberg	Settlement		Wolfenbüttel	Lower Saxony	Germany	Undetermined/ mixed	Dirks 2000, cat. nr. 32
56	Remlingen-Hohberg	Cemetery	Remlingen-Semmelstedt	Wolfenbüttel	Lower Saxony	Germany	Bernburg	Dirks 2000, cat. nr. 21

Site nr.	Site name	Site type	Municipality	District	Province	Country	Pottery style	Reference
57	Schöningen-Fährberg	Settlement		Helmstedt	Lower Saxony	Germany	Bernburg	Dirks 2000, cat. nr. 13
58	Helmstedt-Pfingstberg	Settlement		Helmstedt	Lower Saxony	Germany	Undetermined/ mixed	Dirks 2000, cat. nr. 10
59	Höhbeck	Stray finds/ unclear		Lüchow-Dannenberg	Lower Saxony	Germany	Undetermined/ mixed	Dirks 2000, cat. nr. 45
60	Pevestorf 19	Cemetery	Höhbeck	Lüchow-Dannenberg	Lower Saxony	Germany	Undetermined/ mixed	Meyer 1993
61	Kapern	Stray finds/ unclear	Schnackenburg	Lüchow-Dannenberg	Lower Saxony	Germany	Undetermined/ mixed	Dirks 2000, cat. nr. 46
62	Nägelstedt-Bornhög	Settlement		Unstrut-Hainich-Kreis	Thuringia	Germany	Bernburg	Bücke 1986
63	Gräfentonna-Lohberg	Settlement	Tonna	Gotha	Thuringia	Germany	Bernburg	Bücke 1986
64	Gotha-Kleiner Seeberg	Potential settlement		Gotha	Thuringia	Germany	Bernburg	D.W. Müller 1972
65	Erfurt-Fundstelle 13	Potential settlement		Erfurt	Thuringia	Germany	Undetermined/ mixed	Walter *et al*. 1987, 107
66	Erfurt-Pappelstieg	Potential settlement		Erfurt	Thuringia	Germany	Undetermined/ mixed	Lippman 1982
67	Hanum	Potential cemetery	Jübar	Salzwedel	Saxony-Anhalt	Germany	Globular Amphora	Beier 1988, cat. nr. 16
68	Derenburg-Steinkuhlenberg	Settlement	Blankenburg	Harz	Saxony-Anhalt	Germany	Bernburg	Hille 2020
69	Sargstedt-Thieberg	Cemetery	Halberstadt	Harz	Saxony-Anhalt	Germany	Globular Amphora	Beier 1988, cat. nr. 106
70	Magdeburg-Altstadt, Fundplatz 1	Potential settlement		Magdeburg	Saxony-Anhalt	Germany	Undetermined/ mixed	Beier 1988, cat. nr. 74
71	Gerwisch 9	Settlement	Biederitz	Burg	Saxony-Anhalt	Germany	Undetermined/ mixed	Wetzel 1979, 135 cat. nr. 524
72	Latdorf	Cemetery	Nienburg (Saale)	Salzlandkreis	Saxony-Anhalt	Germany	Globular Amphora	Beier 1988, cat. nr. 143
73	Wolterslage 1	Settlement	Osterburg (Altmark)	Stendal	Saxony-Anhalt	Germany	Undetermined/ mixed	Wetzel 1979, 188 cat. nr. 34
74	Barby	Cemetery		Salzlandkreis	Saxony-Anhalt	Germany	Undetermined/ mixed	Beier 1988, cat. nr. 82
75	Halle-Dölauer Heide	Settlement		Halle	Saxony-Anhalt	Germany	Bernburg	Behrens and Schröter 1980, 51
76	Rietzmeck	Settlement		Dessau-Roßlau	Saxony-Anhalt	Germany	Undetermined/ mixed	Beier 1988, cat. nr. 179
77	Kleinkühnau-Fundplatz 4	Settlement	Dessau	Dessau-Roßlau	Saxony-Anhalt	Germany	Undetermined/ mixed	Beier 1988, cat. nr. 169
78	Lanz	Settlement		Prignitz	Brandenburg	Germany	Undetermined/ mixed	Wetzel 1969
79	Strodehne-Fundplatz 10	Settlement	Havelaue	Havelland	Brandenburg	Germany	Schönfeld	Kirsch 1993, cat. nr. 1264
80	Strodehne-Fundplatz 8	Settlement	Havelaue	Havelland	Brandenburg	Germany	Globular Amphora	Kirsch 1993, cat. nr. 1263
81	Kietz-Fundplatz 1	Stray finds/ unclear		Havelland	Brandenburg	Germany	Undetermined/ mixed	Kirsch 1993, cat. nr. 1246
82	Kietz-Fundplatz 3	Settlement		Havelland	Brandenburg	Germany	Schönfeld	Kirsch 1993, cat. nr. 1247
83	Bahnitz-Fundplatz 3	Settlement	Milower Land	Havelland	Brandenburg	Germany	Undetermined/ mixed	Kirsch 1993, cat. nr. 1238
84	Siegrothsbruch-Fundplatz 2	Stray finds/ unclear	Dreetz	Ostprignitz-Ruppin	Brandenburg	Germany	Undetermined/ mixed	Kirsch 1993, cat. nr. 974
85	Plaue	Stray finds/ unclear	Brandenburg (Havel)	Brandenburg	Brandenburg	Germany	Undetermined/ mixed	Kirsch 1993, cat. nr. 887
86	Havelsee/ Briest-Fundplatz 2	Stray finds/ unclear		Potsdam-Mittelmark	Brandenburg	Germany	Undetermined/ mixed	Kirsch 1993, cat. nr. 807

Site nr.	Site name	Site type	Municipality	District	Province	Country	Pottery style	Reference
87	Giesenhorst-Bredowscher Sandhorst	Stray finds/ unclear	Dreetz	Ostprignitz-Ruppin	Brandenburg	Germany	Undetermined/ mixed	Kirsch 1993, cat. nr. 962
88	Lochow-Fundplatz 3	Stray finds/ unclear	Stechow-Ferchesar	Havelland	Brandenburg	Germany	Globular Amphora	Kirsch 1993, cat. nr. 1250
89	Tieckow-Fundplatz 7	Stray finds/ unclear	Havelsee	Potsdam-Mittelmark	Brandenburg	Germany	Undetermined/ mixed	Kirsch 1993, cat. nr. 857
90	Dreetz	Stray finds/ unclear		Ostprignitz-Ruppin	Brandenburg	Germany	Undetermined/ mixed	Kirsch 1993, cat. nr. 960
91	Dreetz-Fundplatz 9	Stray finds/ unclear		Ostprignitz-Ruppin	Brandenburg	Germany	Schönfeld	Kirsch 1993, cat. nr. 956
92	Dreetz-Fundplatz 5	Stray finds/ unclear		Ostprignitz-Ruppin	Brandenburg	Germany	Globular Amphora	Kirsch 1993, cat. nr. 955
93	Hohenferchesar-Fundplatz 1	Stray finds/ unclear	Havelsee	Potsdam-Mittelmark	Brandenburg	Germany	Globular Amphora	Kirsch 1993, cat. nr. 829
94	Hohenferchesar-Hasenberg	Stray finds/ unclear	Havelsee	Potsdam-Mittelmark	Brandenburg	Germany	Undetermined/ mixed	Kirsch 1993, cat. nr. 832
95	Görden-Butterlake	Stray finds/ unclear	Brandenburg (Havel)	Brandenburg	Brandenburg	Germany	Undetermined/ mixed	Kirsch 1993, cat. nr. 872
96	Michaelisbruch	Potential settlement	Dreetz	Ostprignitz-Ruppin	Brandenburg	Germany	Globular Amphora	Kirsch 1993, cat. nr. 968
97	Brandenburg Altstadt-Fundplatz 13	Potential cemetery		Brandenburg	Brandenburg	Germany	Globular Amphora	Kirsch 1993, cat. nr. 865
98	Brandenburg Altstadt-Fundplatz 35	Stray finds/ unclear		Brandenburg	Brandenburg	Germany	Undetermined/ mixed	Kirsch 1993, cat. nr. 866
99	Görden-Am Betzsee	Stray finds/ unclear	Brandenburg (Havel)	Brandenburg	Brandenburg	Germany	Undetermined/ mixed	Kirsch 1993, cat. nr. 873
100	Friesack-Fundplatz 4	Settlement		Havelland	Brandenburg	Germany	Undetermined/ mixed	Kirsch 1993, cat. nr. 1027
101	Friesack-Am Haagschen See	Stray finds/ unclear		Havelland	Brandenburg	Germany	Undetermined/ mixed	Kirsch 1993, cat. nr. 1033
102	Friesack-Lankenbrücke Süd	Stray finds/ unclear		Havelland	Brandenburg	Germany	Undetermined/ mixed	Kirsch 1993, cat. nr. 1035
103	Friesack-Lankenbrücke Nord	Potential settlement		Havelland	Brandenburg	Germany	Undetermined/ mixed	Kirsch 1993, cat. nr. 1034
104	Friesack-Fundplatz 49	Potential settlement		Havelland	Brandenburg	Germany	Globular Amphora	Kirsch 1993, cat. nr. 1031
105	Wildberg-Fundplatz 2	Stray finds/ unclear	Temnitztal	Ostprignitz-Ruppin	Brandenburg	Germany	Undetermined/ mixed	Kirsch 1993, cat. nr. 1112
106	Wagenitz	Potential settlement	Mühlenberge	Havelland	Brandenburg	Germany	Undetermined/ mixed	Kirsch 1993, cat. nr. 1081
107	Brädikow	Settlement	Wiesenaue	Havelland	Brandenburg	Germany	Undetermined/ mixed	Kirsch 1993, cat. nr. 994
108	Brädikow-Fundplatz 13	Settlement	Wiesenaue	Havelland	Brandenburg	Germany	Globular Amphora	Kirsch 1993, cat. nr. 996
109	Brädikow-Fundplatz 11	Potential settlement	Wiesenaue	Havelland	Brandenburg	Germany	Globular Amphora	Kirsch 1993, cat. nr. 995
110	Paulinenaue-Fundplatz 6	Potential settlement		Havelland	Brandenburg	Germany	Undetermined/ mixed	Kirsch 1993, cat. nr. 1072a
111	Groß Behnitz-Fundplatz 9	Stray finds/ unclear	Nauen	Havelland	Brandenburg	Germany	Undetermined/ mixed	Kirsch 1993, cat. nr. 1040
112	Wachow	Potential cemetery	Nauen	Havelland	Brandenburg	Germany	Globular Amphora	Kirsch 1993, cat. nr. 1080
113	Wachow-Fundplatz 5	Stray finds/ unclear	Nauen	Havelland	Brandenburg	Germany	Undetermined/ mixed	Kirsch 1993, cat. nr. 1078
114	Gohlitz-Fundplatz 5	Potential settlement	Nauen	Havelland	Brandenburg	Germany	Globular Amphora	Kirsch 1993, cat. nr. 1038
115	Groß Kreutz-Fundplatz 3	Stray finds/ unclear		Potsdam-Mittelmark	Brandenburg	Germany	Undetermined/ mixed	Kirsch 1993, cat. nr. 1160

Site nr.	Site name	Site type	Municipality	District	Province	Country	Pottery style	Reference
116	Niebede-Fundplatz 2	Stray finds/ unclear	Nauen	Havelland	Brandenburg	Germany	Undetermined/ mixed	Kirsch 1993, cat. nr. 1070
117	Schmergow-Fundplatz 1	Settlement		Potsdam-Mittelmark	Brandenburg	Germany	Undetermined/ mixed	Kirsch 1993, cat. nr. 1203
118	Lietzow	Stray finds/ unclear	Nauen	Havelland	Brandenburg	Germany	Undetermined/ mixed	Kirsch 1993, cat. nr. 1060
119	Fehrbellin-Hakenberg	Stray finds/ unclear	Fehrbellin	Ostprignitz-Ruppin	Brandenburg	Germany	Undetermined/ mixed	Kirsch 1993, cat. nr. 1101
120	Lietzow-Fundplatz 3	Stray finds/ unclear	Nauen	Havelland	Brandenburg	Germany	Undetermined/ mixed	Kirsch 1993, cat. nr. 1059
121	Lietzow-Fundplatz 2/3	Stray finds/ unclear	Nauen	Havelland	Brandenburg	Germany	Globular Amphora	Kirsch 1993, cat. nr. 1058
122	Ketzin-Fundplatz 2	Cemetery		Havelland	Brandenburg	Germany	Globular Amphora	Kirsch 1993, cat. nr. 1048
123	Ketzin-Fundplatz 8	Potential settlement		Havelland	Brandenburg	Germany	Undetermined/ mixed	Kirsch 1993, cat. nr. 1050
124	Nauen	Stray finds/ unclear		Havelland	Brandenburg	Germany	Undetermined/ mixed	Kirsch 1993, cat. nr. 1069
125	Nauen-Fundplatz 24	Potential settlement		Havelland	Brandenburg	Germany	Globular Amphora	Kirsch 1993, cat. nr. 1065
126	Nauen-Fundplatz 51	Stray finds/ unclear		Havelland	Brandenburg	Germany	Undetermined/ mixed	Kirsch 1993, cat. nr. 1067
127	Kienberg-Fundplatz 1	Settlement		Havelland	Brandenburg	Germany	Undetermined/ mixed	Kirsch 1993, cat. nr. 1054
128	Alt Töplitz-Fundplatz14(c)	Potential cemetery	Werder (Havel)	Potsdam-Mittelmark	Brandenburg	Germany	Globular Amphora	Kirsch 1993, cat. nr. 1140
129	Kienberg-Fundplatz 3	Stray finds/ unclear		Havelland	Brandenburg	Germany	Undetermined/ mixed	Kirsch 1993, cat. nr. 1055
130	Brieselang/ Bredow-Fundplatz 12	Settlement	Brieselang	Havelland	Brandenburg	Germany	Undetermined/ mixed	Kirsch 1993, cat. nr. 1001
131	Brieselang/ Bredow-Fundplatz 2	Settlement	Brieselang	Havelland	Brandenburg	Germany	Globular Amphora	Kirsch 1993, cat. nr. 1000
132	Hoppenrade	Stray finds/ unclear		Havelland	Brandenburg	Germany	Undetermined/ mixed	Kirsch 1993, cat. nr. 1047
133	Wustermark-Fundplatz 11	Settlement		Havelland	Brandenburg	Germany	Globular Amphora	Kirsch 1993, cat. nr. 1086
134	Buchow-Karpzow-Am Wublitzsee	Stray finds/ unclear	Wustermark	Havelland	Brandenburg	Germany	Undetermined/ mixed	Kirsch 1993, cat. nr. 1013
135	Hoppenrade-Fundplatz 1	Potential settlement		Havelland	Brandenburg	Germany	Globular Amphora	Kirsch 1993, cat. nr. 1044
136	Wustermark-Am ehemaligen Bahnhof	Stray finds/ unclear		Havelland	Brandenburg	Germany	Undetermined/ mixed	Kirsch 1993, cat. nr. 1088
137	Buchow-Karpzow-Fundplatz 2	Stray finds/ ritual site?	Wustermark	Havelland	Brandenburg	Germany	Undetermined/ mixed	Kirsch 1993, cat. nr. 1005
138	Dyrotz-Fundplatz 6	Potential settlement	Wustermark	Havelland	Brandenburg	Germany	Undetermined/ mixed	Kirsch 1993, cat. nr. 1017
139	Satzkorn-Fundplatz 3	Potential settlement	Potsdam	Potsdam	Brandenburg	Germany	Globular Amphora	Kirsch 1993, cat. nr. 1194
140	Rohrbeck-Fundplatz 1	Potential settlement	Dallgow-Döberitz	Havelland	Brandenburg	Germany	Globular Amphora	Kirsch 1993, cat. nr. 1074
141	Neu Fahrland-Fundplatz 4	Stray finds/ unclear	Potsdam	Potsdam	Brandenburg	Germany	Undetermined/ mixed	Kirsch 1993, cat. nr. 1176
142	Potsdam-Fundplatz 3	Settlement		Potsdam	Brandenburg	Germany	Undetermined/ mixed	Kirsch 1993, cat. nr. 1222
143	Sacrow-Fundplatz 1	Potential settlement	Potsdam	Potsdam	Brandenburg	Germany	Undetermined/ mixed	Kirsch 1993, cat. nr. 1227
144	Mildenberg-Fundplatz 10	Stray finds/ unclear	Zehdenick	Oberhavel	Brandenburg	Germany	Undetermined/ mixed	Kirsch 1993, cat. nr. 897

Site nr.	Site name	Site type	Municipality	District	Province	Country	Pottery style	Reference
145	Stralau-Fundplatz 3	Stray finds/ unclear		Berlin	Berlin	Germany	Undetermined/ mixed	Kirsch 1993, cat. nr. 2
146	Schmöckwitz-Fundplatz 1	Potential settlement		Berlin	Berlin	Germany	Globular Amphora	Kirsch 1993, cat. nr. 11
147	Müggelheim-Fundplatz 11	Settlement		Berlin	Berlin	Germany	Globular Amphora	Kirsch 1993, cat. nr. 8
148	Müggelheim-Fundplatz 4	Settlement		Berlin	Berlin	Germany	Globular Amphora	Kirsch 1993, cat. nr. 6
149	Parchim-Löddigsee	Settlement		Ludwigslust-Parchim	Mecklenburg Western Pomerania	Germany	Undetermined/ mixed	Becker 2002
150	Pernarec	Settlement		Plzeň North	Plzeň	Czech Republic	Cham	Matuschik 1996, list 1 nr. 126
151	Skupeč-Vinice	Settlement		Plzeň North	Plzeň	Czech Republic	Cham	Burger 1988, cat. nr. 93
152	Kaliště-Tepla skála	Settlement		Klatovy	Plzeňský kraj	Czech Republic	Cham	Burger 1988, cat. nr. 81
153	Bzi-Velká skála	Settlement		Plzeň South	Plzeň	Czech Republic	Cham	Burger 1988, cat. nr. 80
154	Starý-Plzenec-Hurka	Settlement		Plzeň South	Plzeň	Czech Republic	Cham	Burger 1988, cat. nr. 94
155	Šťáhlavice-Lopata	Settlement		Plzeň South	Plzeň	Czech Republic	Cham	Burger 1988, cat. nr. 86
156	Vlkov-Babiny	Settlement		Plzeň South	Plzeň	Czech Republic	Cham	Burger 1988, cat. nr. 87
157	Stehelčeves-Homolka	Settlement		Kladno	Středočeský kraj	Czech Republic	Řivnáč	Ehrich and Pleslová-Štiková 1968
158	Tuchoměřice	Settlement		Prague-West	Hlavní město Praha	Czech Republic	Řivnáč	Sankot and Zápotocký 2011
159	Prague 9-Miškovicích	Settlement		Prague	Hlavní město Praha	Czech Republic	Řivnáč	Ernée *et al*. 2007
160	Klučov-Na vrchu	Settlement		Kolín	Středočeský kraj	Czech Republic	Řivnáč	Zápotocký and Kudrnáč 2008
161	Kutná Hora-Denemark	Settlement		Kutná Hora	Středočeský kraj	Czech Republic	Řivnáč	Zápotocký and Zápotocká 2008
162	Vysočany-Palliardiho hradisko	Settlement		Znojmo	Jihomoravský kraj	Czech Republic	Jevišovice	Medunová-Benešová 1977
163	Plotiště nad Labem	Settlement	Hradec Králové	Hradec Králové	Královéhradecký kraj	Czech Republic	Bošaca	Vokolek and Zápotocký 1990
164	Grešlové Mýto-Nad Mírovcem	Settlement		Znojmo	Jihomoravský kraj	Czech Republic	Jevišovice	Medunová-Benešová 1973
165	Jevišovice-Starý Zámek	Settlement		Znojmo	Jihomoravský kraj	Czech Republic	Jevišovice	Medunová-Benešová 1972
166	Raabs-Oberndorf	Settlement	Raabs	Waldviertel	Lower Austria	Austria	Jevišovice	Ruttkay 2000
167	Podolie	Settlement		Nové Mesto nad Váhom	Trenčiansky kraj	Slovakia	Bošaca	Šuteková 2008
168	Iža	Settlement		Komárno	Nitriansky kraj	Slovakia	Kostolac	Němejcová-Pavúková 1968
169	Lieskovec-Hrádok	Settlement	Lieskovec	Zvolen	Banskobystrický kraj	Slovakia	Late Baden	Malček 2013
170	Mastacăn	Cemetery		Neamţ	Moldavia	Romania	Globular Amphora	Mihailescu-Bîrliba 2005
171	Verona-Rocca di Rivoli	Stray finds/ unclear		Verona	Venetia	Italy	Undetermined/ mixed	Primas 1982

Appendix 2. Central and eastern European sites of the Late Neolithic with evidence of textile-roughened pottery and published radiocarbon dates (for calibration plots see Figures 6–8).

Lab code	Site nr. Appendix 1	Site	Country	BP	Std. dev. ±	Sampled material	Feature type	Pottery style	Association with texti-le-roughened pottery	Reference
Beta-372689	21	Burgerroth-Altenberg	Germany	3950	30	Grain	Pit house	Burgerroth	Feature containing tex-tile-rougehened pottery	Link 2018
Beta-372690	21	Burgerroth-Altenberg	Germany	4050	30	Grain	Pit house	Burgerroth	Feature containing tex-tile-rougehened pottery	Link 2018
Erl-20204	21	Burgerroth-Altenberg	Germany	4036	39	Grain	Ditch	Burgerroth	No direct relation/general site activities	Link 2018
Erl-20206	21	Burgerroth-Altenberg	Germany	4098	40	Grain	Ditch	Burgerroth	No direct relation/general site activities	Link 2018
Fra-86	21	Burgerroth-Altenberg	Germany	4040	100	Bone	Settlement	Burgerroth	No direct relation/general site activities	Link 2018
MAMS-25468	21	Burgerroth-Altenberg	Germany	4091	27	Hazelnut/ grain	Ditch	Burgerroth	No direct relation/general site activities	Link 2018
Erl-2143	29	Dietfurt an der Altmühl	Germany	4048	88	Bone	Pit feature 4	Cham	No direct relation/general site activities	Gohlisch 2005
Erl-2144	29	Dietfurt an der Altmühl	Germany	4089	90	Bone	Pit feature 4	Cham	No direct relation/general site activities	Gohlisch 2005
Erl-2145	29	Dietfurt an der Altmühl	Germany	4129	110	Bone	Pit feature 4	Cham	No direct relation/general site activities	Gohlisch 2005
Erl-2146	29	Dietfurt an der Altmühl	Germany	4257	54	Bone	Settlement	Cham	No direct relation/general site activities	Gohlisch 2005
Erl-2147	29	Dietfurt an der Altmühl	Germany	4440	56	Bone	Settlement	Cham	No direct relation/general site activities	Gohlisch 2005
Erl-2148	29	Dietfurt an der Altmühl	Germany	3989	53	Bone	Settlement	Cham	No direct relation/general site activities	Gohlisch 2005
Hv-17224	29	Dietfurt an der Altmühl	Germany	4360	175	Charcoal	Pit feature 151	Cham	No direct relation/general site activities	Gohlisch 2005
Hv-17225	29	Dietfurt an der Altmühl	Germany	4175	130	Charcoal	Pit feature 86	Cham	No direct relation/general site activities	Gohlisch 2005
Hv-17226	29	Dietfurt an der Altmühl	Germany	4315	75	Charcoal	Pit feature 52	Cham	No direct relation/general site activities	Gohlisch 2005
Hv-17228	29	Dietfurt an der Altmühl	Germany	4245	145	Charcoal	Pit feature 48	Cham	No direct relation/general site activities	Gohlisch 2005
Hv-17229	29	Dietfurt an der Altmühl	Germany	4105	105	Charcoal	Stone paving feature 148	Cham	No direct relation/general site activities	Gohlisch 2005
GrN-7798	33	Prutting-Dobl	Germany	4150	60	Charcoal	Ditch	Cham	No direct relation/general site activities	Burger 1988
GrN-7799	33	Prutting-Dobl	Germany	4240	60	Charcoal	Ditch	Cham	No direct relation/general site activities	Burger 1988

Lab code	Site nr. Appendix 1	Site	Country	BP	Std. dev. ±	Sampled material	Feature type	Pottery style	Association with textile-roughened pottery	Reference
MAMS-47639	34	Chieming-Markstatt	Germany	3869	25	Bone	Cultural layer	Cham	No direct relation/general site activities	Pechtl and Möslein 2020
Hd-8113-8166	37	Moosham-Flickermühle	Germany	4180	65	Charcoal	Ditch feature 1	Cham	No direct relation/general site activities	Matuschik 2001
Hd-8114-8165	37	Moosham-Flickermühle	Germany	4230	60	Charcoal	Ditch feature 1	Cham	No direct relation/general site activities	Matuschik 2001
Hd-7409-7435	38	Riekofen-Kellnerfeld	Germany	4170	35	Charcoal	Enclosure A, ditch 1	Cham	No direct relation/general site activities	Matuschik 2001
Hd-7411-7437	38	Riekofen-Kellnerfeld	Germany	4225	45	Charcoal	Enclosure A, ditch 1	Cham	No direct relation/general site activities	Matuschik 2001
Hd-7412-7439	38	Riekofen-Kellnerfeld	Germany	4245	35	Charcoal	Wall trench feature 73	Cham	No direct relation/general site activities	Matuschik 2001
Hd-15029-15543	39	Aiterhofen-Ödmühle	Germany	4444	31	Bone	Pit feature 196	Cham	Feature containing textile-roughened pottery	Hanöffner and Siftar 2006
Hd-15057-15673	39	Aiterhofen-Ödmühle	Germany	4335	36	Bone	Ditch feature 93	Cham	Other features/ site activities	Hanöffner and Siftar 2006
Hd-16974	43	Ebsdorfergrund-Wittelsberg	Germany	4348	57	Charcoal	Pit	Wartberg	No direct relation/general site activities	Raetzel-Fabian 2000
Hd-16976	43	Ebsdorfergrund-Wittelsberg	Germany	4202	69	Charcoal	Pit	Wartberg	No direct relation/general site activities	Raetzel-Fabian 2000
UtC-3321	43	Ebsdorfergrund-Wittelsberg	Germany	4010	120	Charcoal	Pit	Wartberg	No direct relation/general site activities	Raetzel-Fabian 2000
Hd-17559	45	Lohne-Hasenberg	Germany	4319	23	Bone	Pit	Wartberg	No direct relation/general site activities	Raetzel-Fabian 2000
KN-3056	45	Lohne-Hasenberg	Germany	4160	50	Bone	Pit	Wartberg	No direct relation/general site activities	Raetzel-Fabian 2000
Hd-16871	47	Gudensberg-Bürgel	Germany	4105	42	Bone	Western ditch part	Wartberg	No direct relation/general site activities	Raetzel-Fabian 2000
Hd-17123	47	Gudensberg-Bürgel	Germany	3848	47	Bone	Eastern ditch part	Wartberg	No direct relation/general site activities	Raetzel-Fabian 2000
KN-2459	60	Pevestorf 19	Germany	4270	55	Charcoal	Burial pit	Undetermined/ mixed	Feature containing textile-roughened pottery	Meyer 1993
KN-2460	60	Pevestorf 19	Germany	4130	55	Charcoal	Burial pit	Undetermined/ mixed	No direct relation/general site activities	Meyer 1993
KN-4903	68	Derenburg-Steinkuhlenberg	Germany	4291	42	Bone	Pit 68	Bernburg	No direct relation/general site activities	Hille 2020
KN-4904	68	Derenburg-Steinkuhlenberg	Germany	4084	27	Bone	Pit 79	Bernburg	No direct relation/general site activities	Hille 2020
M-16312	68	Derenburg-Steinkuhlenberg	Germany	4411	25	Bone	Pit 13	Bernburg	No direct relation/general site activities	Hille 2020
M-16314	68	Derenburg-Steinkuhlenberg	Germany	4386	24	Bone	Pit 37	Bernburg	No direct relation/general site activities	Hille 2020

Lab code	Site nr. Appendix 1	Site	Country	BP	Std. dev. ±	Sampled material	Feature type	Pottery style	Association with textile-roughened pottery	Reference
M-16315	68	Derenburg-Steinkuhlenberg	Germany	4377	23	Bone	Pit 46	Bernburg	No direct relation/general site activities	Hille 2020
M-16316	68	Derenburg-Steinkuhlenberg	Germany	4440	27	Bone	Pit 68	Bernburg	No direct relation/general site activities	Hille 2020
M-16317	68	Derenburg-Steinkuhlenberg	Germany	4358	26	Bone	Pit 79	Bernburg	No direct relation/general site activities	Hille 2020
M-16318	68	Derenburg-Steinkuhlenberg	Germany	4383	24	Bone	Pit 96	Bernburg	No direct relation/general site activities	Hille 2020
Bln-838	75	Halle-Dölauer Heide	Germany	4105	100	Charcoal	Pit	Bernburg	No direct relation/general site activities	Breunig 1987
Bln-838A	75	Halle-Dölauer Heide	Germany	4380	100	No information	Pit	Bernburg	No direct relation/general site activities	Breunig 1987
Bln-912	75	Halle-Dölauer Heide	Germany	4340	100	No information	Pit	Bernburg	No direct relation/general site activities	Breunig 1987
Bln-3825	149	Parchim-Löddigsee	Germany	4080	150	Charcoal	Mixed cultural layer	Undetermined/ mixed	No direct relation/general site activities	Becker 2002
Bln-3828	149	Parchim-Löddigsee	Germany	4290	100	Charcoal	Mixed cultural layer	Undetermined/ mixed	No direct relation/general site activities	Becker 2002
Poz-27423	156	Vlkov-Babiny	Czech Republic	3840	35	No information	Settlement	Cham	No direct relation/general site activities	John 2009
Poz-27424	156	Vlkov-Babiny	Czech Republic	4095	35	No information	Settlement	Cham	No direct relation/general site activities	John 2009
Poz-27425	156	Vlkov-Babiny	Czech Republic	4005	35	No information	Settlement	Cham	No direct relation/general site activities	John 2009
GrN-4065	157	Stehelčeves-Homolka	Czech Republic	4260	70	No information	Settlement	Řivnáč	No direct relation/general site activities	Ehrich and Pleslová-Štiková 1968
OxA-15797	158	Tuchoměřice	Czech Republic	4316	36	Grain	Obj. 12	Řivnáč	Feature containing textile-rougehened pottery	Sankot and Zápotocký 2011
KIA-30944	159	Prague 9-Miškovicích	Czech Republic	4330	31	Bone	Pit house	Řivnáč	Feature containing textile-rougehened pottery	Ernée *et al.* 2007
Bln-2892	161	Kutná Hora-Denemark	Czech Republic	4150	60	No information	Obj. 22	Řivnáč	No direct relation/general site activities	Zápotocký and Zápotocká 2008
Bln-3265	161	Kutná Hora-Denemark	Czech Republic	4120	50	Plant remains	Obj. 41a	Řivnáč	Feature containing textile-rougehened pottery	Zápotocký and Zápotocká 2008
Bln-3266	161	Kutná Hora-Denemark	Czech Republic	4280	70	Plant remains	Obj. 41a	Řivnáč	Feature containing textile-rougehened pottery	Zápotocký and Zápotocká 2008
Bln-3267	161	Kutná Hora-Denemark	Czech Republic	3890	50	Charcoal	Obj. 41	Řivnáč	Feature containing textile-rougehened pottery	Zápotocký and Zápotocká 2008
Bln-3268	161	Kutná Hora-Denemark	Czech Republic	4200	70	Charcoal	Obj. 36	Řivnáč	Feature containing textile-rougehened pottery	Zápotocký and Zápotocká 2008

Lab code	Site nr. Appendix 1	Site	Country	BP	Std. dev. ±	Sampled material	Feature type	Pottery style	Association with textile-roughened pottery	Reference
Bln-3269	161	Kutná Hora-Denemark	Czech Republic	4110	50	Charcoal	Obj. 1	Řivnáč	No direct relation/general site activities	Zápotocký and Zápotocká 2008
Bln-2170	167	Podolie	Slowakia	4215	65	No information	Settlement	Bošáca	No direct relation/general site activities	Breunig 1987
Bln-556	167	Podolie	Slowakia	4455	80	Charcoal	Settlement	Bošáca	No direct relation/general site activities	Breunig 1987
Hela-2470	not mapped	Žemaitiškes 2	Lithuania	4351	32	Charred residue	Pottery vessel	Baltic Textile Pottery	Direct date from pottery adhesions	Piličiauskas 2012
Hela-2566	not mapped	Žemaitiškes 3	Lithuania	5319	35	Charred residue	Pottery vessel	Baltic Textile Pottery	Direct date from pottery adhesions	Piličiauskas 2012
Hela-751	not mapped	Loona Saare	Estonia	4165	90	Charred residue	Pottery vessel	Baltic Textile Pottery	Direct date from pottery adhesions	Kriiska *et al.* 2005
Hela-752	not mapped	Akali	Estonia	4055	40	Charred residue	Pottery vessel	Baltic Textile Pottery	Direct date from pottery adhesions	Kriiska *et al.* 2005
Hela-754	not mapped	Kullamägi	Estonia	4140	70	Charred residue	Pottery vessel	Baltic Textile Pottery	Direct date from pottery adhesions	Kriiska *et al.* 2005
Hela-755	not mapped	Kullamägi	Estonia	3605	40	Charred residue	Pottery vessel	Baltic Textile Pottery	Direct date from pottery adhesions	Kriiska *et al.* 2005
Hela-761	not mapped	Akali	Estonia	4155	65	Charred residue	Pottery vessel	Baltic Textile Pottery	Direct date from pottery adhesions	Kriiska *et al.* 2005

Decades of drought in the twenty-eighth century BC and its effects on settlement and culture

Joachim Pechtl and Alexander Land

Abstract

Tree rings of subfossil oaks from southern Germany document a 19-year drought phase from 2745–2727 denBC. This drought phase is one of the most severe anomalies during the Holocene in terms of duration and accumulated precipitation deficit. Significant yield reductions are likely to have occurred in all sectors of the food economy, but especially in crop production. In the long run, it was not possible to compensate for such losses either by stockpiling or by expanding gathering, hunting and fishing. The most successful strategy would have been to expand extensive forms of livestock farming, provided there was sufficient grazing land. At least in particularly hard-hit regions of southern central Europe, such a food crisis could have caused a collapse of settlement. Due to the existing dating uncertainties in most region, however, this can only be verified for the pile dwelling settlements of Switzerland and neighbouring south-western Germany, which are also dated by dendrochronology. In fact, construction activities in the only recently established settlements of the Corded Ware culture in this area declined in parallel with the onset of the drought and eventually ceased altogether. However, as the drought phase progressed, activities increased again and reached their highest intensity soon after the end of the drought. It is possible that the general trend in the Corded Ware culture towards a greater emphasis on livestock farming facilitated successful adaptation to drought conditions and thus promoted the spread of this new lifeway, which led to a permanent increase in the proportion of animal food.

Keywords: Corded Ware culture, settlement, livestock, precipitation reconstruction, drought

Introduction

There is no question that climatic conditions set the frame for the development of human economic and cultural systems and are thus of crucial importance. The same applies to fluctuations of varying duration, ranging from extreme weather events on single days to glacial cycles lasting for many millennia. Hence, weather and climate fluctuations have great potential to decisively influence the course of human history

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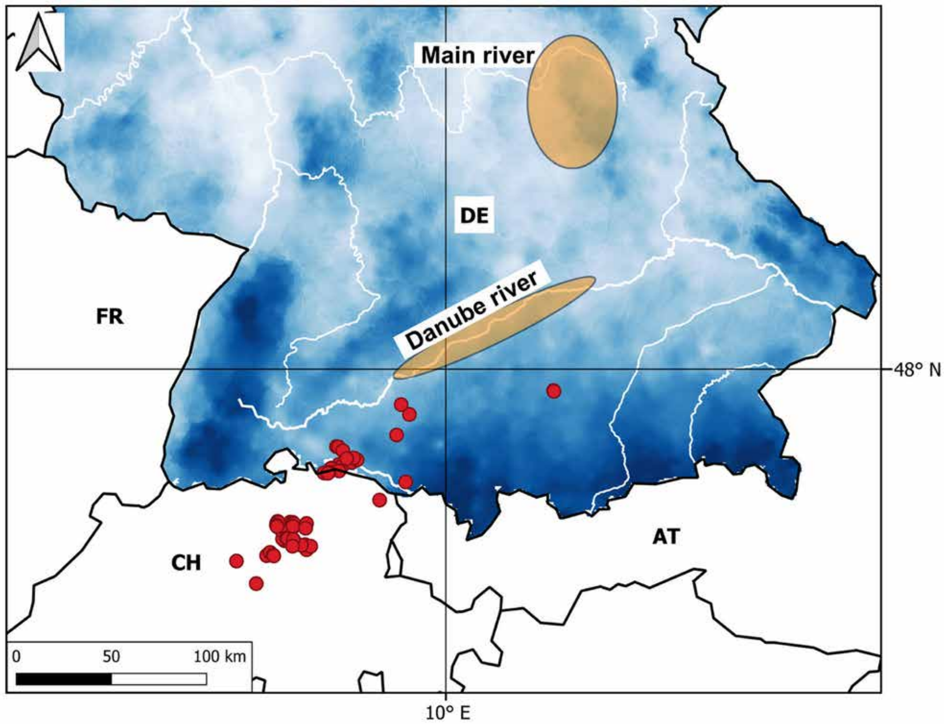

Figure 1. Map of study area in central Europe. The two orange ellipsoids indicate where ancient (subfossil) trees from the Main river and Danube river (southern Germany) were found. The red dots show archaeologically analysed Neolithic settlements (see Appendix 1 for detailed information). Superimposed is the modern multi-annual (AD 1991–2020) mean of spring (March–May) precipitation rates for Germany (source: Deutscher Wetterdienst, HYRAS version 5). Light–dark blue = 100–550 mm.

(Behringer 2007; Gerste 2015; Lamb 1982; Meller and Puttkammer 2017). Although such connections can be proven in historical times, there is — quite rightly — often a strong scepticism when applying such reasoning in prehistoric archaeology (e.g. Lüning 1997, 29). While in areas with extreme conditions even small changes are sufficient to cross tipping points in ecosystems, central Europe has a temperate climate and the Holocene is considered as a quite stable climate phase, so that very resilient systems can be expected. Nevertheless, extremely dry or extremely wet conditions during individual years have the potential to cause serious crop failures (e.g. Rahlf 1996). Especially when several years of low yields occur in succession, this can cause severe famine and create lasting trauma in the collective memory. An example is the "great famine" in Ireland (1845–1849), which was triggered by summer dampness (Lamb 1982, 279–80), and independently of the question of its historical accuracy the biblical myth of Joseph and the seven years of famine in the eastern Mediterranean is remembered even millennia later (Gen. 41).

There are two fundamental problems in dealing with such questions. The first is simply the temporal correlation between climate events and cultural changes. This problem exists especially for events with a duration of years to decades at the most. Such a high temporal resolution is far beyond the possibilities of ^{14}C dating, but the dating of both archaeological material and many climatic proxies mostly depends on exactly this method. The second problem is that both human societies as well as the climate and the ecosystems influenced by it are highly complex systems. Therefore, it is often questionable what exactly caused an observed change and what the consequences of it were. Simple cause–effect relationships are therefore not necessarily to be expected and there is much room for interpretation.

This study investigates the possible consequences of a 19-year drought period in southern central Europe in the twenty-eighth century BC, which is one of the most extreme fluctuations of the entire Holocene (Figure 1). This happened in a highly dynamic period, as Late Neolithic phenomena such as the Horgen culture and the Cham culture were replaced by the Final Neolithic Corded Ware culture in southern central Europe around this time, which was part of a profound supra-regional change (Dörfler and Müller 2008; Kaiser 2019; Klejn *et al.* 2018). The evidence of drought is provided by precisely dated tree rings and their sensitivity to rainfall. Since almost the entire vegetation suffered from the same drought stress, economic losses for human societies of the time can be inferred in close connection with this. In addition, the dendrochronological dating of pile dwelling settlements makes it possible to check for effects on contemporaneous settlement. Dendroclimatology thus offers a key to dating and correlating climatic fluctuations and human responses with annual precision.

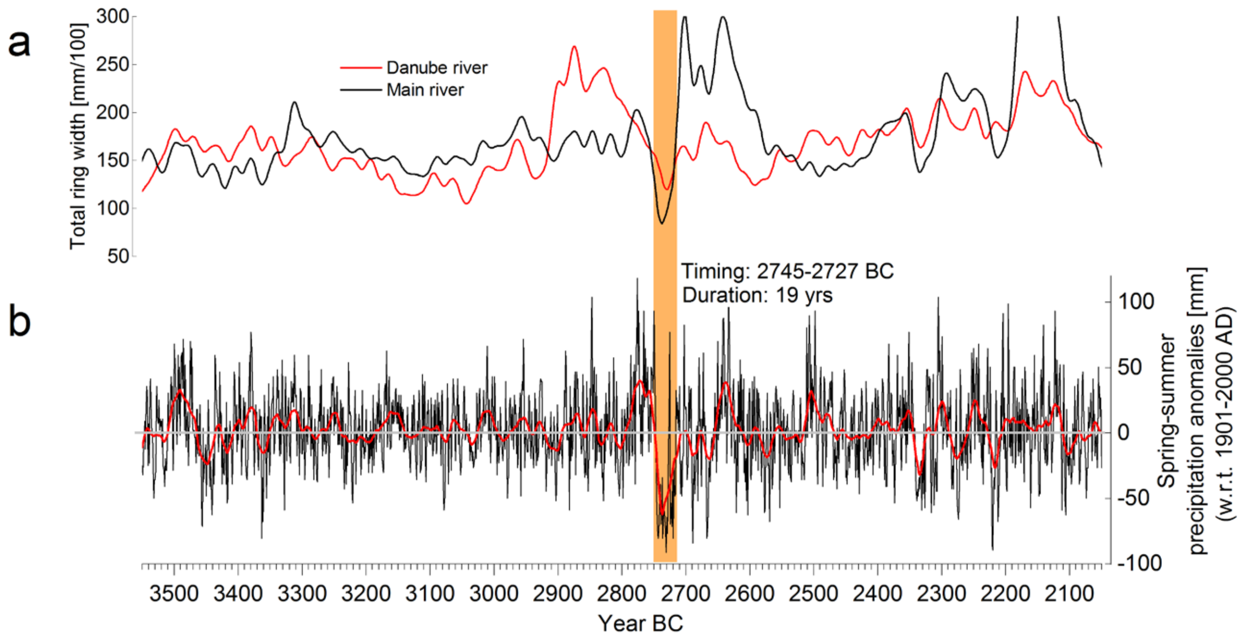

Figure 2. a) Radial growth of tree-ring records (ten-year weighted average). b) Reconstructed annual (black) and decadal (red) warm-season (spring–summer) precipitation anomalies for southern Germany as inferred from tree rings. Orange bar indicates the prolonged warm-season drought event starting from 2745 denBC.

Precipitation anomalies during the fourth and third millennia BC as inferred from tree rings

Tree-ring data and precipitation reconstruction

Tree rings are suitable for reconstructing past climatic conditions. They are frequently used to visualise the dynamic of past climate conditions at different spatial (e.g. continental–local) and temporal (e.g. decadal–annual) resolutions. Such tree-ring inferred climate reconstructions are vital for example for archaeological investigations and are key in the debate of modern climate change.

To develop a precipitation record of high temporal resolution, spanning from the middle of the fourth to the entire third millennium BC, precisely dated tree-ring series of ancient (subfossil) oaks from the Main river and Danube river (southern Germany) were used, allowing an investigation of the dynamic of past spring–summer (warm-season) rainfall variability on a high–low temporal scale, as well as the identification of single-year drought events and multi-year drought periods. The tree-ring series used are part of the Hohenheim tree-ring archive and were found in alluvial deposits of the Main and Danube (Figure 1). The distance between the two rivers is ~150 km. In the first instance, these oak trees represent local–regional climate conditions, but also hold valuable central European-wide climate information. Thus, the developed record of precipitation anomalies is suited to yield insights into the spatio-temporal behaviour of warm-season rainfall fluctuations (e.g. Land *et al.* 2019; Pechtl and Land 2019; Spurk *et al.* 2002).

Before a precise reconstruction of past climate conditions was developed, living oak trees were investigated in order to assess their sensitivity to different climatic parameters (temperature, precipitation etc.). This so-called calibration/verification process is a standard procedure in dendroclimatology (for details see e.g. Cook and Kairiukstis 1990; Cook *et al.* 1999; Land 2022; Land *et al.* 2019) and was carried out for oak trees along the Main river and Danube river (Figure 1). The living oak trees revealed a high, significant sensitivity to spring–summer precipitation amounts. Thereafter, a climate-growth model was developed and applied in order to reconstruct the amount of spring–summer (warm-season) precipitation on the basis of subfossil tree-ring series from the Main river oaks. As can be seen from Figure 2, the annual–decadal growth dynamics of the trees in the Main river and Danube river regions show highly similar behaviour, indicating that the trees reacted in similar ways to past precipitation conditions. The oak trees from the Main river are thus representative for southern Germany (and central Europe). For the final reconstruction of warm-season precipitation anomalies, the Main river tree-ring series were used, and a record of deviations with respect to (henceforth abbreviated w.r.t.) the modern period AD 1901–2000 was calculated.

Long-lasting severe drought from 2745–2727 denBC

During the third millennium BC an unusually severe and marked drought occurred, as inferred from the tree rings. Even though the ancient trees reflect climatic conditions primarily on a regional scale, such a severe, long-lasting drought clearly affects the entire central European region. Figure 2a highlights that the trees from the Main river and Danube river reveal similar growth dynamics. In both areas, tree growth suddenly decreased in the year 2745 denBC (Main river) and 2743 denBC (Danube river). This growth reduction persists for two decades before growth recovers. Figure 2b depicts the reconstruction of warm-season precipitation anomalies (w.r.t. AD 1901–2000) at annual resolution.

From the middle of the fourth millennium BC, warm-season rainfall exhibits high year-to-year as well as decadal changes. Dry seasons appeared for instance in the years 3457, 3363 and 3078 denBC and a decade with below-average rainfall around 3450 denBC. Two decades before the long-lasting drought event (2745–2727 denBC), a wet period is documented before rainfall severely drops, leading right into the decadal-long dry period. During the severe drought event itself, warm-season rainfall was consistently low for 19 years. The following decade is still characterised by below-average rainfall, interrupted by occasionally occurring wet seasons. Between 2715 and 2660 denBC a high year-to-year fluctuation is detected, meaning that a wetter season was followed by a drier season and vice versa. Furthermore, three exceptionally dry seasons occur in the years 2689, 2667 and 2666 denBC. Thereafter, rainfall increases and a period with above-average precipitation amounts follows with single, exceptionally wet seasons.

Considering the precipitation reconstruction before and after the long-lasting drought, it is evident that rainfall is much more variable (high year-to-year changes and high number of dry/wet seasons) from 2700–2000 denBC than from 3500–2800 denBC. This indicates a sudden change in the regional/European-wide weather and atmospheric circulation that may have been triggered by changes in the overall climate system.

Setting the long-lasting drought from 2745–2727 denBC into a Holocene context, and when we consider the intensity as well as the duration of that extraordinarily dry period, it is in the top five list of the severest and most prolonged droughts within the past ten millennia in southern Germany, and central Europe as a whole. During the past century (AD 1901–2000), central Europe did not suffer such a long-lasting drought period. But during single-year dry seasons, such as in the years AD 1976 and 2018, our society has been confronted with the consequences of extreme droughts. These single-year droughts led to dramatic crop failures due to a heavy reduction in soil moisture, in turn resulting in severe European-wide turbulences on the financial markets.

Presumed drought effects on the Late and Final Neolithic economy

Severe droughts lead to a variety of effects that influence the yield of human subsistence strategies even under central European conditions. Recent drought events provide actualistic insights into the mechanisms involved. Due to the current public and political attention regarding the effects of the ongoing anthropogenic climate change, there is vast data especially for the exceptional drought years AD 2003 and 2018 (Bayerisches Landesamt für Umwelt 2017; Bundesanstalt für Gewässerkunde 2006; Bundesministerium für Landwirtschaft und Ernährung 2018; Buras *et al.* 2020; Deutscher Bundestag 2019; Gobin 2012; Stahl *et al.* 2016). In 2003 and 2018, precipitation in Germany was about a quarter lower than the long-term average (Deutscher Bundestag 2019, 81–82; Imbery *et al.* 2018). In 2018, the precipitation deficit from April to August, i.e. in a crucial phase of the growing season for both wild plants and crops, was -150 mm in Germany, which is 40.6 % lower than the long-term average of the years 1961–1990 (Imbery *et al.* 2018, 3–4). In addition to the severity of the precipitation deficit, numerous other factors determine the intensity of drought effects. Important factors include time and duration of the drought, temperature, soil moisture present at the beginning, and many local factors such as soil type, sun exposure, wind and local vegetation (e.g. Buras *et al.* 2020, 1667; Deutscher Bundestag 2019, 81; Gobin 2012). Accordingly, even during large-scale droughts, the consequences differ considerably on a small scale (e.g. Buras *et al.* 2020). For instance, paradoxically, in extremely humid locations the growth conditions for some plants may even improve. Furthermore it should be noted that the effects of a multi-year drought presumably do not simply add up annual effects (Deutscher Bundestag 2019, 8), but that complex interactions are also likely to occur in the entire ecological system (Sutanto *et al.* 2020).

Actualistic comparison therefore to some extent allows for qualitative assessment of the consequences of a prehistoric drought period on human subsistence. But quantification of losses would be a very complex task and is far beyond the aims of this study. First of all, lack of precipitation causes a reduction in soil moisture as well as a reduction in runoff, and thus a decrease in the levels of groundwater and surficial water bodies (Bundesanstalt für Gewässerkunde 2006, 173–79, 191; Deutscher Bundestag 2019, 75–77, 89). As a result of lower soil moisture, less water is available for evapotranspiration of the vegetation, which leads to a lower primary production of biomass (Bundesanstalt für Gewässerkunde 2006, 173–79; Buras *et al.* 2020, 1656; Ciais *et al.* 2005). Finally, this has a negative impact on the fauna — and on the human population as well.

Economically, Late and Final Neolithic communities in central Europe largely relied on agricultural practices, as shown by archaeological (e.g. Hafner and Suter 2012, 24–27; Jacomet and Maier 2016; Lüning 1997) and isotopic data (e.g. Asam *et al.* 2006; Münster *et al.* 2018, 10 fig. 3). It should be emphasised that there is no evidence of artificial irrigation in central Europe. Any threat to the crop yield of arable farming and horticulture thus constituted a fundamental problem. Moderate drought only marginally reduces crop yields, especially of cereals. Thus, during the period AD 1971–1976, the moderate losses of five drought years were largely compensated by the above-average yields of the wetter year 1974 (Deutscher Bundestag 2019, 81–82). In contrast, severe droughts cause significant crop losses, as in AD 2003 and 2018, when various cereals saw an average decline of 11–17 %, but in some places even around 80 % (Bundesanstalt für Gewässerkunde 2006, 176). Prehistoric communities are likely to have suffered particularly badly from crop failures during a multi-year drought, for two reasons. Firstly, the soil moisture deficit would have gradually worsened in many places over the years. It should be emphasised that even the oaks used here for rainfall reconstruction show significant growth losses, although they grew in floodplains. Hence, an adequate supply of crops is likely to have become problematic at times, in particular in the densely populated "*Altsiedellandschaften*" such as the usually dry loess plains next to the rivers Danube and Main (Figure 1). Secondly, repeated crop losses in larger areas could not be compensated either by own storage or by imports.

Animal husbandry was also an important component of the economic strategies of Late and Final Neolithic communities and often its role as a stabilising factor in times of crisis is emphasised (Hafner and Suter 2012, 25–27; Lüning 1997; Schibler 2008; Stephan and Steppan 2016). Although generally of less importance for nutrition than plant cultivation, meat and dairy products from livestock farming played an increasingly important role (Evershed *et al.* 2022, 2 fig. 1c). During severe droughts, both livestock yields (meat and milk) and reproduction can decrease due to restrictions on feed and water, as well as heat stress (Stahl *et al.* 2016, 807). However, this is likely to have been sufficiently counteracted by flexible herd management and spatial relocation. An increased use of livestock could therefore initially mitigate the consequences of a drought on plant cultivation. In a drought phase lasting several years, however, the goals of a short-term increase in slaughter rates on the one hand and a build-up of herds as an adaptive strategy on the other contradict each other.

The collection of wild plants and probably also of mushrooms contributed to the diet of Late and Final Neolithic populations (Jacomet and Maier 2016; Lüning 1997, 62–63). In terms of nutritional value, nuts and fruit — the products of forests or forest edges and hedges — were probably the most important. At least locally, however, resources from other locations were also used, such as fruit of the water caltrop from shallow water areas of lakes (Karg 2016). Although growth conditions can improve during a drought in particularly humid locations, there are significant declines in most areas. In forests, severe leaf loss, significant growth reduction and increased tree mortality have been observed during recent droughts. Frequently, weakened trees are additionally damaged by fungal infestation, insects and forest fires. Severe damage to the trees is often particularly pronounced in the following year and prolonged droughts lead to irreversible damage (Schuldt *et al.* 2020; Zimmermann *et al.* 2020). In shrublands, too, biomass production suffers from droughts and species richness decreased in AD 2003 at most sites (Peñuelas *et al.* 2007). Finally, grasslands proved to be particularly sensitive to recent droughts (Buras *et al.* 2020, 1656). Overall, gross primary production fell by about 30 % during the 2003 drought (Buras *et al.* 2020, 1665; Ciais *et al.* 2005). Accordingly, an expansion of the gathering economy during a Neolithic drought is a way to compensate for harvest declines in plant cultivation. But this is associated with an enormous amount of work, especially since wild plants also suffer considerably at the same time. Especially in densely populated areas, an overuse of collecting areas is to be expected in the long term.

Drinking water supply is of paramount importance to all humans. During recent droughts, water levels dropped and some springs and streams dried up. Above all, the water quality of many surface waters deteriorated (Bundsanstalt für Gewässerkunde 2006, 191; Deutscher Bundestag 2019, 75–77; Stahl *et al.* 2016, 807–09). Under comparable conditions, it was certainly more difficult for some Neolithic communities to maintain an adequate supply of drinking water. However, at most settlement sites in central Europe this problem could probably have been solved by accepting to travel longer distances to water sources.

The last component of the Neolithic diet is hunting and fishing, which fluctuated considerably in importance over space and time (Baumeister and Köninger 2016; Lüning 1997, 66–92; Schibler 2010; Stephan and Steppan 2016). Observations in Swiss Neolithic wetland settlements show that the intensification of hunting activities was a strategy frequently chosen in times of crisis (Hafner and Suter 2012, 25). Red deer, roe deer, aurochs and wild boar were the most important meat suppliers (Lüning 1997, 82; Schibler 2010; von den Driesch 2004, 334, 345–46). As a result of the effects of droughts, prey also suffers from water and food shortages (Deutscher Bundestag 2019, 11). Such a weakening of the animals, combined with increased hunting pressure, is likely to have a negative impact on the reproduction of game. In the event of longer droughts, game populations could therefore have collapsed regionally. Hence, an intensification of hunting could only be sustained in the long term if there were sufficiently large hunting grounds. The same applies to fisheries. A reduction of water surfaces and thus the habitat, increased water temperature, declining oxygen content and often poorer ecological quality of the water damage the stocks of fish, crabs and mussels (Bayerisches Landesamt für Umwelt 2017, 12, 191–92; Bundesanstalt für Gewässerkunde 2006, 170–71; Stahl *et al.* 2016, 807–09). Sinking water levels with a concomitant concentration of animals in a smaller area with fewer hiding places and escape routes may have facilitated fishing at first. During a short but severe drought, fishing is likely to have provided an easily accessible food source. However, this would soon have changed if the drought event lasted for many years, when on the one hand the reproduction of the animals is disturbed and on the other hand fishing is intensified, so that stocks decrease locally.

The 19-year drought of 2745–2727 denBC undoubtedly led to considerable reductions in biomass production over a large area, at least in southern central Europe. Precipitation deficits during the growing seasons probably did not reach the extreme values of the reference years AD 2003 and 2018 (-110 mm in 2018: Bundesministerium für Landwirtschaft und Ernährung 2018, 4). But due to the repeated rainfall deficits of 50–80 mm during the growing seasons (Figure 2), the damage to flora and fauna accumulated. Severe and long-term consequences for the human subsistence economy are therefore to be expected in any case, although this might have taken regionally different forms. In particular, plant cultivation, the most important cornerstone of the Neolithic diet, would have suffered severe losses. For example, famines as a direct result even of one-year crop failures are well documented in historical times (Abel 1978, 28). Therefore, the drought phase during the third millennium BC, which lasted almost one human generation, presumably resulted in massive stress for both economic and social structures. This, in turn, could have had serious consequences for population and settlement, at least in particularly affected areas. Traditional strategies to compensate for crop losses, such as storage, reliance on social networks, the intensification of hunting activities and the slaughter of livestock, would only have had a limited effect due to the long duration of the drought. Apart from relocating settlements to wetter areas, more extensive strategies of hunting and animal husbandry would have been successful ways to cope with the crisis. For this to succeed, however, the availability of correspondingly large economically usable areas was a mandatory prerequisite. Especially in the densely populated centres of Late Neolithic settlement, which are usually located in extremely dry areas, this could have led to considerable problems.

Testing possible drought effects on Late and Final Neolithic settlement

Method for the determination of human settlement intensity

Neither typochronology nor radiocarbon dates allow us to date settlements of the later fourth and third millennia BC with sufficient accuracy to investigate occupation intensity at a decadal or annual resolution (Furholt 2008). Hence, for this purpose only dendrochronologically dated sites can be used. In central Europe such sites are largely restricted to Switzerland and adjacent areas of southern Germany and eastern France. However, sites in western Switzerland and France are not included because of the great distance to the areas which we have here investigated dendroclimatologically.

Our archaeological analyses are thus based on available data from central and eastern Switzerland, as well as southern Germany (southern Baden-Württemberg, southern Bavaria) (Figure 1; Appendix 1). The use of a site as a settlement during a given year is assumed if at least one reliable dendrochronological date is available. Subsequently, the number of settlements per year for which settlement activities are attested is statistically evaluated (e.g. Billamboz and Köninger 2008). Limitations arise not only from the relatively small number of settlements that can be included and the geographical distance from the Danube and Main, where the oak trees we have used were found. More importantly, pile dwellings represent a special form of settlement with spatially and temporally limited distribution. In the northern Alpine area pile dwellings appeared in the later fifth millennium BC and were present through the Late Neolithic to the Final Neolithic until about 2400 BC. Later on, pile dwellings are absent for several centuries and only reappear in the developed Early Bronze Age in the second millennium BC (Hafner *et al.* 2016). This specific settlement system was extremely flexible: the period of use at individual sites was usually in the range of only one or two decades. Often, the settlements moved and returned decades later to the same sites (e.g. Matuschik and Müller 2016). A long-term absence of this type of settlement certainly is due to cultural reasons. A short-term absence, on the other hand, can have a variety of reasons, such as gaps in research, lake-level fluctuations or social factors. Finally, it is not totally clear whether the special location of the pile-dwelling settlements correlated with special economic strategies, and thus whether there were fundamental differences to contemporaneous settlements in the loess areas, for example.

In the time span 3550–2400 BC, a total of 1068 identifiable years of settlement from 66 sites have

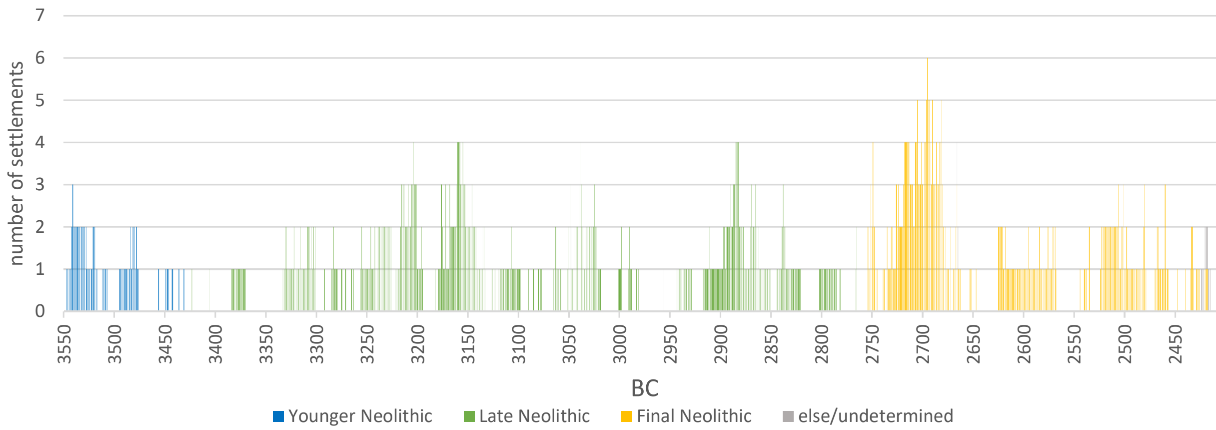

Figure 3. Number of settlements with direct dendrochronological settlement evidence per year between 3550–2400 denBC in central and eastern Switzerland and southern Germany (see Appendix 1 for detailed information). Cultural attribution is based on the find material.

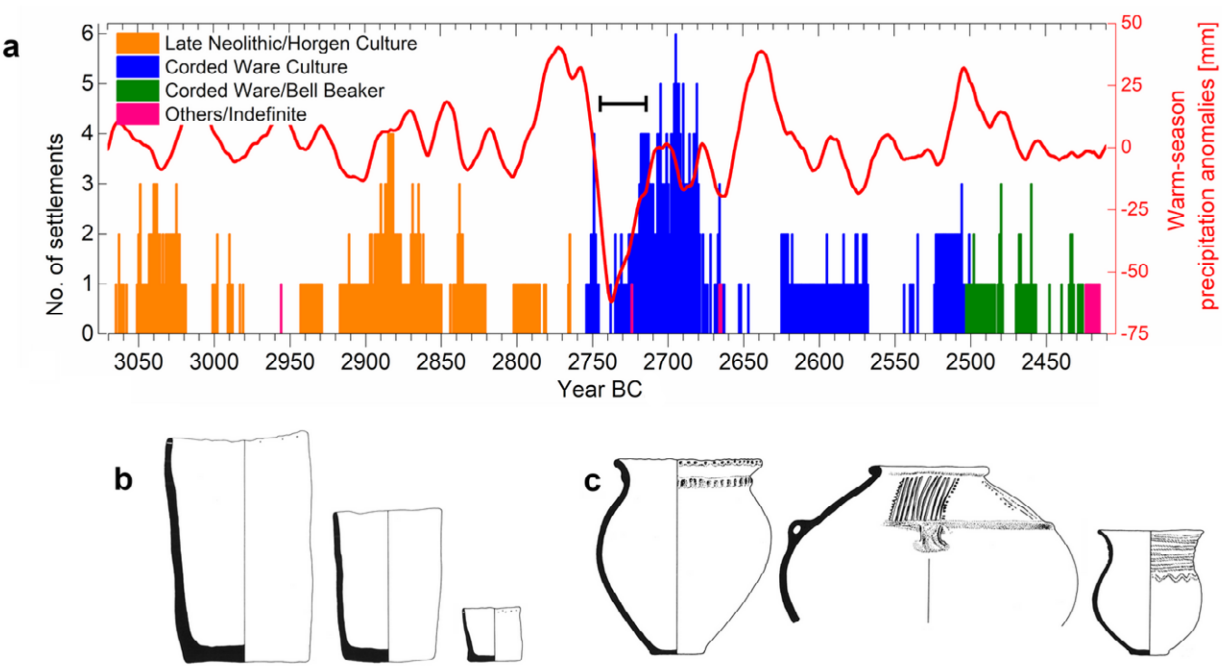

Figure 4. a) Number of settlements from different cultural groups with superimposed warm-season (spring–summer) precipitation deficits (red line, 21-year weighted average) from the central European tree-ring network (horizontal bar = duration of drought event). Culture-specific ceramics from Zürich in central Switzerland (reproduced from Stöckli *et al*. 1995, fig. 19.1–3, fig. 20.11.14.17 with kind permission of Archäologie Schweiz); b) Late Horgen culture; c) Corded Ware culture.

been registered (Figure 3; Appendix 1). In addition, the cultural affiliation of a settlement, as determined by the finds material, has been assigned. The frequency of settlement occurrences per year is used as a proxy of the overall settlement intensity in southern central Europe. Of course, it is a questionable proxy for the named reasons, but nevertheless it is the best proxy available.

Development of pile-dwelling settlement and the probable effect of the great drought

In the research area, settlements of the Younger Neolithic (mostly Pfyn culture) as well as the Late Neolithic (mostly Horgen culture) and the Final Neolithic (mostly Corded Ware culture and later on Bell Beaker culture) are attested quite regularly but with low frequency from the beginning of the study period at 3550 BC up to about 2400 BC (Figure 3). Thus, pile dwellings were an integral part of the respective cultural systems for more than 1000 years. Gaps in the evidence up to several decades are often documented. It is remarkable that during the final phase of the Horgen culture, the frequency of pile dwellings is rather low until its most recent occurrence at 2765 denBC, which marks the end of this culture (Figure 4).

The highest frequency of pile dwellings is found during the older Corded Ware culture of 2754–2679 denBC (Figure 3). There is a gap of only a decade between the youngest Horgen and the oldest Corded Ware settlements. As there is no temporal overlap between the two cultures, the Corded Ware culture has obviously spread very quickly. A frequency peak around 2749 denBC shows that the establishment of this new culture was initially very successful. Then, however, a rapid decline in the number of settlements is observed. From 2745–2739 denBC the settlement record breaks down completely. From 2739 denBC onwards, a process of continuous recovery of the settlement numbers took place over two decades and at 2695 denBC the highest settlement density of the entire period under consideration is reached. Decline, settlement abandonment and the beginning of the recovery phase coincide exactly with the drought period of 2745–2727 denBC (Figure 4). Thus, it is very likely that the onset of the great drought caused the collapse of the settlement system of the Corded Ware culture, which was still in the establishment phase. It took some years to achieve steady settlement again. It is therefore highly probable that the supra-regional severe drought phase and the breakdown of pile dwelling settlement in eastern Switzerland and south-western Germany are indeed causally related. This is particularly noteworthy, as the economy of pile dwelling settlements was presumably less dependent on cereal cultivation than that of contemporaneous settlements in loess areas, for example. Due to poorer preservation conditions, there is relatively little data available on the consumption of plant food in settlements located on loess soils, but it is becoming apparent that cereals, and barley in particular, played a major role (Zuber 2019, 282). It can therefore be assumed that the effects of the drought were much more severe in these kinds of settlement landscapes.

Any effects on cultural systems?

It is thus very likely that the 19-year drought period from 2745–2727 denBC had direct consequences for settlement in southern central Europe, whereby in some regions the existing settlement systems may have collapsed. Another question is whether this also had long-term consequences for entire cultural systems. Over roughly six centuries pile dwellings of the Late Neolithic Horgen culture were present in varying numbers (Figure 3). The latest maximum is attested around 2890 denBC. From then on, the number of settlements dropped until the most recent site at 2765 denBC. After a decade without any attested pile dwellings, settlement of the same region by the Corded Ware culture started at 2754 denBC and flourished a few years later. This took place immediately before the onset of the great drought. Neither the end of the Horgen culture nor the beginning of the Corded Ware culture can therefore be linked to the drought in any way (Figure 4). This sudden shift in the cultural systems in the study area is clearly independent of the drought. On the contrary, the dynamically developing settlement system of the Corded Ware culture apparently collapsed under the drought at first. Remarkably, however, settlement gradually recovered already during the drought phase from 2739 denBC onwards, and soon after the end of the drought, in 2695 denBC, it even reached the highest values within the 1150 years studied (Figure 3). The population associated with the Corded Ware settlements thus seems to have coped exceptionally well with the situation. It should be borne in mind that successful active economic adaptation to drought conditions is unlikely to have been achieved within a few years, as populations initially may have waited for conditions to improve. Social groups who in any case already followed a subsistence regime that happened to be more adapted to the new conditions (as the Corded Ware groups did) would, in contrast, have been able to react more quickly.

This leads to another hypothesis: the phenomenon of the Corded Ware culture spread from eastern Europe, where much older settlements are attested (Furholt 2008). There is much to suggest that not only people and cultural features, like new prestige systems, found their way from the eastern European steppes to central Europe as part of the Corded Ware culture, but also economic preferences (Furholt 2008; Haak *et al.* 2015; Kaiser 2019). Analyses of carbon and nitrogen isotopes from skeletal remains show that in large parts of central Europe the share of animal products in human nutrition increased with the Corded Ware culture (Asam *et al.* 2006; Münster *et al.* 2018). At least in Bavaria, at the same time regular use of milk is attested by isotope analysis on human bones (Hagl *et al.* 2013). This chimes with the fact that animal bone assemblages from settlements, for example in Switzerland, show an intensification of animal husbandry in general and of cattle in particular (Schibler 2008). However, due to the widespread lack of burials of the late forth and early third millennia BC in southern Germany, there is no possibility to isotopically date the beginning of significant milk consumption closely. Nevertheless, lipid analyses of pottery finds now prove that milk was already used in the period of the preceding Cham culture in southern

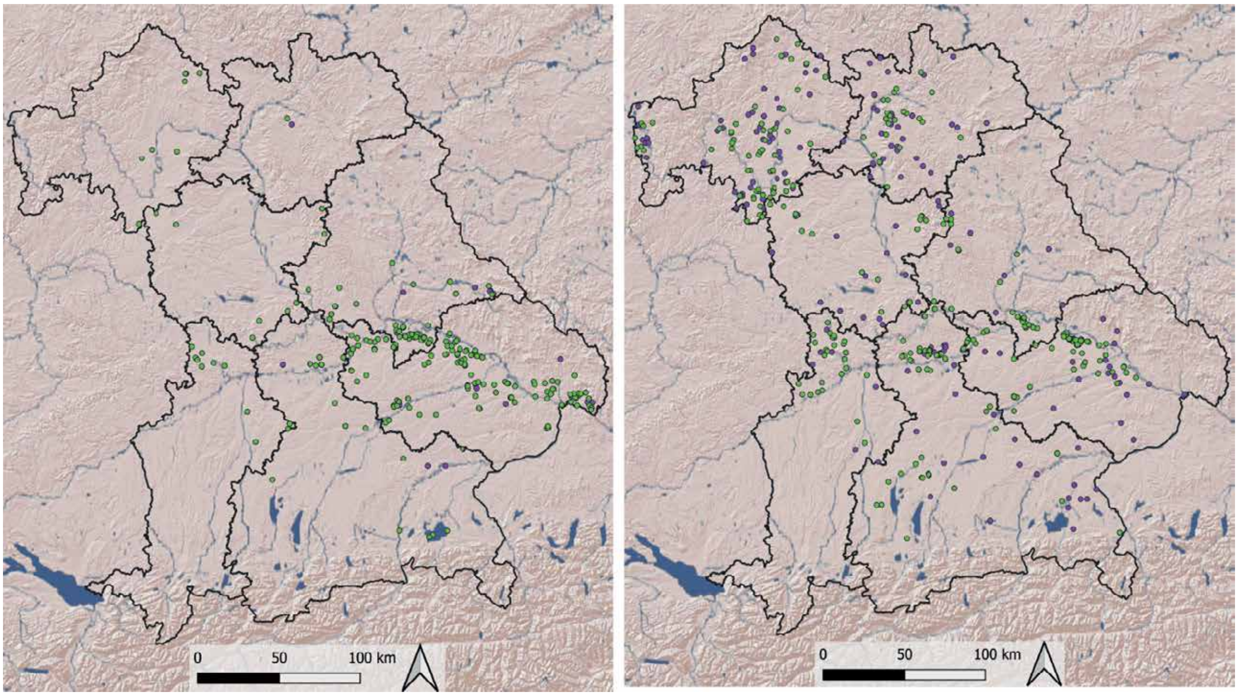

Figure 5. Settlement areas of the Late Neolithic (left) and Corded Ware culture (right) in Bavaria. Green: attested settlements and burial sites; purple: single finds. Technical data: Bayerisches Landesamt für Denkmalpflege (data query 29.7.2021); base map: ESRI shaded relief; graphics: T. Ruhland and J. Pechtl.

Bavaria (Dunne *et al.* 2023). In addition, the same tendency is already evident earlier in the eastern European steppe regions and in the presumed area of origin of the Corded Ware culture (Kadrow 2008; Kaiser 2019). In this respect, it should be considered whether the Corded Ware culture, due to its connections to the steppe area with its more pastoral economies, showed an economic preadaptation which proved to be advantageous especially during the long drought period. If so, the severe drought event would not have directly promoted the first spread of the Corded Ware culture to southern central Europe, but its recovery and more solid establishment when climate became more humid again. Competing cultural models that were more focused on agriculture may therefore have fallen behind and a diet with a higher proportion of animal components became permanently established in central Europe.

A comparison of the settlement distribution shows how fundamental the change from the Late Neolithic to the Corded Ware culture actually was (Figure 5). In Bavaria, for example, the strong focus of settlement on the zones with the highest soil quality was abandoned. Instead, areas that had previously been largely uninhabited, though probably already used for economic purposes, were now more regularly colonised. The new system of subsistence farming thus obviously opened up far more choices and thus probably also laid the foundations for Bronze Age development.

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Appendix 1. Dendrochronologically documented years with settlement activities in pile-dwelling settlements in central and eastern Switzerland and southern Germany.

Site	Country	District	Final Neolithic (year denBC)	Late Neolithic (year denBC)	Younger Neolithic (year denBC)	References
Allensbach-Strandbad	D	Konstanz		2821–2842, 2998–3001,3142–3147 (Horgen)		Hafner and Suter 2012; Landesamt für Denkmalpflege im Regierungspräsidium Stuttgart 2011
Bodman-Schachen II	D	Konstanz	2666 (Corded Ware)			Hafner and Suter 2012
Degersee I	D	Bodenseekreis		2956 (Goldberg III?)		Million and Billamboz 2015
Hegne-Galgenacker	D	Konstanz	2672, 2681 (Corded Ware)			Hafner and Suter 2012
Hornstaad-Hörnle	D	Konstanz	2690 (Corded Ware)	3176 (Horgen)		Landesamt für Denkmalpflege im Regierungspräsidium Stuttgart 2011
Hornstaad-Hörnle IB	D	Konstanz			3507–3512, 3517–3521, 3528–3542 (Pfyn)	Billamboz 2006; Hafner and Suter 2012
Hornstaad-Schlössle	D	Konstanz	2672, 2681 (Corded Ware)			Hafner and Suter 2012
Litzenstetten-Ebnewiesen II	D	Konstanz	2575–2576 (Corded Ware)			Billamboz and Köninger 2008
Ludwigshafen-Seehalde	D	Konstanz	2418–2421 (Corded Ware)			Hafner and Suter 2012
Maurach-Ziegelhütte	D	Bodenseekreis	2666–2668 (Corded Ware)	2865, 3134–3160, 3316–3331 (Horgen)		Billamboz and Köninger 2008
Nussdorf-Seehalde	D	Bodenseekreis		3308–3309, 3332–3333 (Horgen)		Hafner and Suter 2012
Olzreute-Enzisholz	D	Biberach		2897 (Goldberg III)		Landesamt für Denkmalpflege im Regierungspräsidium Stuttgart 2011
Pestenacker	D	Landsberg am Lech			3476–3495 (Altheim/ Lechgruppe)	Schönfeld 2009a
Schreckensee	D	Ravensburg		3263, 3265 (Horgen)		Bleicher 2009; Landesamt für Denkmalpflege im Regierungspräsidium Stuttgart 2011
Sipplingen-Osthafen	D	Bodenseekreis	2415–2424, 2665–2666	2854–2917, 2981, 2983, 2990–2991, 3019–3032, 3060–3063, 3065, 3077, 3085, 3148–3150, 3200, 3303–3316, 3330 (Horgen)		Billamboz 2010; Hafner and Suter 2012
Torwiesen II	D	Biberach		3279–3281, 3283 (Horgen)		Bleicher 2009
Unfriedshausen	D	Landsberg am Lech			3519–3537 (Altheim/ Lechgruppe)	Schönfeld 2009b
Wallhausen-Ziegelhütte	D	Konstanz		2838–2839, 3025, 3255, 3274–3275, 3282–3285, 3292, 3301–3303, 3305 (Horgen)		Billamboz and Köninger 2009
Wangen-Hinterhorn	D	Konstanz		2844, 3246 (Horgen)		Landesamt für Denkmalpflege im Regierungspräsidium Stuttgart 2011
Arbon-Bleiche 3	CH	Thurgau		3370–3384 (Horgen)		Hafner and Suter 2012
Cham-St. Andreas-Strandbad	CH	Zug	2535, 2540, 2669, 2680–2697, 2701 (Corded Ware)	3133–3134 (Horgen)		Hochuli *et al.* 2010; Hafner and Suter 2012

Site	Country	District	Final Neolithic (year denBC)	Late Neolithic (year denBC)	Younger Neolithic (year denBC)	References
Erlenbach-Winkel	CH	Zürich	2432–2435, 2460, 2467, 2480–2481 (Bell Beaker/Corded Ware) 2501–2524, 2535 (Corded Ware)	2765–2766 (Horgen)		Hafner and Suter 2012
Erlenbach-Wyden	CH	Zürich	2731 (Corded Ware)			Hafner and Suter 2012
Ermatingen-Westerfeld	CH	Thurgau		2862, 2889, 3049, 3146 (Horgen)		Hafner and Suter 2012
Fällanden-Rietspitz	CH	Zürich	2692–2696, 2705–2708 (Corded Ware)			Hafner and Suter 2012
Freienbach-Hurden Seefeld	CH	Schwyz	2748 (Corded Ware)			Hafner and Suter 2012
Greifensee-Furren	CH	Zürich	2677, 2686, 2693 (Corded Ware)			Hafner and Suter 2012
Greifensee-Storen/ Wildsberg	CH	Zürich	2686, 2694–2695, 2707 (Corded Ware)			Hafner and Suter 2012
Hombrechtikon-Feldbach West	CH	Zürich	2523, 2539 (Corded Ware)			Hafner and Suter 2012
Hombrechtikon-Rosenberg	CH	Zürich	2726, 2735 (Corded Ware)	2869–2870, 3034 (Horgen)		Hafner and Suter 2012
Horgen-Dampfschiffsteg	CH	Zürich	2698 (Corded Ware)			Hafner and Suter 2012
Horgen-Scheller	CH	Zürich	2457–2470 (Bell Beaker/Corded Ware)	3037, 3039, 3044–3045, 3048–3051 (Horgen)		Eberli 2002; Hafner and Suter 2012
Hühnenberg-Chämleten (1980)	CH	Zug		3159–3161, 3240–3256 (Horgen)		Hafner and Suter 2012
Küsnacht-Hörnli	CH	Zürich	2433–2434, 2448, 2460, 2479–2482 (Bell Beaker/Corded Ware) 2501, 2506 (Corded Ware)			Hafner and Suter 2012
Männedorf-Leuenhaab	CH	Zürich		2785–2787 (Horgen)		Hafner and Suter 2012
Männedorf-Strandbad	CH	Zürich	2468, 2480 (Bell Beaker/Corded Ware)			Hafner and Suter 2012
Maur-Schifflände	CH	Zürich	2674–2677 (Corded Ware)			Hafner and Suter 2012
Maur-Weierwis	CH	Zürich	2738 (Corded Ware)	3038–3049 (Horgen)		Hafner and Suter 2012
Meilen-Feldmeilen-Vorderfeld	CH	Zürich	2652–2653, 2746 (Corded Ware)	3023–3040, 3058, 3080, 3195, 3209–3217, 3235–3239 (Horgen)		Hafner and Suter 2012
Meilen-Im Grund	CH	Zürich	2595 (Corded Ware)	3038–3043 (Horgen)		Hafner and Suter 2012
Meilen-Rorenhaab	CH	Zürich	2618, 2621–2625, 2647, 2663–2667, 2679, 2687–2688, 2696–2698 (Corded Ware)	2890, 2896, 2988–2990, 2998, 3406, 3423 (Horgen)		Hafner and Suter 2012
Meilen-Schellen	CH	Zürich	2484–2503 (Bell Beaker/Corded Ware) 2505–2509, 2709–2726, 2749 (Corded Ware)	2890–2894, 3135 (Horgen)		Hafner and Suter 2012
Pfäffikon-Irgenhausen	CH	Zürich		2765 (Horgen)		Hafner and Suter 2012
Rapperswil-Jona-Untiefe Ost	CH	St. Gallen		3271, 3301 (Horgen)		Hafner and Suter 2012
Sempach-See	CH	Luzern	2428–2429 (Bell Beaker/Corded Ware)	2836–2838 (Horgen)		Hafner and Suter 2012
Stäfa-Uerikon im Länder	CH	Zürich		3036 (Horgen)		Hafner and Suter 2012

Site	Country	District	Final Neolithic (year denBC)	Late Neolithic (year denBC)	Younger Neolithic (year denBC)	References
Stansstad-Kehrsiten	CH	Nidwalden		3172 (Horgen)	3431, 3436, 3442–3443, 3446–3449, 3456, 3478, 3480–3482, 3484 (Pfyn)	Michel-Tobler *et al.* 2010
Steckborn-Schanz	CH	Thurgau		3322 (Horgen)		Hafner and Suter 2012
Steckborn-Turgi	CH	Thurgau	2695 (Corded Ware)	3107, 3307 (Horgen)		Hafner and Suter 2012
Steinhausen-Sennweid	CH	Zug	2724, 2726, 2730, 2739, 2745, 2751, 2754 (Corded Ware)	2850–2854, 2864–2869 (Horgen)		Hochuli *et al*. 2010; Ruoff 2007; Hafner and Suter 2012
Uetikon-Schifflände	CH	Zürich	2747–2752 (Corded Ware)			Hafner and Suter 2012
Wädenswil-Vorder Au	CH	Zürich	2426–2427, 2440 (Bell Beaker/Corded Ware) 2569–2571 (Corded Ware)			Hafner and Suter 2012
Wetzikon-Robenhausen	CH	Zürich	2682, 2705–2707 (Corded Ware)			Hafner and Suter 2012
Zug-Schutzengel	CH	Zug		3155 (Horgen)		Hafner and Suter 2012
Zug-Schützenmatt	CH	Zug		3152–2168 (Horgen)		Hafner and Suter 2012
Zug-Vorstadt-Rössliwiese	CH	Zug		3050 (Horgen)	3541 (Pfyn)	Hafner and Suter 2012
Zürich-AKAD/Pressehaus	CH	Zürich	2681, 2690, 2713–2719 (Corded Ware)	3172 (Horgen)		Hafner and Suter 2012
Zürich-Breitingergasse 1994	CH	Zürich	2681–2724 (Corded Ware)			Hafner and Suter 2012
Zürich-Grosser Hafner	CH	Zürich		3196–3199, 3201–3209 (Horgen)		Hafner and Suter 2012
Zürich-KanSan	CH	Zürich	2679–2685, 2689–2706, 2710–2718 (Corded Ware)	2882–2887, 2911, 3078, 3158, 3168, 3175–3179,3201–3216, 3226–3239 (Horgen)		Hafner and Suter 2012
Zürich-Kleiner Hafner	CH	Zürich		2781–2782, 2788–2802, 3201–3206, 3213–3222, 3242 (Horgen)		Hafner and Suter 2012
Zürich-Mozartstrasse	CH	Zürich	2498 (Bell Beaker/Corded Ware) 2510–2522, 2538, 2544, 2568–2625, 2700–2705 (Corded Ware)	2882–2888, 2929–2943, 3098–3120, 3123–3124, 3126 (Horgen)	3538–3547 (Pfyn)	Bleicher 2015; Hafner and Suter 2012
Zürich-Mythenschloss	CH	Zürich	2584, 2680 (Corded Ware)			Hafner and Suter 2012
Zürich-Parkhaus Opéra	CH	Zürich	2727–2735, 2749–2754 (Corded Ware)	2877–2885, 3063, 3090, 3153–3176, 3204, 3226–3234 (Horgen)		Bleicher and Harb 2015
Zürich-Wollishofen-Hausmesser	CH	Zürich		3182, 3196 (Horgen)		Hafner and Suter 2012
Zürich-Wollishofen-Strandbad	CH	Zürich	2725, 2749 (Corded Ware)			Hafner and Suter 2012

In the middle of nowhere — Burgerroth and the Early Final Neolithic in Franconia

Thomas Link

Abstract

Evidence for the Late Neolithic and Early Final Neolithic period is very sparse in the region of Franconia (northern Bavaria/northern Württemberg). However, recent investigations give at least some new information and raise questions concerning inter-regional as well as chronological connections and cultural relations. Geophysical prospections and test excavations at the hilltop settlement of Burgerroth (Lkr. Würzburg, Lower Franconia) in 2012–2014 provided new insights into one of the major sites of the period. A previously unknown ditch system came to light and several settlement features can be interpreted as pit houses of a type characteristic for the Late and Final Neolithic. Surprisingly, Late Neolithic elements seem to have remained present at Burgerroth until the mid third millennium and associated finds of Corded Ware domestic pottery point to the parallel existence of regional Late Neolithic traditions and Final Neolithic innovations.

Keywords: Late Neolithic, Final Neolithic, Corded Ware culture, Franconia, Burgerroth, hilltop settlement, pit houses

Numerous "cultural groups", which have a rather limited regional extent in comparison with the larger-scale entities of the preceding Younger Neolithic, characterise the archaeological map of the late fourth and early third millennium BC (e.g. von Schnurbein 2009, 70–76). This is why regionalisation is often supposed to be a major culture-historical trend of the period. However, archaeological data is scarce in many regions and virtually absent in others. At the same time, the individual regional groups share many material culture features. The supposedly regionalised character

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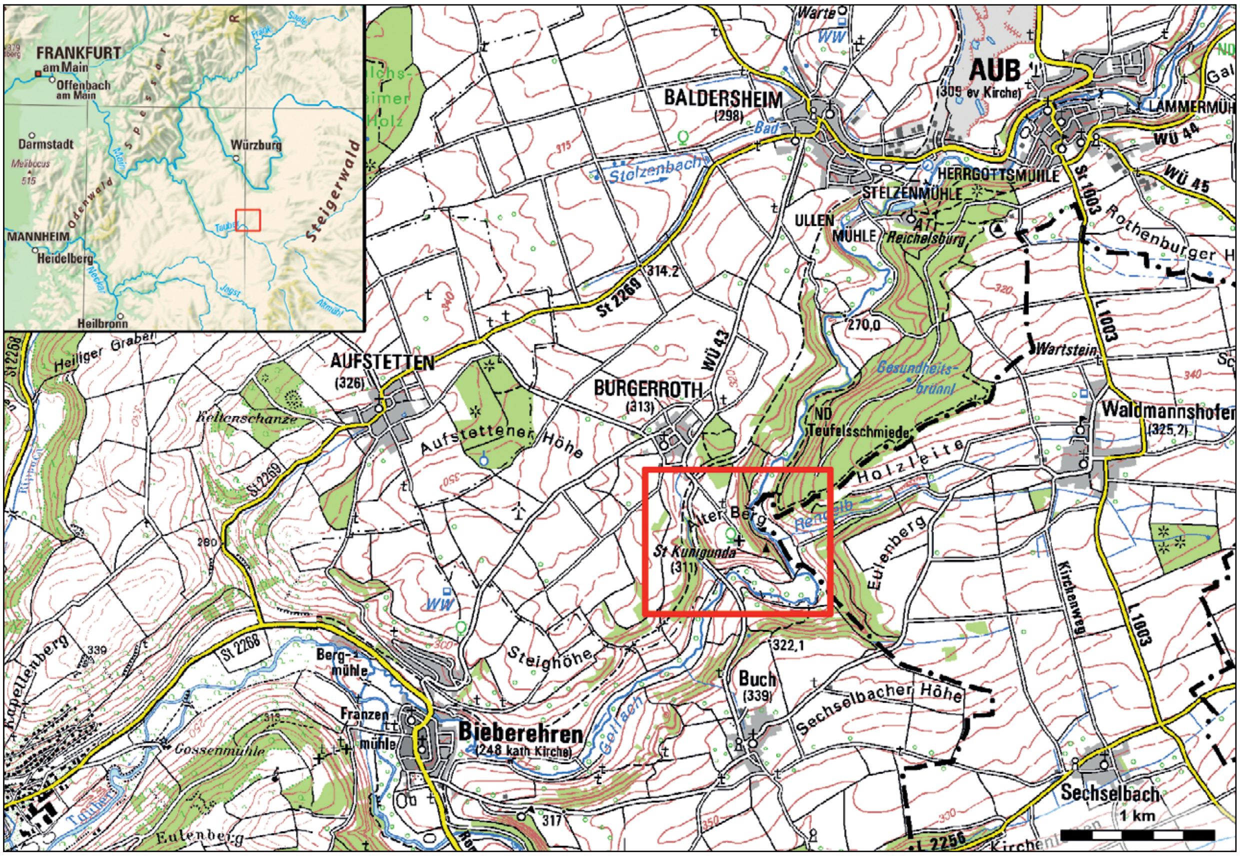

Figure 1. Geographical position and topographic situation of the site Burgerroth "Altenberg" (maps: Bundesamt für Kartographie und Geodäsie and Bayerische Vermessungsverwaltung, www.geodaten.bayern.de).

of the Late Neolithic (LN) and Early Final Neolithic (EFN)[1] groups thus could very well be a product of lack of data rather than a reflection of prehistoric reality.

Cultural attribution is especially problematic for regions in between the larger and better-defined "cultural groups". Franconia (northern Bavaria/ northern Württemberg) is one of these regions. Evidence for the LN/EFN is very limited and most find complexes are small. Already in 1985, D. Spennemann summarised the relevant sites and the state of research has not changed much since then (Spennemann 1985). A Late Neolithic pit house had already been excavated in 1979 at Schwanfeld (Lkr. Schweinfurt), but was only published after Spennemann's synopsis (Lüning 1999), as was a Bernburg culture grave complex from Großeibstadt (Lkr. Rhön-Grabfeld; Koch 2014). The only recent addition to Spennemann's list is a settlement at Gollhofen (Lkr. Neustadt a.d. Aisch-Bad Windsheim) with a ditched enclosure measuring 50–60 m in diameter and four small pit houses (Beigel and Nadler 2013). Two of the sites already listed by Spennemann have been further investigated during the last two decades: Voitmannsdorf (Lkr. Bamberg; Dürr *et al.* 2004) and Burgerroth (Lkr. Würzburg; Link 2013; 2018; 2023; Link and Herbig 2016).

1 There is some variation in the use of the terms "Late Neolithic" (LN) and "Early Final Neolithic" (EFN) between different traditions of chronological terminology. J. Lüning (1996) established the term "Late Neolithic" as a phase between the Younger Neolithic and Final Neolithic (which mainly comprises the beaker-using cultures), while in some literature from south-western Germany "Early Final Neolithic" is still being used for the Late Neolithic or the younger part of it. However, this is not only a nomenclature problem. "Late Neolithic" traditions originating in the late fourth millennium BC have a long duration and exist in parallel with the "Final Neolithic" Corded Ware culture (CWC) almost until the middle of the third millennium BC. To avoid a terminological overlap in the chronological model, this phase (c. 2800–2600 calBC) should be referred to as "Early Final Neolithic". At the same time, tradition and continuity imply that there cannot be a sharp boundary between the "Late" and the "Early Final" Neolithic. This means that the "cultural" groups of the transition phase at the end of the "Late" and the beginning of the "Final" Neolithic cannot be satisfactorily covered by either one or the other of the two terms. They are therefore summarised as "Late Neolithic/Early Final Neolithic" or "LN/EFN" here, which refers to the timespan between c. 3200 and 2600 calBC.

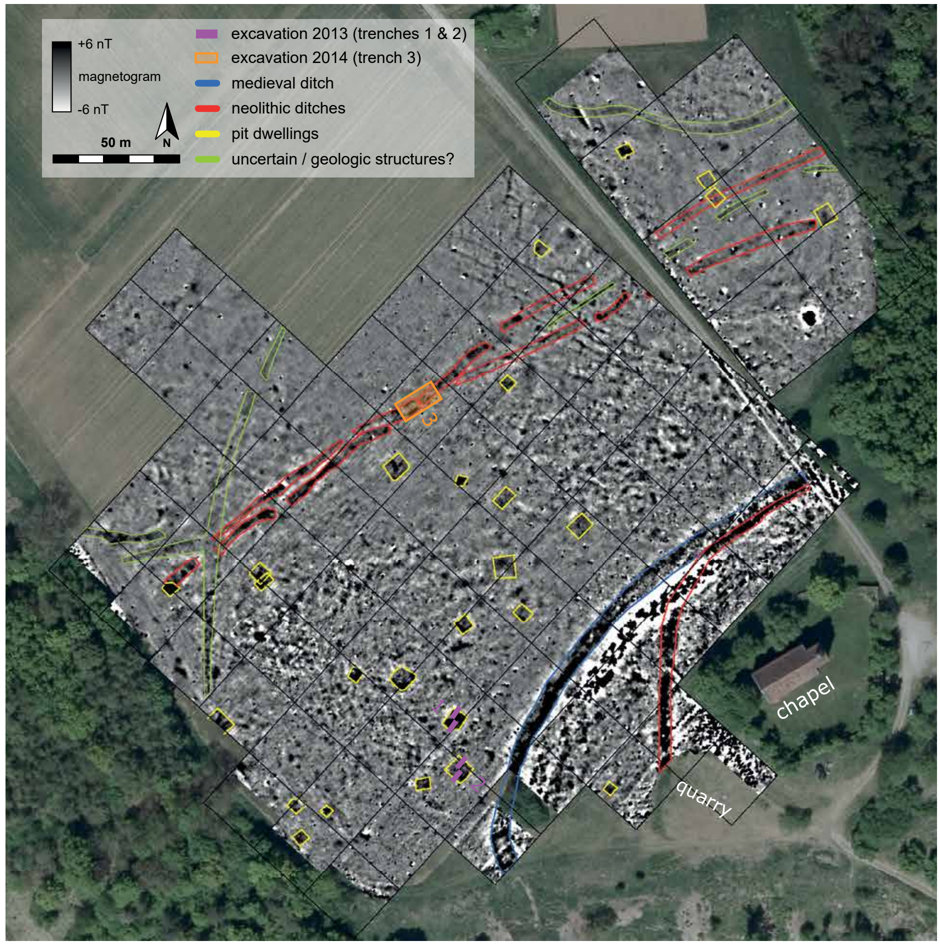

Figure 2. Magnetogram with archaeological interpretation. Magnetic survey with dual fluxgate gradiometer Bartington Grad 601-2, point density 12.5 × 50 cm (interpolated to 12.5 × 25 cm), dynamics ±6 nT / 256 grey levels (aerial photo: © Bayerische Vermessungsverwaltung, www.geodaten.bayern.de; magnetogram T. Link, University of Würzburg).

Recent investigations at Burgerroth

Burgerroth "Altenberg" has been a major reference point for the LN/EFN since the first excavations in 1919–1921. Even 100 years later it remains the most abundant LN/EFN find complex in Franconia and probably the region's most promising site for future research on this period.

The site is situated on a promontory rising about 40–50 m above the valley of the Gollach (Figure 1), a tributary of the Tauber river. Large parts of the hilltop were affected by quarrying in the nineteenth and early twentieth centuries. Rescue excavations led by G. Hock and J. Maurer in 1919–1921 uncovered several LN/EFN features, which were dug into the Middle Triassic limestone bedrock. Some of them had a more or less rectangular shape and were interpreted as building structures. A Neolithic ditch was excavated, too, but could not be clearly separated from a medieval fortification. Six decades later, Spennemann (1984) put together and analysed the available data and material systematically, complemented by some small-scale field activities. His seminal work remained the status quo until 2012.

In 2012–2014, the University of Würzburg carried out new investigations at Burgerroth. The first results of the fieldwork have already been presented in some detail elsewhere (Link and Herbig 2016; Link 2018; 2023) and will only be shortly summarised here.

Geophysical prospection

Magnetic prospection in the outer areas of the promontory helped to clarify the layout of the Neolithic ditch, which had already been cut by the first excavation and was again observed by Spennemann (1984, 36–38, 42 fig. 22). But what is more, a previously unknown system of two or three linear anomalies was discovered about 80 m further north-west (Figure 2), indicating a multi-phase ditch system. While the previously known inner ditch system enclosed about 1–1.5 ha, this newly discovered structure has enlarged the site to around 4 ha.

Between the inner and the outer ditch systems, the magnetic survey plan shows a significant number of square or slightly rectangular anomalies, with sides measuring about 4–6 m. In shape and size these features

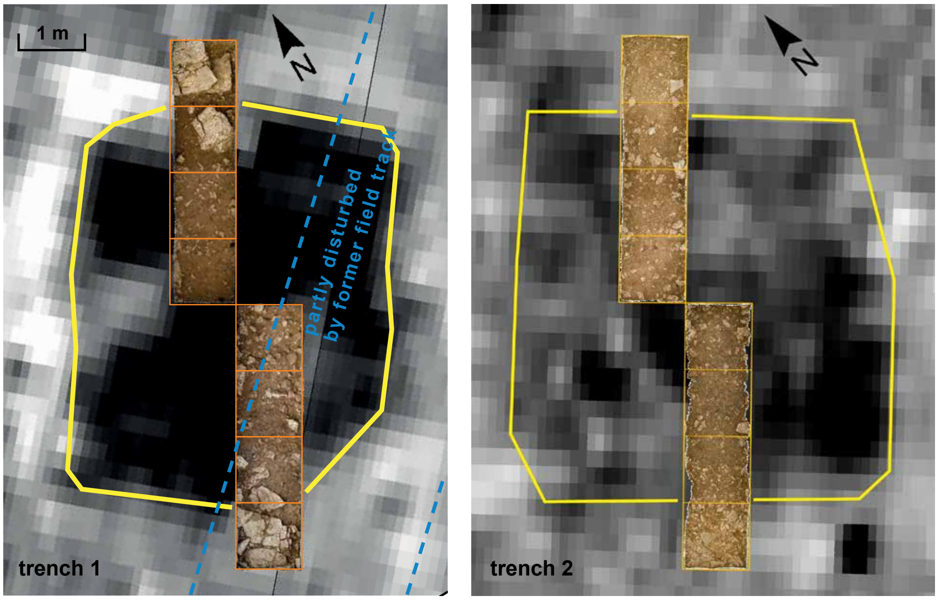

Figure 3. Overlay of the magnetogram (Figure 2) and photogrammetric plans of trench 1 (planum 3) and 2 (planum 2) (T. Link, University of Würzburg).

Figure 4. Central pit of the pit dwelling in trench 2 (T. Link, University of Würzburg).

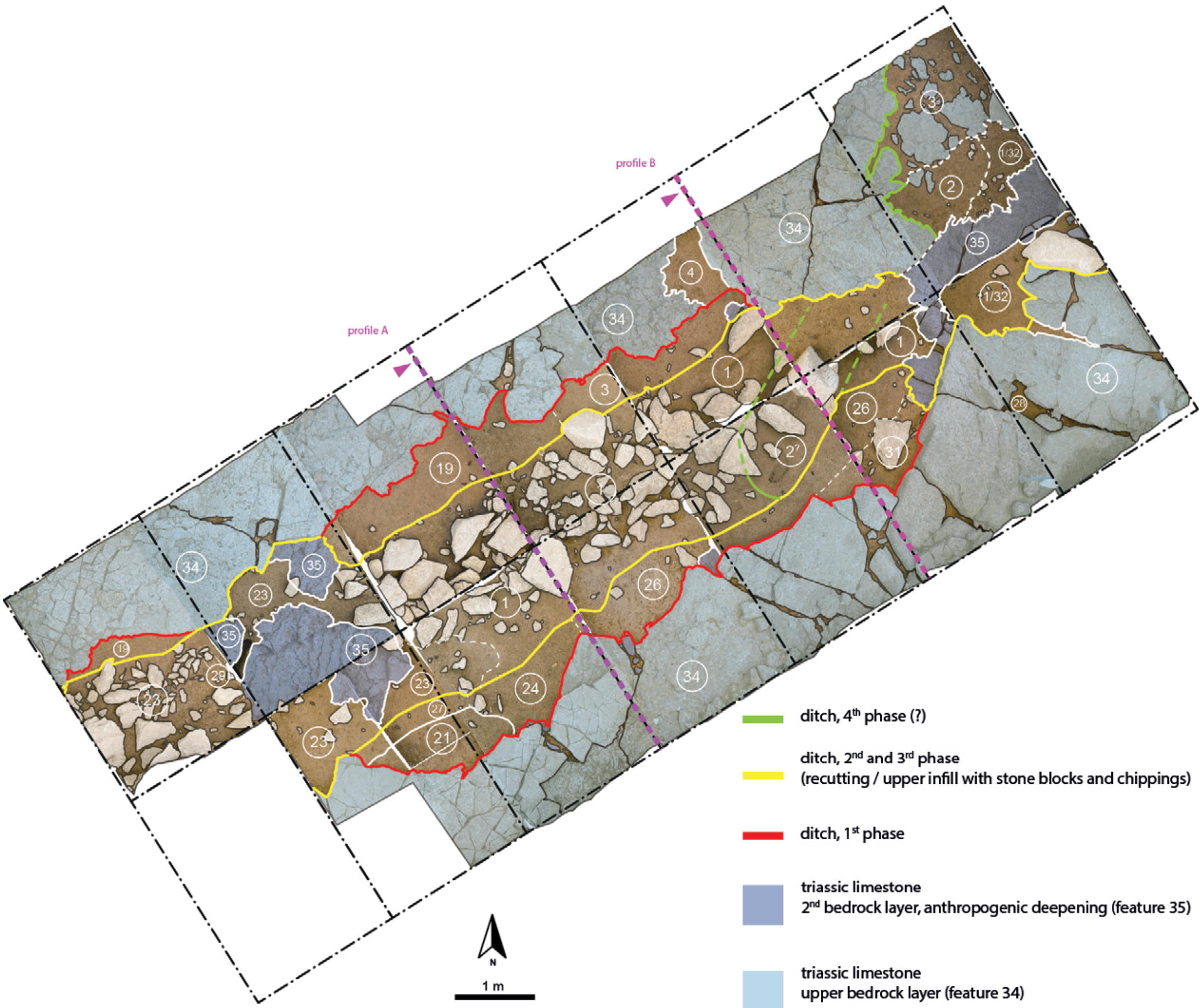

Figure 5. Photogrammetric plan with highlighted phases of the ditch system (white: stones in the backfill/third phase; blue: limestone bedrock). Numbers indicate stratigraphic features (T. Link, University of Würzburg).

conform very closely to the "pit houses" known from numerous Late and Final Neolithic sites (see below).

Test trenches

In 2013, two small test trenches measuring 1 × 8 m each were excavated through two of the square anomalies (Link and Herbig 2016) (Figure 2, Nos 1–2, Figure 3). In both trenches, pits with straight, steep sides measuring 6.3 m (trench 1) and 5.7 m (trench 2) came to light, which had been dug into the limestone bedrock to a depth of about 30–40 cm (i.e. c. 50–60 cm below the modern ground surface). Both features had a flat, level bottom and a shallow pit in their centre, which was about 10–20 cm deeper than the rest of the base and measured around 1–1.5 m in diameter (Figure 4). No postholes were identified, but the overall square structures with a level base and especially the central pits confirm the interpretation of these features as buildings (see discussion on "pit houses" below). Both features were very rich in LN/EFN find material.

In 2014, a test trench measuring 14 × 6 m was excavated through the outer ditch system at a position where the two ditches overlap each other (Figure 2, Nr. 3). The ditch system had been dug into the limestone bedrock to a maximum depth of c. 50 cm (80 cm below the modern ground surface) and varied in width from 2.5–3.5 m. The stratigraphy turned out to be rather complex (see Link 2018, 182–86 for more detail): at least two building phases followed by a phase of intentional backfilling have been identified (Figure 5). In its first phase, the ditch system probably had multiple entrances formed by ridges of residual bedrock. In the second phase, the upper layers of these ridges were removed and the fill of the ditch was partly dug out again. Both the first and the second phase are associated with LN/EFN material only. Finally, the ditch was intentionally filled

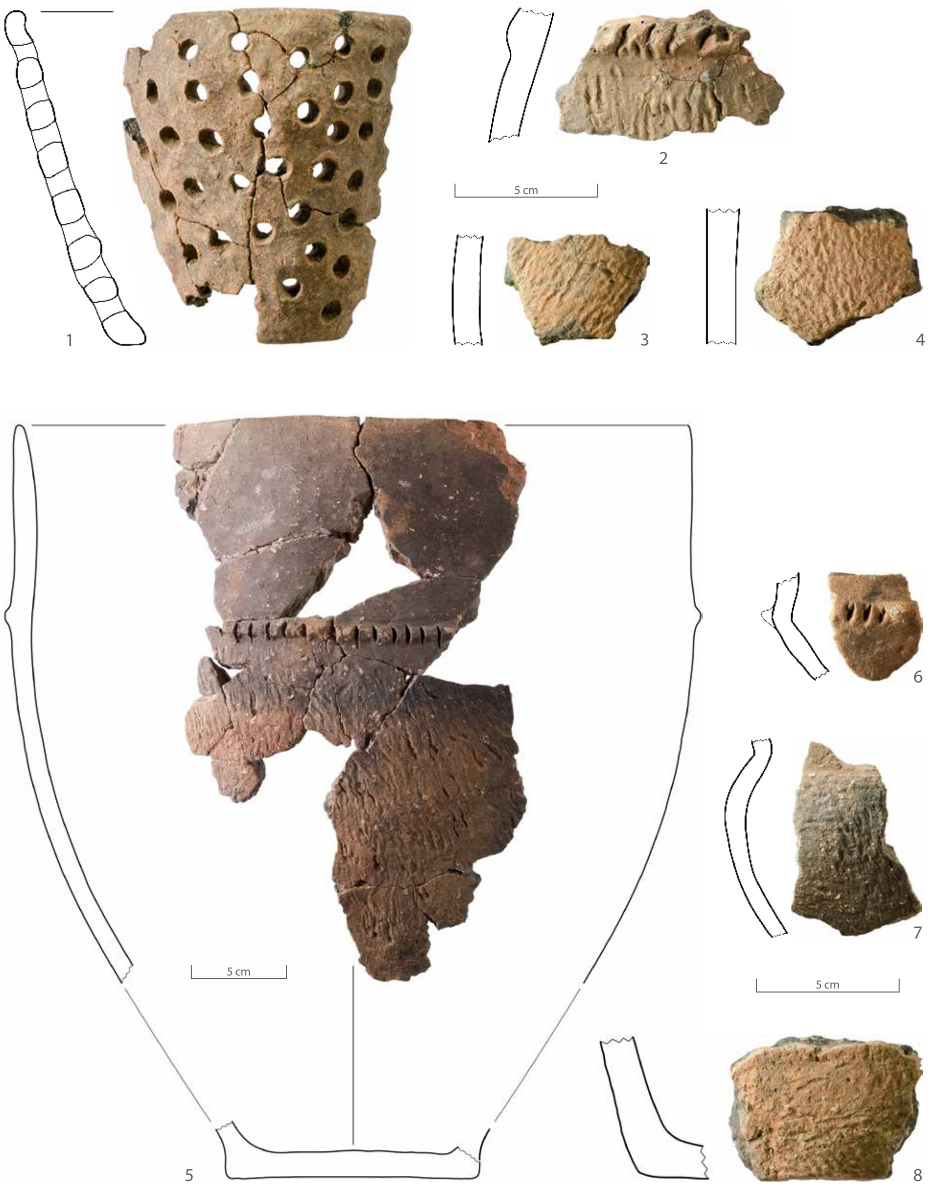

Figure 6. Typical LN/EFN pottery from trenches 1, 2 and 3 (drawings P. Schinkel, photos T. Link, University of Würzburg).

with stone blocks and large cobbles. Finds of Iron Age pottery indicate that this third phase of building activity may have taken place a long time after the Neolithic use life of the ditch system. A human skeleton of a juvenile individual, which lay in supine position transversally to the ditch axis, is stratigraphically associated with the Iron Age stone backfill.

A single radiocarbon date from the second quarter of the fourth millennium calBC (Erl-20205: 4871±43 BC, 3763–3534 calBC [2σ]) and a single sherd with an arcade rim (Link 2018, 188 fig. 9.9) indicate that the earthwork could have had its origin already in the Younger Neolithic and have been recut during the LN/EFN. The assumed entrances of the first phase would also fit very well into a Younger Neolithic context. Ditch systems with a large number of entrances located close to each other are a characteristic element of the Michelsberg culture and other groups of the Younger Neolithic (Seidel 2008, 356–58). They can be laid out in a closed, round or oval shape (e.g. Ilsfeld-Ebene: Seidel 2008, 72–83) or as ditch sections on mountain spurs, as was the case at Burgerroth (e.g. Heilbronn-Klingenberg: Seidel 2008, 187–229).

The find material

The excavations in 2013 and 2014 yielded a high quantity of finds, most of them heavily fragmented. The material has already been presented in some detail elsewhere (Link 2018, 187–95; Link and Herbig 2016, 108–20), so I here focus on the discussion of its cultural and chronological context.

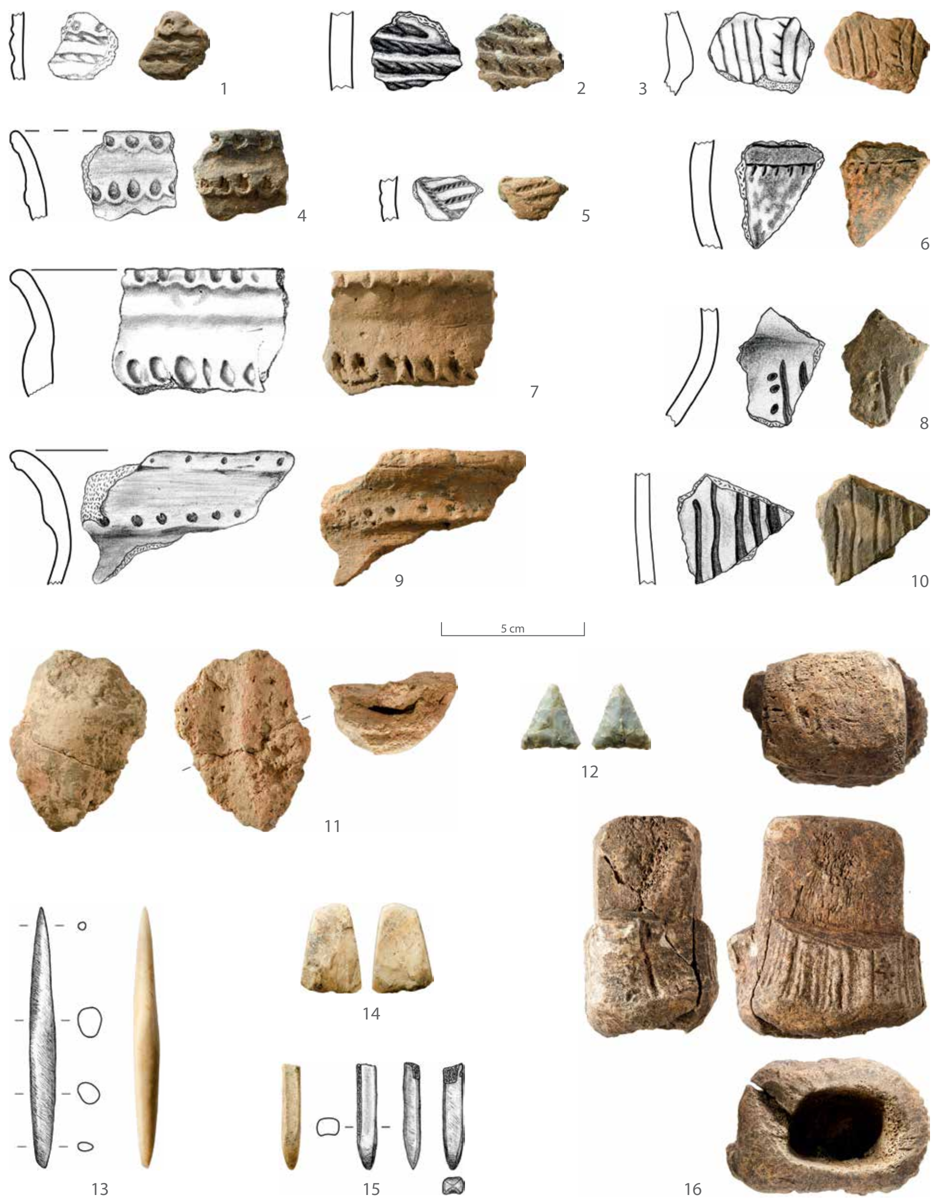

Figure 7. Cord ornamented pottery (1, 2 and 5) and CWC domestic pottery (3, 4 and 6–10) from trenches 1 and 2; possible loom weight, burnt daub (11); examples of chert (12), bone (13–15) and antler (16) tools (drawings P. Schinkel, photos T. Link, University of Würzburg).

Pottery

The pottery shows typical LN/EFN elements. It is predominantly coarse, thick-walled and strongly tempered with sand and crushed limestone or quartz. Information concerning vessel shapes is limited due to the high degree of fragmentation; closed shapes with slightly biconical profiles and flat bases prevail. Shoulders are often accentuated by a slight offset in the profile or ornamentation (Figure 6.5–7). Upper and lower parts of the vessels are often contrasted by surface decoration being restricted to the lower part only.

The degree of ornamentation is low and its spectrum is limited. "Functional" decorations, such as plastic bands (Figure 6.2.5) and especially surface roughening, are most common. The latter was in most cases created by rolling cord coils across the vessel's surface (Figure 6.2–4.7.8) (commonly called "mat roughening" or "textile impression", see Gleich this volume; Schlichtherle 2018 for critical review and technological details). Roughening by brushing or barbotine application occurs only rarely. The spectrum of plastic elements is complemented by lugs, plastic cordons and handles (e.g. Link 2018, 188 fig. 9.10).

Two well-preserved ceramic sieves were found close together inside the central pit in trench 1 (Figure 6.1). Both are slightly conical in shape and open at both the upper and lower ends. Holes measuring 5–8 mm are evenly distributed all over their surface. They differ typologically from the sieves of the Bernburg culture, which typically have only two rows of holes near the vessel's upper and lower rims, but find close parallels in the Cham culture (Matuschik 1990, 176–84 pl. 146; Spennemann 1984, 129–30).

Cord impressions occur on three sherds in total (Figure 7.1.2.5). They fit well into the typological spectrum of the Corded Ware culture (CWC). But as cord ornamentation already appears earlier during the LN/EFN (e.g. Cham group or Globular Amphora culture: Beran 1999, e.g. pl. 86.4–5.13–14.20, pl. 89.14; Matuschik 1990, 434–36, 503–19), they do not necessarily prove the presence of CWC. However, some clearly identifiable sherds of CWC domestic pottery were found in the two pit houses. Five sherds from trench 1 (e.g. Figure 7.4.7.9) with notched plastic cordons on the vessels' neck and rim find close comparisons in pottery from lakeside settlements in south-western Germany and northern Switzerland (e.g. Zürich-Mozartstrasse: Hardmeyer 1992, 180–85; 1993, 328–33) or, geographically much closer, from the settlement of Motzenstein in Upper (i.e. eastern) Franconia (Seregély 2008, pl. 23.9). At least three sherds from trench 2 with incised lines accompanied by dots or short strokes can probably be interpreted as fragments of "Strichbündel" amphorae (Figure 7.3.6.8, possibly also Figure 7.10). These are typical of CWC domestic pottery and also especially well known from Swiss lakeside settlements (e.g. Beran 1999, pl. 88.17.20; Hardmeyer 1992, figs 2–3; 1993, 296 fig. 428, 319 fig. 466).

Bone and antler tools

Antler and bone finds were abundant and well preserved, due to the calcareous conditions in the limestone. Apart from typical settlement refuse, in particular the material from the two pit houses contained a large number of bone tools, such as chisels, axes and various pointed tools (Figure 7.13–15). Most noteworthy among them are seven antler sleeves (Figure 7.16) of a type that is well known from Goldberg III, Horgen and CWC contexts in Upper Swabia, at lake Constance and in the Swiss Lakes region (Billamboz and Schlichtherle 1985, 164, figs 1–2, figs 9–10; Hafner and Suter 2003, 12–14; Schlichtherle 1999, 42–45). An antler hoe with a rectangular shaft hole (Link 2018, 192 fig. 13.3) finds its closest parallels in the same region (e.g. Hafner and Suter 2003, 14–15). The abundance of antler sleeves is a special characteristic of Burgerroth, as 32 specimens had already been found during the 1920s excavations (Spennemann 1984, 80).

Stone tools

Unlike pottery, bone and antler, lithic finds are not very abundant. Two triangular chert arrowheads and a fragment of a bilaterally retouched blade, probably made of Baiersdorf tabular chert, are the most noteworthy pieces among the flint artefacts (Figure 7.12; Link and Herbig 2016, 117 fig. 13.6–8). Stone axes are represented only by some tiny fragments of metamorphic rock with small parts of polished surfaces. Grinding stones are missing from the two pit houses, but three heavily worn fragments were found in the backfill of the ditches.

A loom weight?

Among a larger quantity of burnt daub, a singular object can with some plausibility be interpreted as a fragment of a loom weight. It is roughly ball-shaped with a straight perforation (Figure 7.11). While early loom weights from the Younger Neolithic are mostly cone- or pear-shaped, the more round or ovoid forms with vertical perforation are primarily known from Early Final Neolithic contexts, such as Horgen or CWC settlements in Switzerland (Hafner and Suter 2005, fig. 5A; Suter 1987, 142 pl. 79.6–10, pl. 81.8–9) or the Cham culture in Bavaria (Matuschik 1990, 190–92 pl. 29.2; 1991, fig. 4.16–17; 1999, 74 fig. 4.16–17).

Cultural context and interregional relations

Several attempts have been made to define a new local group based mainly on Burgerroth (e.g. Burger 1988: "Wartberg-Burgerroth-Gruppe"; U. Fischer 1981: "Altenberg Gruppe"; Matuschik 1990: "Burgerroth/'Altenberg'"). However, they remain unsatisfying, as there are no exclusive typological features that could define this group. On the contrary, all of its elements can also be found in neighbouring groups like Goldberg III, Wartberg, Bernburg, Cham or Řívnač (Seregély 2008, 155; also already Spennemann 1984, 137–42; 1985, 135).

Connections to the north, i.e. to the Bernburg and Wartberg cultures, are an apparent element of the LN/EFN in Franconia. This is best documented at Prosselsheim and Schwanfeld in the eastern Main triangle (Lüning 1999; Pescheck 1976), Voitmannsdorf in Upper Franconia (Dürr *et al.* 2004, 27–29) and by the collective graves at Großeibstadt in the north of the region (Koch 2014). However, connections to other regions are present as well and interregional entanglements are much more complex. As the type spectrum in many regions is very similar in the LN/EFN and mainly differs quantitatively, it is virtually impossible to identify types that are characteristic for only one LN/EFN group and could be classified as foreign elements if found in another region.

For example, surface roughening of the vessels' lower parts by coiled cord impression (so-called "mat roughening") is especially typical for the Wartberg and Goldberg III groups, but also appears in Cham, Bernburg and other groups. Roughening by brushing, on the other hand, is mainly known from the eastern groups of Cham, Řivnáč and Jevišovice, but not from Goldberg III (Burger 1988, 147–48; Gohlisch 2006, 184; Matuschik 1999, 72–73; Schlichtherle 1999, 44). At

Burgerroth, “mat roughening” is far more abundant, but brushing also sporadically appears.

Plastic cordons are another example for a widespread typological element. In the Cham culture, cordons with deep notches or finger impressions are especially common, and these are often grouped together horizontally and vertically (Burger 1988, 56; Gohlisch 2006, 174–77; Matuschik 1990, 434–36; 1999, 73, 84–85). Cordons of the Cham type sporadically also occur at Burgerroth (Figure 6.2.5 or Spennemann 1984, pl. 47.389). In the Goldberg III group, cordons are typically left plain, run horizontally along the vessel’s shoulder and separate the roughened lower from the undecorated upper part (Schlichtherle 1999, 39, figs 5–9). This layout is also common at Burgerroth (Spennemann 1984, pl. 33.236; or Figure 6.5, but with a notched cordon and a shape that finds better parallels in Cham than in Goldberg III). On other vessels from Burgerroth, the transition between the roughened lower and the plain upper parts is in most cases not emphasised by a cordon, but only by a slight offset in the profile (Spennemann 1984, pl. 41.310, pl. 49.438, pl. 51). This is common in the Goldberg III group, too, but more abundant in the Wartberg culture.

Broad band handles — like a specimen from the ditch (Link 2018, 188 fig. 9.10) and several others from the 1920s excavation (Spennemann 1985, 136, figs 1–3, figs 6–10) — are most common in the Bernburg culture (cf. Dirks 2000, 41–67; Gohlisch 2006, 181–82; Matuschik 1990, 491, 495; Torres-Blanco 1994, 161–62, 169–72). However, handles and lugs are to some degree known from most regions during the LN/EFN and for this reason cannot be regarded as a cultural connection to the Bernburg region.

The abundance of antler sleeves at Burgerroth is especially striking as they are rather uncommon in the neighbouring cultural groups to the south-east (Cham) and to the north (Wartberg, Bernburg) (Matuschik 1990, 206–09, 495–99 pl. 157.8–11), but very common in the lakeside settlements of the Alpine foothills. Burgerroth stands out as the northernmost site where antler sleeves occur in large quantities, which clearly illustrates cultural connections towards the south. Interestingly, the regional contrast in the distribution of antler sleeves remains the same during the CWC. The presence of antler sleeves obviously reflects a long-standing regional differentiation in the use of a specific tool type and not a distinction between archaeological “cultures”.

At other sites in Franconia, such as Schwanfeld, Prosselsheim and Großeibstadt, connections to the north are much more predominant than at Burgerroth, where connections towards the north, south and east are more or less equally present. On the other hand, there are strong connections to the south at Burgerroth, which are missing at other sites in the region.

“Pit houses” of the Late and Final Neolithic

“Pit houses” or “sunken floor dwellings” — i.e. buildings with a floor dug deep enough into the ground that the lower part of the walls was formed by the depression’s edges — are a widespread phenomenon throughout prehistory and historic times (Wüstehube 1996). However, the interpretation of archaeological features as “pit houses” in contrast to other settlement pits is highly problematic in many cases (see also Lichter 1993, 24–25). In central Europe, the oldest plausible examples date from the first half of the fifth millennium BC (Middle Neolithic according to the southern and western German chronological systems). S. Friederich (2011, 410–14) compiled the existing evidence, although her list includes some rather uncertain examples. The most clearly interpretable houses are the ones from Osterhofen-Schmiedorf and Aldersbach-Kriestorf (Riedhammer *et al.* 1999, 16–29), both in eastern Bavaria and dating to SOB (South-East Bavarian Middle Neolithic) phase IIa and II/III respectively, and two features from Těšetice-Kyjovice in Moravia (Lengyel culture/Moravian Painted Ware; Podborský 1993, 126 fig. 69.4.7). The pits vary in size from 2.1 × 2.6 m (Osterhofen-Schmiedorf) to around 4.5 x 4.5 m (Těšetice-Kyjovice) and all of them have interior posts in different configurations, which indicates some kind of roof construction. Because of its small size, the pit from Osterhofen has been interpreted as a cellar or storage facility (Riedhammer *et al.* 1999, 29). As we know large above-ground house constructions from the Middle Neolithic period, the same could hold true for the larger “pit houses” as well, and they probably had some special economic function, for instance as workshops or storerooms, rather than being used as dwellings.

In the initial phase of the Younger Neolithic in the second half of the fifth millennium a new type of buildings with sunken floors emerges. They are much larger than the Middle Neolithic pit houses and can reach lengths of more than 15 m, with a rectangular or slightly trapezoidal shape. At a number of sites, uniformly constructed buildings of this type are closely arranged in parallel rows (Zeeb 1996, 105–16), which indicates an organised settlement structure with a pathway system and makes the interpretation as regular dwellings very plausible.

Rectangular sunken floor dwellings of similar sizes sporadically also occur in the fourth millennium Michelsberg culture (Höhn 2002, 5–28). But also small square to rectangular pit constructions similar to the Middle Neolithic features continue to exist during the Younger Neolithic. For the Michelsberg culture, five features from the enclosure at Urmitz in the middle Rhine valley, and another one from Hattersheim in Hessen, are the best examples (Bergmann 2008; Boelicke 1976/77, 79–80, 104). The houses from Urmitz range from 3.8 ×

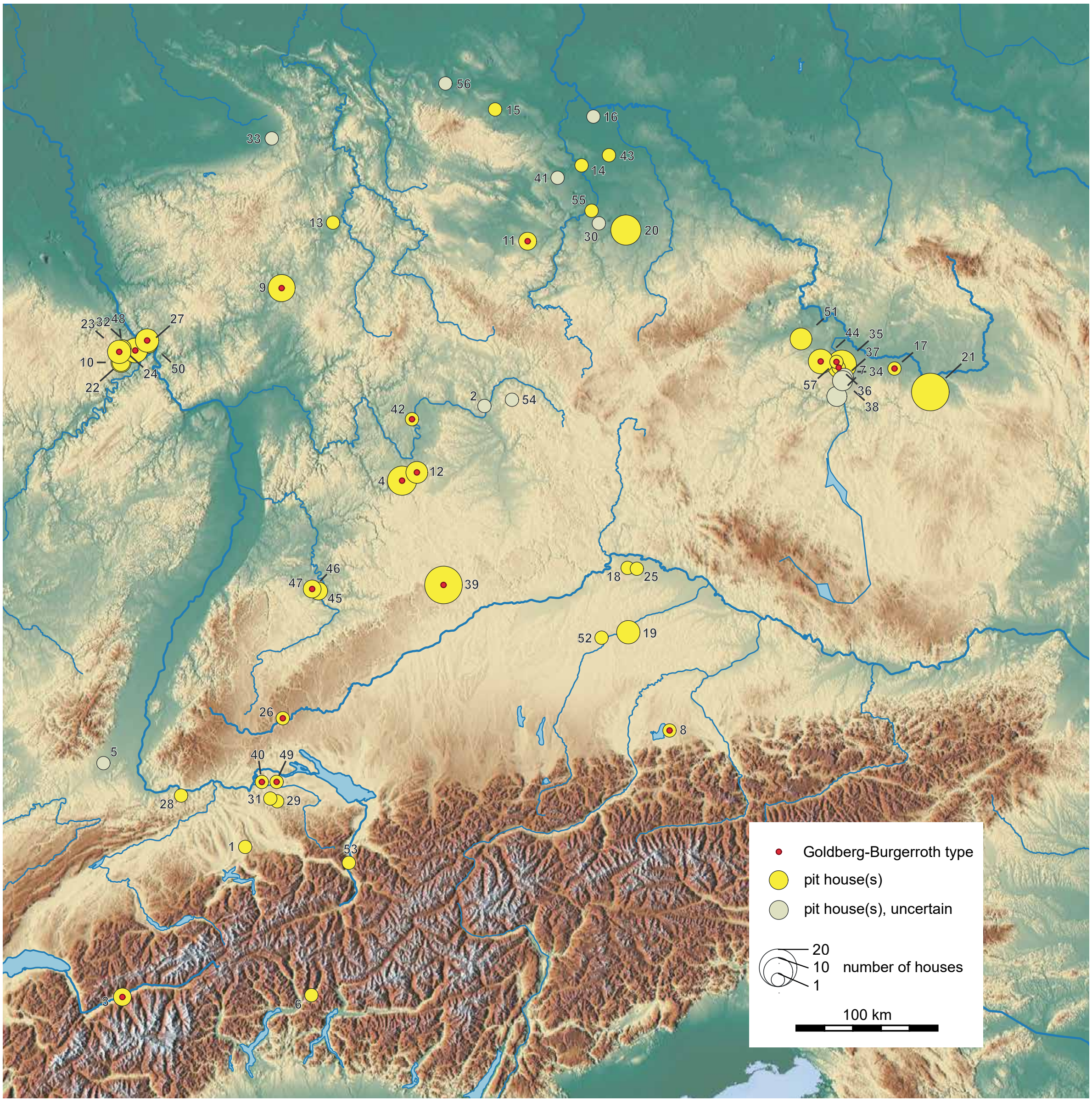

Figure 8. Pit houses from the fourth and third millennia BC in southern central Europe. The "Goldberg-Burgerroth type" is characterised by a square or slightly rectangular shape and a central pit (T. Link). 1 Baar-Früebergstrasse; 2 Baunach-Hahnleite; 3 Bramois; 4 Burgerroth; 5 Burnhaupt-le-Bas; 6 Castaneda-Pian del Remit; 7 Černošice-Kazín; 8 Chieming; 9 Ebsdorfergrund-Wittelsberg; 10 Gering; 11 Großobringen; 12 Gollhofen; 13 Gudensberg-Bürgel; 14 Halle-Dölauer Heide; 15 Halberstadt-Sonntagsfeld; 16 Kleinzerbst; 17 Klučov; 18 Köfering-Kelleräcker II; 19 Landshut-Sallmannsberg; 20 Luckaer Forst; 21 Kutná Hora-Denemark; 22 Maifeld-Gering; 23 Mayen "An der Sauperg"; 24 Mendig-Thür; 25 Mintraching-Sengkofen; 26 Mühlheim a. d. Donau-Stetten; 27 Mülheim; 28 Mumpf-Kapf; 29 Neftenbach-Aspach; 30 Oberwerschen; 31 Oberwinterthur-Römerstrasse 229; 32 Ochtendung; 33 Paderborn; 34 Praha-Bubeneč; 35 Praha-Bohnice Zámka; 36 Praha-Lysolaje; 37 Praha-Vyšehrad; 38 Praha-Zlíchov "Kloboućek"; 39 Riesbürg-Goldburghausen Goldberg; 40 Rudolfingen-Schlossberg; 41 Schraplau; 42 Schwanfeld; 43 Sandersdorf-Brehna; 44 Stehelčeves-Homolka; 45 Stuttgart-Hofen "Mittlere Wohlfahrt"; 46 Stuttgart-Stammheim "Neubaugebiet Süd"; 47 Stuttgart-Stammheim "Sieben Morgen"; 48 Thür; 49 Uerschhausen-Horn; 50 Urmitz; 51 Vraný-Čertovka; 52 Wang "Ziegelberg"; 53 Wartau-Ochsenberg; 54 Wattendorf-Motzenstein; 55 Weißenfels-Eselsweg; 56 Werlaburgdorf-Lietfeld; 57 Žalov-Řivnáč (base map by maps-for-free.com).

3.6 m to 6 × 4.6 m. They have posts in their corners and in the centre, as well as a central fireplace.

A number of similar examples exist in the mid fourth millennium Altheim culture in eastern Bavaria. The latest compilation by F. Eibl and G. Raßhofer (Eibl and Raßhofer 2015, 24–27 fig. 5, based on Schönfeld 2001, 23–28 and Limmer 2010, 88–92) lists nine examples. All of them have a more or less regular rectangular or square shape. Their maximum wall lengths range from c. 2.8 m to 4.5 m. Post arrangements vary considerably. At least in one case, a shallow central pit was documented which seems to have served as a fireplace (Landshut-Sallmannsberg Obj. 186: Limmer 2010, 91; Schönfeld 2001, 27). As with the Middle Neolithic features, a dwelling function for the "pit houses" is generally thought unlikely. An interpretation as special-purpose buildings or cellars within above-ground constructions seems more plausible (Limmer 2010, 92; Schönfeld 2001, 28–36). G. Schönfeld also raised the idea that some of the features might in fact be foundations of larger above-ground buildings (Schönfeld 2001, 20–23, 36).

During the late fourth and the third millennium BC, "pit houses" or "sunken floor dwellings" become more widespread than before (or are at least more commonly known from the archaeological record). There is still a wide variety in constructions, but a specific "Goldberg-Burgerroth type" stands out, as the examples below will show. It is characterised by a square or slightly rectangular shape with wall lengths of around 3–6 m, a flat base, vertical edges and in many cases a shallow pit in the centre of the floor (Figure 4). Especially the central pit seems to be characteristic for a group of Late to Final Neolithic pit houses with a wide distribution across southern central Europe (Figure 8). As the above compilation shows, this specific type of building has some precursors in the Younger and even Middle Neolithic. Especially the features from Urmitz closely resemble the LN/EFN houses of the "Goldberg-Burgerroth type" and probably can be seen as immediate predecessors or earliest examples of the type.

Although not fully excavated, the two features from Burgerroth clearly qualify as representative examples of this building type. Some of the structures from the 1920s excavations complement the picture. The best and most abundant analogies to the pit houses from Burgerroth exist in southern, western and central Germany, Bohemia and Switzerland. More than 50 features were already excavated between 1911 and 1929 at the Goldberg (phase III) in the Nördlinger Ries (eastern Baden-Württemberg) by G. Bersu (Bersu 1937). It is a reasonable assumption that Maurer's and Hock's excavations at Burgerroth from 1919–1921 and probably also their interpretation of the excavated features were strongly inspired by Bersu's contemporary research. The pit houses at the Goldberg are square to slightly rectangular with rounded corners and sizes ranging from 12–28 m² or 6 m maximum side length. Postholes measuring 10–25 cm in diameter were documented in most of the buildings. Their arrangement varies, however: most commonly, posts run along the sides of the buildings, but in some cases they can also be located within the interior space. Almost all of the buildings have central pits, which are 20 cm deep on average. These central pits are commonly associated with traces of fire.

Although LN/EFN evidence is rare in Franconia, at least two more sites with pit houses complement the evidence from Burgerroth. The closest examples were excavated in 2013 only 12 km north-east of Burgerroth at Gollhofen (Beigel and Nadler 2013). Four rather small square pits measuring 3–3.9 m lie inside a ditch or palisade system. One of them has a central pit, two features show traces of posts. A single but well-documented pit house comes from Schwanfeld (Figure 9.5), 44 km north of Burgerroth (Lüning 1999). It is associated with find material of the Bernburg culture.

Some close analogies of pit dwellings with central pits come from Baden-Württemberg. At Stuttgart-Stammheim (Figure 9.3) and Stuttgart-Hofen, five dwellings were documented of which at least three had central pits (Matuschik and Schlichtherle 2009, 18–21; Schlichtherle *et al.* 2009). They were associated with early Goldberg III material and were radiocarbon dated to the last third of the fourth or the beginning of the third millennium. At Mühlheim-Stetten on the upper Danube (Figure 9.4) a square pit house was fully excavated (Hietkamp and Hanöffner 2005). It has a small central pit measuring 80 cm in diameter and 10 cm in depth. Find material can be associated with the Horgen culture, a radiocarbon date ranges between 3340–2885 calBC (2σ).

A larger number of pit houses is known from Late and Final Neolithic sites in Switzerland: Baar-Früebergstrasse, Kt. Zug (Gnepf Horisberger *et al.* 2005), two features at Bramois-Immeuble Pranoé D, Kt. Vallais (Figure 9.7) (Mottet *et al.* 2011), Castaneda-Pian del Remit, Kt. Graubünden (Vogt 2000), Mumpf-Kapf, Kt. Aargau (Harb 2009), Neftenbach-Aspach, Kt. Zürich (C. Fischer 1998), Oberwinterthur-Römerstrasse, Kt. Zürich (Janke 1996), Rudolfingen-Schlossberg, Kt. Zürich (Figure 9.6) (Hasenfratz 1989), Uerschausen-Horn, Kt. Thurgau (Figure 9.8) (Hasenfratz and Schnyder 1998, 156–57) and Wartau-Ochsenberg, Kt. St. Gallen (Primas *et al.* 2004, 73–137). Most of the features are roughly square with side lengths ranging from 3.4 to 5.3 m (except Castaneda, which is rectangular and only measures 2.5 × 3.3 m). A number of features have central pits (Rudolfingen, Wartau) or potential fireplaces (Bramois, Neftenbach, Uerschhausen). Posts along the pit edges or in the corners were documented in several cases (Bramois, Castaneda, Mumpf-Kapf), as were interior posts

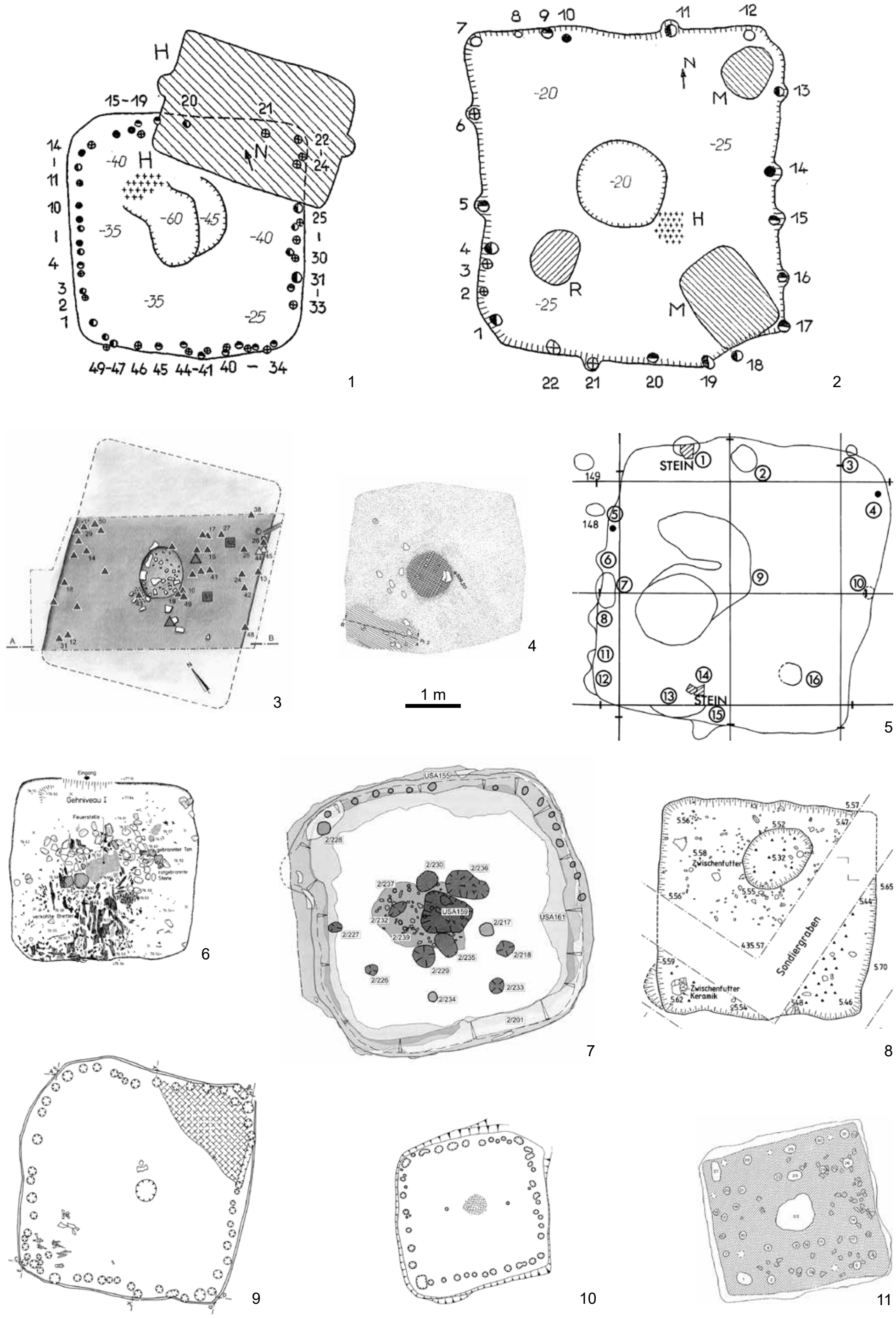

Figure 9. Examples of pit houses of the "Goldberg-Burgerroth type". 1–2 Goldberg (Bersu 1937, figs 1–2); 3 Stuttgart-Stammheim (Matuschik and Schlichtherle 2009, 19 fig. 11); 4 Mühlheim-Stetten (Hietkamp and Hanöffner 2005, 64 fig. 16); 5 Schwanfeld (Lüning 1999, 421 fig. 5); 6 Rudolfingen-Schlossberg (Hasenfratz 1989, 55 fig. 5); 7 Bramois (Mottet *et al.* 2011, 64 fig. 73); 8 Uerschhausen-Horn (Hasenfratz and Schnyder 1998, 157 fig. 154); 9 Praha-Lysolaje (Pleslová-Štiková 1972, 9 fig. 6); 10 Klučov (Zápotocký and Kudrnać 2008, 45 fig. 6a); 11 Ochtendung (Fehr 1978, 100 fig. 5).

(Neftenbach, Rudolfingen). However, in many cases it is disputable whether the posts were static elements of a roof superstructure or rather parts of a wooden planking of the pit walls or of other interior installations. Most of the features date to the Late Neolithic (mainly Horgen culture), while Bramois, Wartau and Uerschhausen date to the Final Neolithic, the latter being culturally associated with the CWC. A potential CWC pit house from Burnhaupt-le-Bas in southern Alsace lies close to the Swiss cluster (Bleckmann 2006).

In southern and central Bavaria, pit houses of the Late and Final Neolithic are rare, although a considerable number of Cham culture settlements exists. One example comes from Köfering-Kelleräcker in eastern Bavaria (Nagel 2001, 3–4). Recently, a feature at Chieming was partially excavated, which showed a flat base with a central pit (Pechtl and Möslein 2020). Interestingly, and similar to Burgerroth, it contained pottery with textile impressions and produced a very young radiocarbon date (2461–2221 calBC [2σ]).[2]

Parallels to the pit houses from Burgerroth can also be found further to the north. At Ebsdorfergrund-Wittelsberg in Hessen, eight pit houses with square to slightly rectangular shapes and wall lengths of around 4 m were excavated (Drummer 2022, 43–58; Fiedler 1991). They date to the younger phase of the Wartberg culture (c. 2800–2600 calBC) and were associated with a double ditch system. Only some of the buildings had central pits, but they were regularly constructed with central posts, reaching depths of up to 60–70 cm below the floors.

A whole group of Late and Final Neolithic buildings (in some cases more precisely dateable to the CWC) stands out in the Middle Rhine region at Ochtendung (Figure 9.11), Mayen, Maifeld-Gering, Mülheim and Mendig-Thür (for further information and literature see Hecht 2007, 138–48; 2008, 258–59 fig. 5.1–3.9–10). Remarkably, it is the same region in which pit houses already occurred during the Younger Neolithic at Urmitz (see above), which could indicate a special regional building tradition. However, the interpretation of the features is controversial in a number of cases. Some of the features, especially four examples from Ochtendung, clearly belong to the Goldberg-Burgerroth type, while others have different construction principles and rather seem to be surface post-built structures with only slightly or partially sunken floors. Such sunken floor dwellings with various shapes and dimensions are widespread during the Late and Final Neolithic in central and especially in northern central Europe (Seregély 2008, 32–38, 116–18). They cannot be directly linked with the Goldberg-Burgerroth type pit houses, however, but reflect a different building tradition.

Sunken floor dwellings in this broader sense are also widespread in central Germany (e.g. Halle-Dölauer Heide: Behrens and Schröter 1980, 13–30). As many potential buildings are difficult to interpret for various reasons, only a few features from central Germany can be clearly assigned to the Goldberg-Burgerroth type. The best examples come from Großobringen in Thuringia, where two pit houses and a ditch system dating to the Bernburg culture were documented (Walter 1991).

Some of the best parallels to Burgerroth, not only regarding the houses but the site characteristics in general, come from Bohemia. The most important sites in this respect are Stehelčeves-Homolka and Kutná Hora-Denemark (Ehrich and Pleslová-Štiková 1968, esp. 20–51; Zápotocký and Zápotocká 2008, esp. 313–15 and chapter 3.1), both dating to the Řivnač culture. Just as Burgerroth, both of them are promontory settlements with fortification ditches and yielded a larger number of pit houses: 23 were documented at Denemark and at least six at Homolka, supplemented by a number of less clearly interpretable features and surface structures. At Klučov, also a hilltop site of the Řivnač culture, a small (2.8 × 2.9 m) but very distinct pit house with multiple posts along the sides and a central fireplace was excavated (Figure 9.10) (Zápotocký and Kudrnáč 2008, 35, 87–88). The Early Řivnač site Praha-Lysolaje yielded a similarly constructed building measuring 4.1 × 4.5 m (Figure 9.9) (Pleslová-Štiková 1972, 6). Four pit houses were documented at Vraný-Čertovka, another Řivnač hilltop site (Pleslová-Štiková 1981, 165). Pit houses are mentioned in the literature for several other sites dating to the Late Eneolithic in Bohemian terminology; however, many of them cannot be reliably evaluated on the basis of the published data.

To sum up, pit houses with various shapes, sizes and constructions occur virtually throughout the entire Neolithic. They are rare in the Early and Middle Neolithic, but become more frequent in the late fifth and during the fourth millennium BC. Beginning with some sporadic Younger Neolithic features, a specific type of square or slightly rectangular building with walls measuring 3–6 m evolves. It becomes more frequent towards the end of the fourth and in the first half of the third millennium BC. While wall and roof constructions seem to vary, many examples have a shallow central pit or fireplace. Pit houses of this specific "Goldberg-Burgerroth type" and of the more universal variant without a central pit occur in different cultural contexts like Goldberg III, Horgen, Wartberg, Bernburg, Cham, Řivnač and the CWC (Figure 8). This shows once more that LN/EFN groups were strongly interconnected in various aspects of material culture, including architecture. Furthermore, this specific building tradition persists from the Late Neolithic into the Final Neolithic CWC, which indicates aspects of cultural continuity despite all the obvious change in material culture at the beginning of the CWC.

2 The Cham culture pit houses from Riedling (Dunne *et al.* 2023) were published too late to be fully taken into account here.

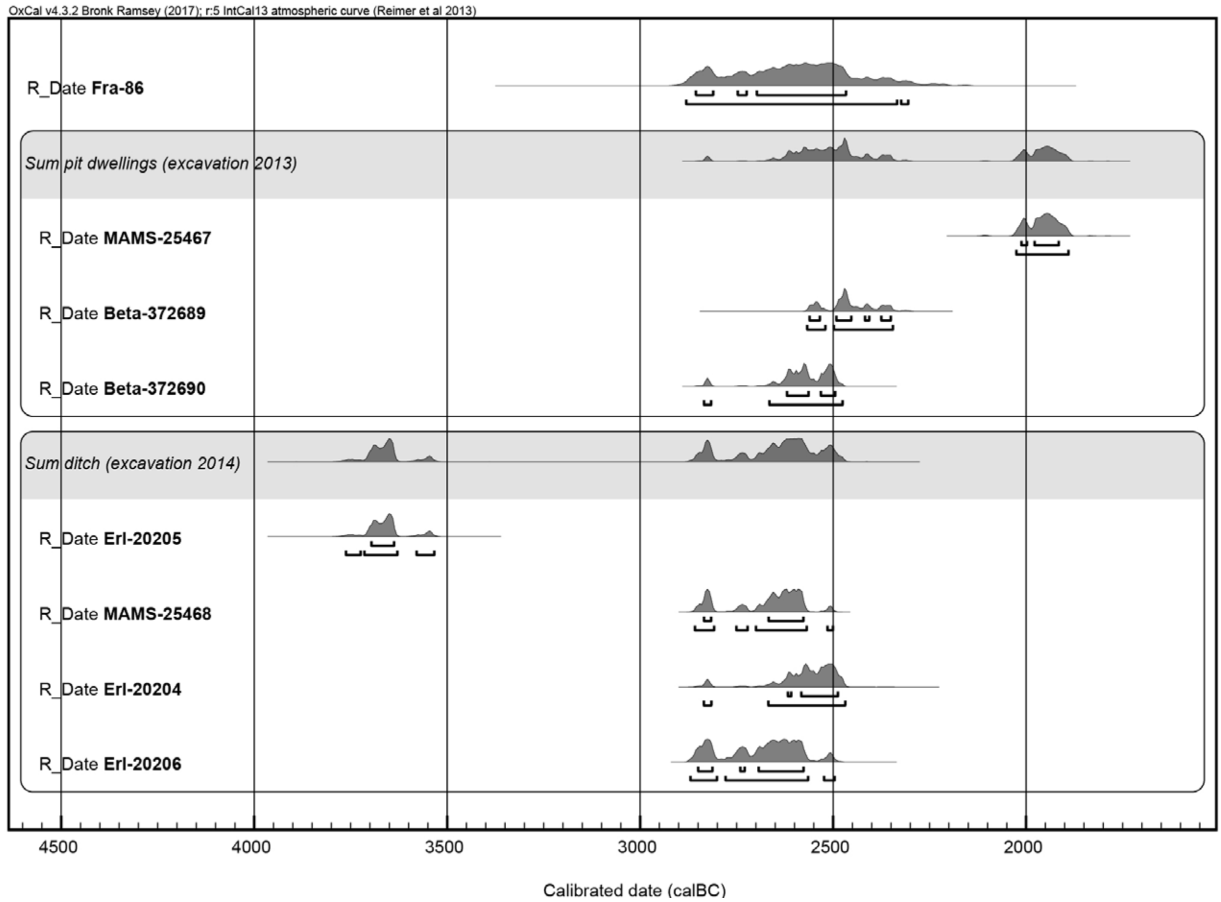

Figure 10. Radiocarbon dates from Burgerroth, calibrated with OxCal v4.3.2 (Bronk Ramsey and Lee 2013; Reimer *et al.* 2013).

The function of the pit houses remains an open question. Finds seem to indicate a workshop function in some cases. For example, a very high proportion of red deer bone in Baar-Früebergstrasse indicates antler or hide processing (Gnepf Horisberger *et al.* 2005, 130–35). In other cases, flint and ground stone artefacts and refuse could reflect the manufacturing of tools (e.g. Rudolfingen-Schlossberg, Mumpf-Kapf, Ebsdorfergrund-Wittelsberg: Drummer 2022, 52; Harb 2009, 17–18; Hasenfratz 1989, 54–55). However, taphonomic considerations have to be taken into account. It should not be taken as given that the find material from a pit house directly represents the activities that took place within it. On the contrary, finds from the infill most probably were deposited after the abandonment of the house and can originate from different contexts within the settlement. Only finds directly from the walking horizon could relate to the terminal use phase of the building. In some cases, it is argued that during the house's use life a process of stratigraphic accumulation took place and the finds from the different occupation layers (as opposed to the later infill) therefore reflect activities within the building (e.g. Lüning 1999, 421–28 for the house at Schwanfeld). The existence of such accumulation processes has to be carefully evaluated for each individual feature, however, and must not be generalised.

At some sites, the central pits showed traces of fire or contained burnt daub or stones and thus have been interpreted as hearths (e.g. Bramois, Uerschhausen-Horn, Rudolfingen-Schlossberg). In other cases (e.g. Stuttgart-Stammheim, Goldberg) charcoal and burnt stones were present in or around the pit, while no direct traces of fire were visible on the pit surface; this might indicate that the pit was used for collecting ash removed from a nearby hearth (Matuschik and Schlichtherle 2009, 18–23). In many other cases, no traces of fire were recorded at all (e.g. Wartau-Ochsenberg, Mühlheim-Stetten, Schwanfeld). The two pits from Burgerroth also did not show any direct traces of fire, although burnt stones were present within the house infills in some quantity, but without clear concentrations. The somewhat unsatisfactory conclusion is that although the central pits are a common characteristic, they probably did not have the same function in every building. They might also have had multiple purposes or changed their function during the use life of the buildings.

Finally, it is important to stress that pit houses were not the only buildings and probably not the main dwellings.

At the Swiss and southern German lakeside settlements, a large number of Late and Final Neolithic post buildings give an idea about the above-ground constructions that we are largely missing in dry soil conditions. Some recently excavated ground plans from CWC mineral soil sites in central Germany indicate that similar post-built houses existed elsewhere, too (Friederich and Jarecki 2014; Kegler 2014, 177–84; Küßner 2019). These larger surface buildings probably were the actual residential dwellings, while the pit houses were presumably used for different economic purposes. This does not mean, however, that each pit house had the same function or was used for one specific task only. It rather looks like they were multifunctional facilities for a wide range of economic and technical activities.

Chronological context

In the course of the new investigations at Burgerroth, seven radiocarbon samples have been dated (Figure 10), all of them short-lived plant macro-remains (esp. cereals[3]). The dates have already been discussed elsewhere (Link 2018, 195–96; 2023), so only a short summary is given here. The dates from Burgerroth mainly span the wiggle zones 2880–2580 calBC and 2620–2480 calBC according to D. Raetzel-Fabian and M. Furholt (Furholt 2003a, 4–5; 2003b, 15–18; Raetzel-Fabian 2001), which indicates an end of the settlement during the twenty-sixth century or around 2500 calBC. They are therefore remarkably young for the LN/EFN. For example, the typologically related Goldberg III group is dendrochronologically dated to the thirtieth to twenty-ninth centuries BC in southern Baden-Württemberg (Bleicher 2009, 154–57, 166). In contrast, the dates from Burgerroth clearly overlap with the early and middle CWC (Furholt 2003a, 8–17; 2003b, 118–24). In the neighbouring Tauber valley, the CWC probably started around 2700 BC or during the twenty-seventh century at the latest (Furholt 2003b, 77–79).

Conclusion: Late Neolithic traditions and Final Neolithic innovations

Taking into account the surprisingly late absolute dates and their evident overlap with the CWC, Burgerroth can hardly be classified as "Late Neolithic" anymore, but rather as "Early Final Neolithic with Late Neolithic traditions". These traditions seem to have survived well into the third millennium BC and in parallel to the emerging CWC. This raises some interesting questions: how does Burgerroth relate to the contemporary CWC cemeteries? Is it a "conservative" settlement that stuck to older traditions longer than others in its surroundings did? Or is the parallel existence of CWC with Late Neolithic traditions far more common than we know so far? And what does this mean for the relations between LN/EFN groups and the CWC in general?

CWC burials are abundant in the Main and Tauber valleys (Dresely 2004; Schußmann 2016), but no settlements are known in the region so far. This imbalance is characteristic of the CWC in many regions. The closest CWC settlements can be found in Upper Franconia, about 100 km east of Burgerroth. Interestingly, they are often located in peripheral settings, like hills or hillslopes, which seem rather unfavourable for prehistoric settlement (e.g. the Motzenstein and the Rothenstein: Seregély 2008; 2012). It remains an open question if this regional concentration and the absence of CWC settlements in other regions reflect prehistoric reality or are mainly biased by the state of research and specific research strategies.

Contact finds indicating contemporaneity and coexistence of CWC with LN/EFN groups are known from a considerable number of sites all over central Europe (see the compilation by Furholt 2008, 20–27). As a conclusion, and in contrast to migrationist models, Furholt (2003a, 13–22, 25–26; 2003b, 124–30; 2004) has pointed out that the early CWC evolved as a super-regional semiotic network that coexisted with persisting regional traditions. Similarly, C. Strahm argued that the CWC was a novel social and ideological concept based on a combination of elements from different regional groups and, once established, had a transformative effect on neighbouring groups (Strahm 2010, 321–23). The presence of CWC domestic pottery in the surprisingly young LN/EFN context at Burgerroth clearly supports these ideas. CWC innovations were not adopted as a "cultural package", but taken up selectively, while at the same time the community still held on to LN/EFN traditions.

The latest aDNA analyses (Furtwängler *et al.* 2020) at first glance seem to contradict this model. They suggest that genetic impact from eastern Europe first appeared during the first half of the third millennium BC in south-western central Europe, which obviously fits well with the emergence of the CWC. In fact, the CWC did appear earlier in the east than in the west (Furholt 2003b, 118–24), which also would give room for migrations. A closer look, however, shows that there is no need to turn back to "steppe invasion" models. Genetic data also indicate that the newcomers from the east did not replace the local population right away, but that both genetic lineages slowly mixed over the course of several centuries. Migrant groups from the east might have been a major element in spreading the CWC, but they did not immediately replace the local populations. This again accords well with the archaeological record as described above: at sites like Burgerroth, CWC elements occurred within a cultural context that held on to LN/EFN traditions until the mid third millennium. Immigrant groups neither completely replaced native populations nor did CWC innovations completely supersede regional cultural traditions.

3 Botanical analysis courtesy of Christoph Herbig, Rodenbach.

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Networks at the turn of the millennium — the situation in northern Bavaria

Martin Nadler

Abstract

For thousands of years, northern Bavaria and especially Middle Franconia was in a contact zone between a large western European and the old Danubian communication area. This can also be observed in the materials of the late fourth millennium BC, which show elements from various neighbouring cultural phenomena. Despite the generally very small number of finds, influences from and references to sometimes distant cultural areas can be observed on the basis of typical features of the time in building and settlement forms, elements of grave construction and the spiritual world. The region was well integrated into the long-distance networks of the late fourth millennium and thus offered favourable conditions for the adoption of the Corded Ware and Bell Beaker elements that dominated the third millennium.

Keywords: Late Neolithic, settlement, long-distance exchange, anthropomorphic stelae, petroglyphs

The fourth millennium BC in northern Bavaria and especially its latter part is one of the darker chapters in southern German prehistory. The number of known sites, let alone excavations for this period, is still extremely limited. Nevertheless, based on the groups of finds and features mentioned below, it can be stated that this geographical area was in line with wider trends and was integrated into supra-regional developments.

As already shown elsewhere (Nadler 2022), the northern Bavarian area is characterised throughout the Neolithic by a strong connection to western cultural phenomena and emerges as a boundary zone within a supra-regional, Mediterranean–western European communication area. During the first half of the fourth millennium, this clear western orientation is reflected in distinctive long-distance trade products and their distribution, such as Rijckholt flint or western Alpine jadeite axes (Nadler 2022, 58–59). Northern Bavaria is part of the large Michelsberg koinë (Nadler 2023a) (Figure 1) at this time. From general considerations, the groups of import finds mentioned can largely be assigned to this period, even if they are almost entirely stray finds without context.

Unlike in southern Bavaria, after the end of Michelsberg, which is also only partially understood, there is a clear gap in knowledge in northern Bavaria. The few datable objects and sites belong to the end of the fourth millennium (Figure 2). Admittedly, there

In D. Hofmann, D. Mischka and S. Scharl (eds) 2025. *The eve of destruction? Local groups and large-scale networks during the late fourth and early third millennium BC in central Europe*, 159–172. Leiden: Sidestone Press.

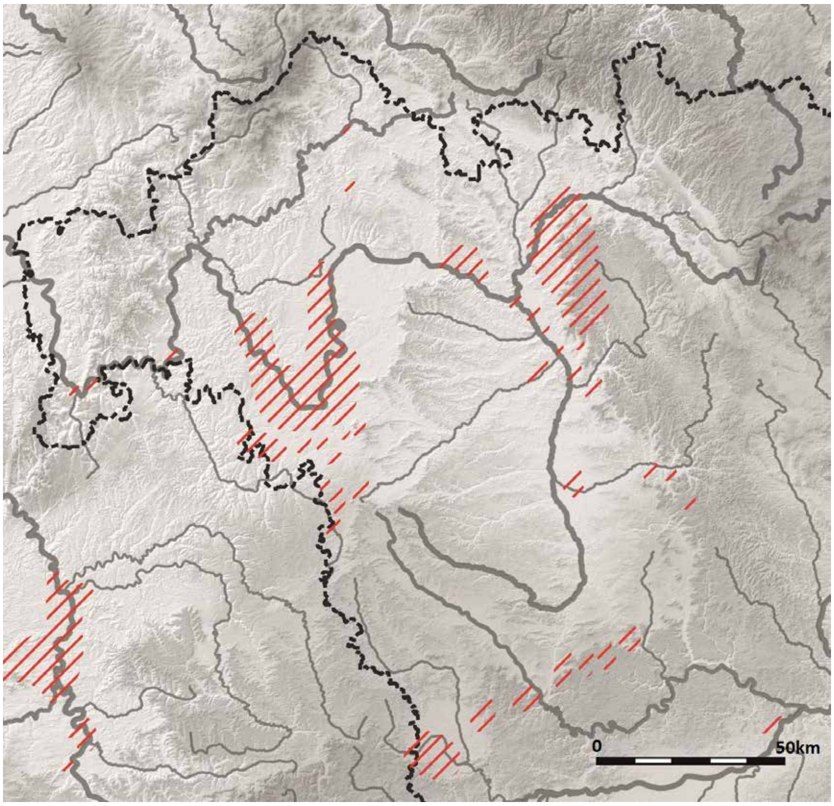

Figure 1. Distribution of Michelsberg culture sites in northern Bavaria (map: U. Maaß, FAU, based on a draft by M. Nadler; geodata: Jarvis *et al*. 2008).

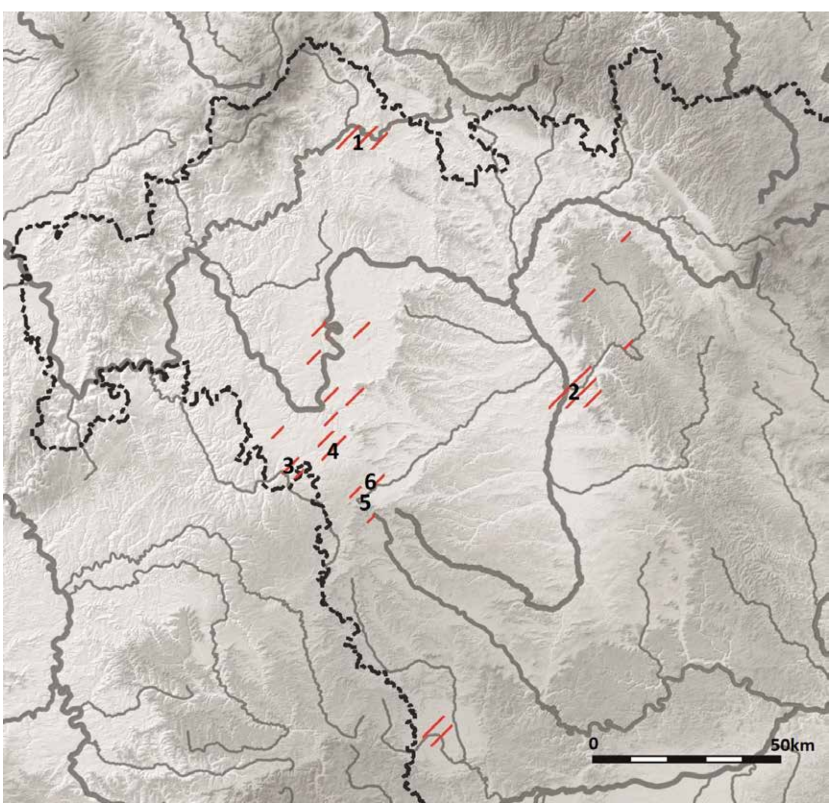

Figure 2. Late Neolithic sites in northern Bavaria. 1 Großeibstadt; 2 Regnitztal; 3 Burgerroth; 4 Gollhofen; 5 Gallmersgarten and Birkach; 6 Burgbernheim (map: U. Maaß, FAU, based on a draft by M. Nadler; geodata: Jarvis *et al*. 2008).

are a large number of bifacial dagger- and sickle-like flint implements of Late and Final Neolithic character as stray finds in the old settlement landscapes frequented more intensively by modern-day collectors, but these cannot be used further for developing a fine chronology. At least they indicate that the area was probably not as depopulated as it seems at first glance. Thomas Link has dealt with the essential settlement-related and chronological aspects in detail in his article for this volume, which is why only selected additional aspects and considerations will be presented and discussed below.

Various petroglyphic monuments have recently been named as evidence of participation in the supra-regional spiritual world. This concerns a well-known group of finds, the so-called "*Zeichensteine*" of the middle Regnitz valley (Figures 3–4; location: Figure 2.2). Their first complete presentation in the archaeological literature (Hennig 1970, 25–30) was still based on the traditional view that these objects dated from the Late Bronze Age to the Hallstatt period. In the meantime, it has been shown that these must be stone monuments of Late Neolithic origin incorporated secondarily into Metal Age burial monuments and that they exhibit a pan-European canon of motifs (Nadler 2011). It was possible to document that the representations on the stone slabs have analogies in various regions from central Germany via Hesse/Westphalia to the western Alps (Nadler 2011; see also Vierzig 2017, 70–71 cat. no. 8.15). The new date of these petroglyphic monuments to the Late Neolithic throws a surprising light on the northern Bavarian region, for which, as mentioned above, hardly any finds can be identified from the second half of the fourth and the beginning of the third millennium BC (Link, this volume).

Among the ornamented stone slabs there is a group that can be regarded as anthropomorphic representations, reduced to the extreme. The motif of the multiple collar garland (Figure 4.1.3.4) is represented a few times, once even with the characteristic nose line (Figure 3), which appears in different variants in many areas of central and western Europe on corresponding representations or stelae of the fourth to third millennium BC. In the relevant literature, it is commonly associated with the so-called "dolmen goddess" (e.g. Behrens *et al.* 1956, 31–34 with fig. 5; Müller 2001). The motif is directly reminiscent of the facial representation on the well-known menhir stela from Pfützthal, Saalekreis, whose connection to a western European pictorial tradition has been repeatedly emphasised (Behrens *et al.* 1956, 41–43; Müller 1991, 25; Vierzig 2017, 71). As is well known, this group of monuments also includes the human figure from Schafstädt, district of Merseburg (Müller 2001), whose belt depiction can also be found on several of the *Zeichensteine*-slabs and thus stylistically places them "in a European context" (Vierzig 2017, 71).

Another group of *Zeichensteine* shows what is known as the so-called cross-band (Figure 4.2), an X-shaped motif which recent research has convincingly interpreted as a "sign of female identity" (Schlichtherle 2006, 127–30; 2010, 275–76, most recently Vierzig 2017, 95–96). This motif, which is based on the female anatomy, appears on one of the two stelae from the Hallstatt period burial ground in Rottenburg (Reim 1988, 28–29). I. Matuschik and H. Schlichtherle have meanwhile rightly established the Copper Age origin of these monuments (Matuschik and Schlichtherle 2009, 39–40). Above all, the cross-band can be seen on various stelae and statue menhirs in the Alpine region, where the female connotation is often further highlighted through the addition of modelled breasts, as was also the case in the much older wall paintings from a burnt house in Ludwigshafen-Seehalde (Schlichtherle 2014, 120–23). Special reference can be made to the small stela from the impressive megalithic complex of Lutry in the canton of Vaud (Schlichtherle 2014, 130), which is also very similar to our *Zeichensteine* in its dimensions. Overall, the cross-band appears in the same regions and contexts as the figures with collar and belt depictions already described.

In addition to these anthropomorphic motifs, a large number of the *Zeichensteine* bear engraved carpet-like patterns consisting of combinations of ornamental bands in the form of herringbone decoration, wavy lines or ladder bands, as can be found, for example, in the stone cist from the Dölauer Heide in central Germany. This stone tomb, constructed from large rectangular slabs (Behrens *et al.* 1956; Müller 1991, 20–21; Schrickel 1957, catalogue entries 85–91) occupies a special position among the Copper Age burial structures in central Europe. The interior of the tomb was completely ornamented; the patterns were either pecked or, fortunately, preserved in painted form. In this richly decorated burial chamber, the all-over zigzag or wavy line ornamentation, as well as multiple combinations of herringbone and ladder bands, exhibits close analogies to the pictorial material of the *Zeichensteine*, in particular the slabs from the burial mound of Mark-Forst (Figure 4.5.8).

Another richly decorated burial chamber, which is also displayed in the Halle Museum today, is the burial chamber of Leuna-Göhlitzsch, which was uncovered in 1750 and was already well documented and published at this time (Müller 1991, 20–21; 2001; Schrickel 1957, catalogue entries 91–96). The interior decoration of this tomb is extraordinarily rich and diverse. The depictions are obviously intended to show wall hangings and decorations as well as equipment hanging on the walls, i.e. the interior of a house. Numerous analogies to the ornamental bands of the *Zeichensteine* can be found in the carpet patterns, again in pecked but also painted versions.

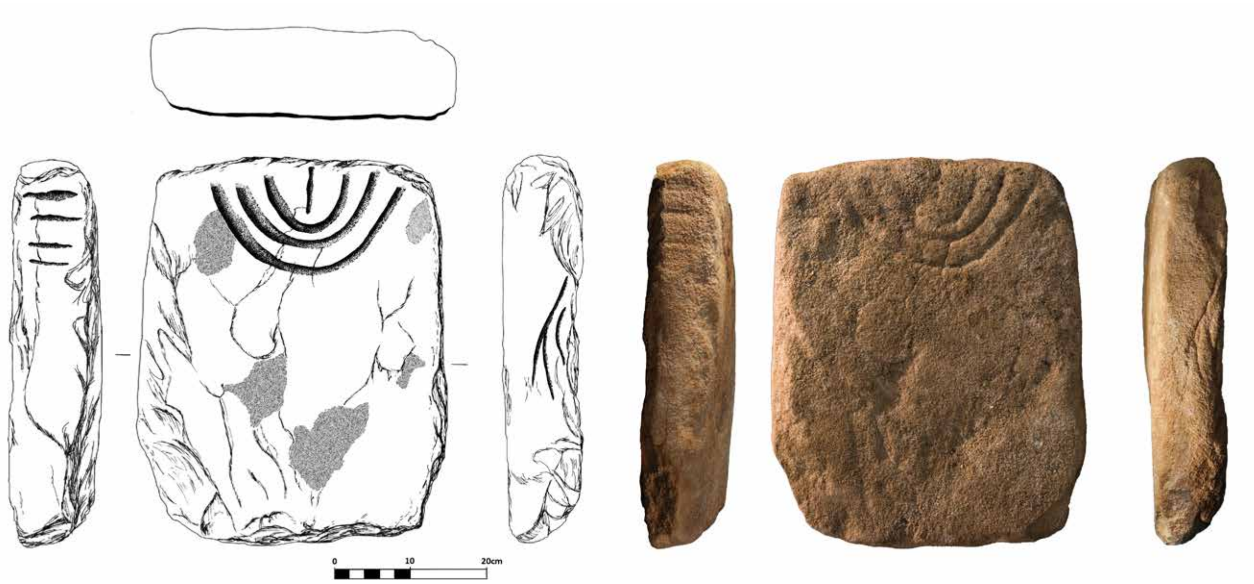

Figure 3. Ornamented slab from a cist grave near Gosberg, district of Forchheim (after Nadler 2011, fig. 16).

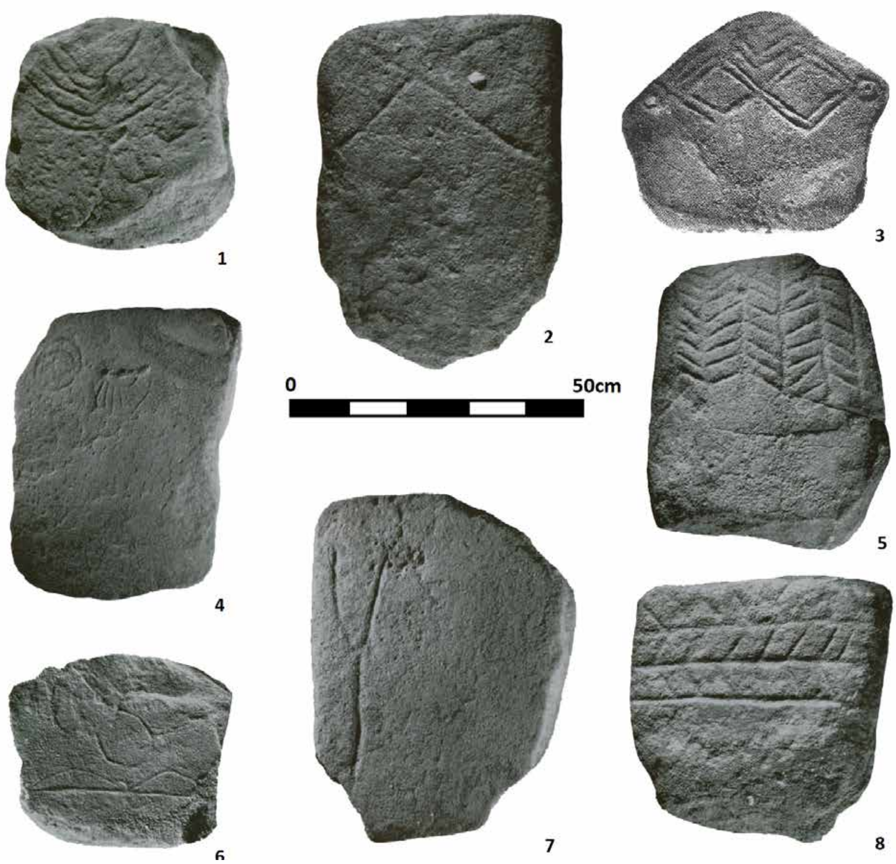

Figure 4. Selection of so-called *Zeichensteine* from the central Regnitz valley. Gosberg: numbers 1, 3, 4, 6 and 7; Mark-Forst: numbers 2, 5 and 8 (after Nadler 2023b, fig. 1).

Figure 5. The statue menhir from Gallmersgarten, district of Neustadt a.d. Aisch-Bad Windsheim. Height 110 cm (photo: F. Wagner).

Figure 6. The stela from Birkach, district of Rothenburg o.d. Tauber. Height 105 cm (© S. Friedrich, Archaeological State Collection Munich).

Among the representations in this burial chamber, the double reflex bow with the associated quiver hanging on the northern wall of the chamber deserves attention. Depictions of bows are not very common, but I would like to go so far as to see at least one stone in Gosberg (Figure 4.6) as showing a greatly abstracted depiction of such a weapon. This motif provides a link to the stelae and statue menhirs of the Alpine region, where the simple as well as the reflex bow are repeatedly depicted as male attributes, particularly on the figures from Sion, but also on the related stelae from Aosta (Bocksberger 1966, 31; De Marinis 1995, 217; Harrison and Heyd 2007, 160–61; Vierzig 2017, 108). On the other hand, there is a surprising similarity between the bow and quiver depiction at Göhlitzsch and a depiction in a megalithic tomb from Klady in the western foothills of the Caucasus (Schunke 2013; Schwarz 2021, 403–04). How the contacts between these three distant regions could have functioned remains to be researched, but underlying common ideas are evident (see also Hansen 2018, 283–85). Furthermore, one of the *Zeichensteine* bears a fork-shaped motif (Nadler 2011, 202) (Figure 4.7), which is commonly interpreted as an abstract depiction of cattle and is known to be widespread in Copper Age Europe (Günther 1990, 52–54).

These monuments already illustrate how the northern Bavarian region at the end of the fourth millennium was connected to partly far away regions of Europe, especially western and western Alpine Europe, through similar images. Subsequently, a new find, secured by fortunate coincidence, has further complemented this picture. This is the statue menhir from Gallmersgarten (Figure 5; location: Figure 2.5), which has already been presented in several short preliminary reports (Nadler 2015; 2019b).

The figure consists of a very hard, fine-grained block of sandstone measuring about 110 × 30 × 20 cm, which has been very accurately shaped into a flat bloc of rectangular

Figure 7. Comparison of the heads of the figures from Gallmersgarten (width of head 23 cm) and Birkach (width of head 25 cm) (photos: M. Nadler, F. Wagner).

cross-section with rounded edges. The front and back have been trimmed and oriented at a slight angle to the layering of the block. This trimming did not follow the stone's natural layers and thus this stela represents the oldest fully sculpted stonemasonry work to date in southern Germany. A semi-circular head section is carefully shaped over distinct shoulders. The highly stylised face has been created by pecking out a horseshoe- or heart-shaped indentation, in which the nose was left as a bridge, while eye holes and a narrow mouth line are pecked in. Other body parts are not shown, but may originally have been painted on.

The stela from Gallmersgarten is an outstanding representative of the group of stone anthropomorphic figures which were widespread in various areas of Europe between the Iberian peninsula and the Eurasian steppes at the end of the fourth millennium — sometimes with several dozen specimens in even a small region (Vierzig 2017). From the region north of the Alps, only few examples had been previously known: the already mentioned figures of Schafstädt and Pfützthal in Saxony-Anhalt, whose

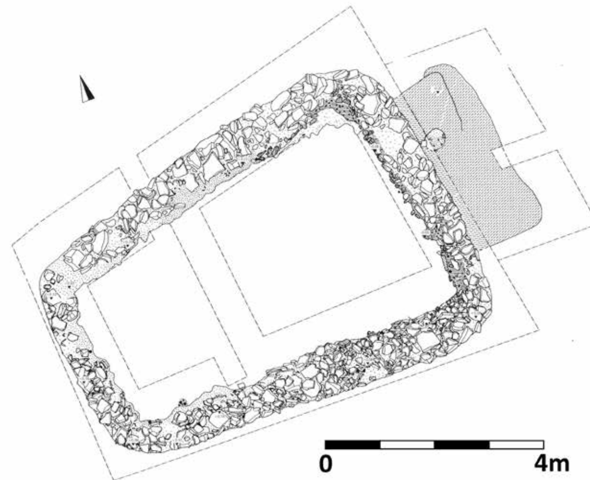

Figure 8. Großeibstadt, district of Rhön-Grabfeld, grave II (modified after Koch 2014, 248).

stylistic connection to the western European/western Alpine world was beyond question from the beginning (Müller 1991, 25; Schrickel 1957, 52), as well as the already mentioned specimens from Rottenburg am Neckar. They had all been found in secondary contexts, as building material in younger burial monuments (Nadler 2011, 206–06; Vierzig 2017, 143–44). On all of them, however, the representations of facial contours, arms or various attributes are executed in the form of scratched or pecked lines. They consist of roughly trimmed stone slabs with a rather irregular outline.

Figures with plastic, mask-like faces and three-dimensionally worked bodies were previously unknown in this area. These features connect the Gallmersgarten find with the well-known statues in southern France and in the Ligurian hinterland, where there are real landscapes of stelae with dozens of corresponding figures (Vierzig 2017, 42–43, 63–64). In the course of studying this stela, renewed attention was also accorded to a figure that had been known for a long time, but had lain neglected in a museum cellar for decades (Figure 6). At the time of its discovery it was situated in the foundation of an eighteenth century house in the hamlet of Birkach, which is only a few kilometres away from Gallmersgarten, and it has a secondary Baroque inscription. When it was first described in 1968, H. Dannheimer tried to explain it as a possible Hallstatt period grave marker, probably under the influence of the then recent sensational finds of the warrior from Hirschlanden and the figures from Tübingen-Kilchberg (Dannheimer 1969, 47–48). The possible existence of (Late) Neolithic stone sculptures in southern Germany was inconceivable at the time.

If one disregards the surface of the Birkach stela, as it was more severely damaged due to being made from a different type of sandstone, the stylistic similarity of

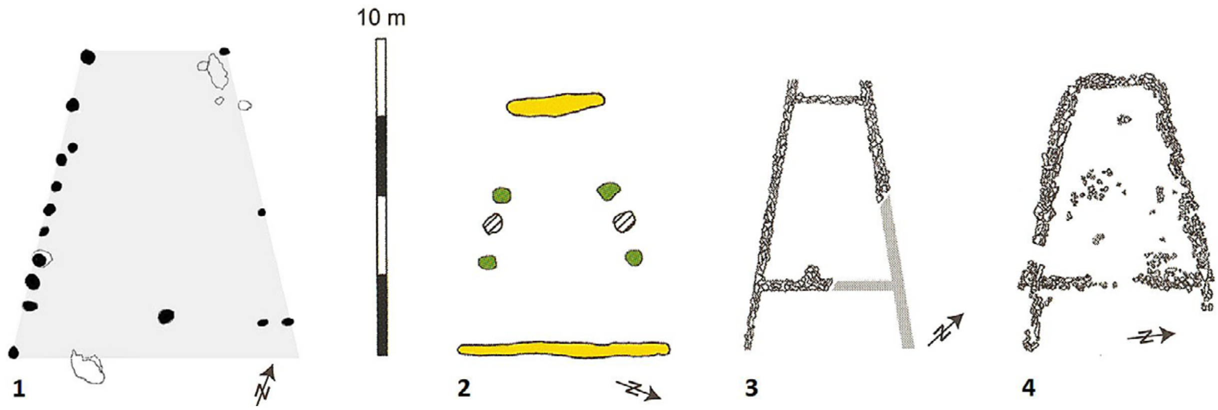

Figure 9. Examples of trapezoidal Late Neolithic so-called stone and walled chambers (“*Stein- und Mauerkammern*”). 1 Burgbernheim; 2 Rottenburg a. Neckar; 3 Neckarwestheim; 4 Oedheim-Degmarn (after Nadler 2022, fig. 8).

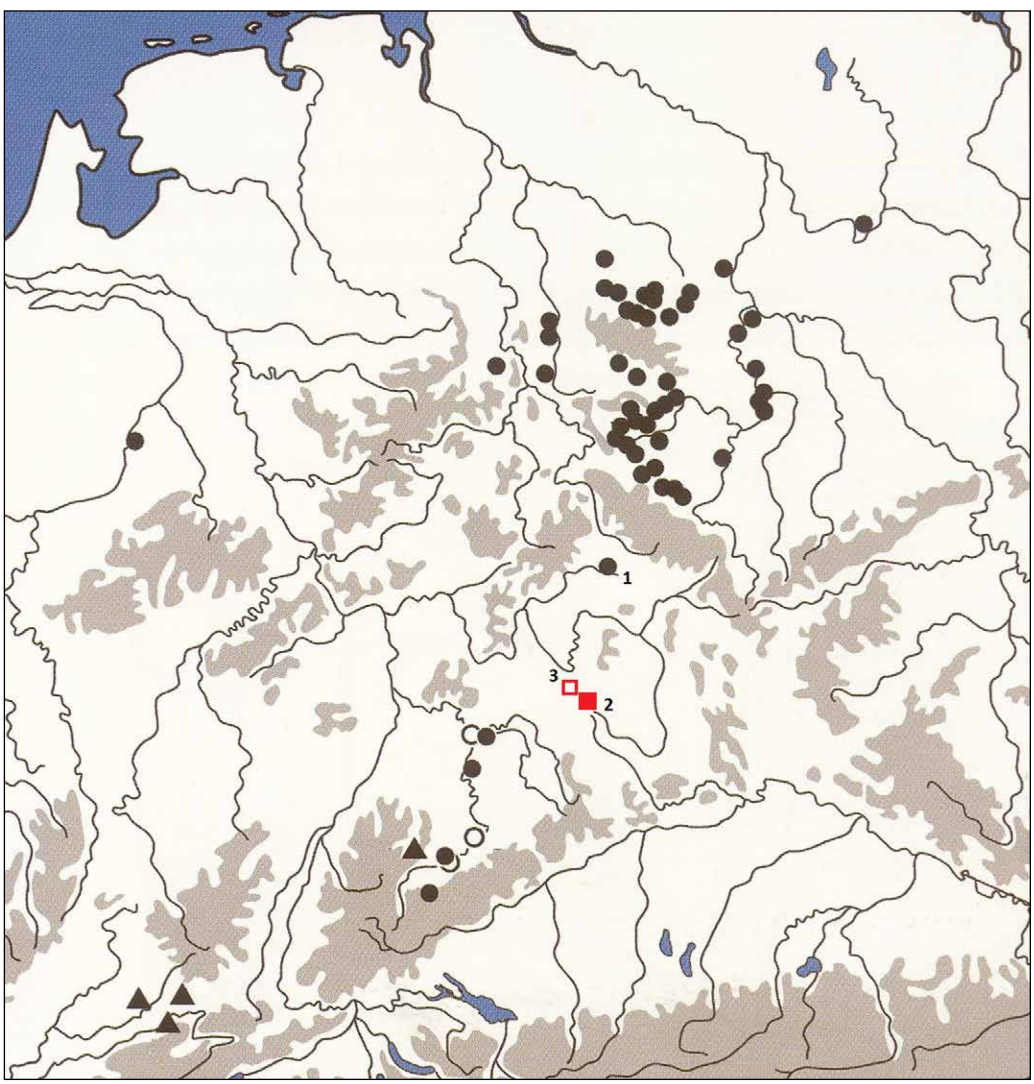

Figure 10. Distribution of so-called “sub-megalithic” monuments in southern and central Germany. 1 Großeibstadt; 2 Burgbernheim; 3 Gaubüttelbronn (M. Nadler, based on a map by Matuschik and Schlichtherle 2009, 41).

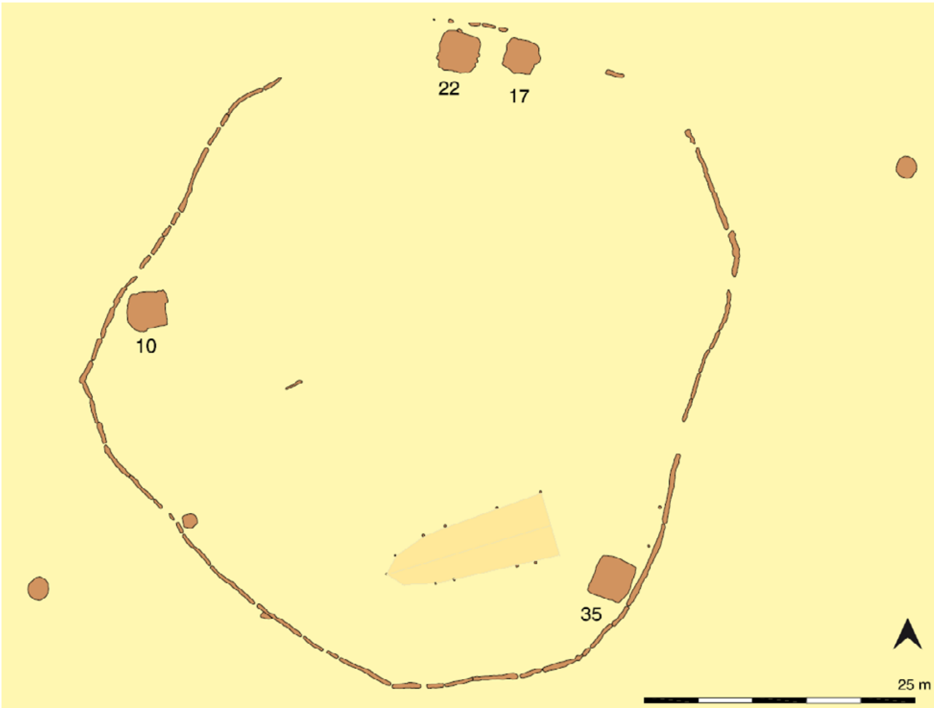

Figure 11. Gollhofen, district of Neustadt a.d. Aisch-Bad Windsheim. Late Neolithic palisade enclosure (plan: R. Beigel, M. Nadler).

its face to that on the Gallmersgarten stela is undeniable (Figure 7). The two figures presumably mark the endpoints of a distinctive pass crossing the main European watershed, which reaches its northernmost point here and separates the catchment area of the Danube from that of the Main-Rhine river system — this region therefore functioned as a hub between the large western European and Danube communication areas for thousands of years (Nadler 2022, 61). In the Main-Franconian area there is further evidence of a western orientation, so that this area can be understood as a fringe zone of the "megalithic" world of ideas, or at least as clearly influenced by it.

Another key piece of evidence for this connection is the small group of grave constructions from Großeibstadt (Figure 8; location: Figures 2.1 and 10.1) (Koch 2014). The site is geographically half-way between a group of such monuments in central Germany and one in south-west Germany. Several small constructions with a trapezoidal layout are known from the latter area, such as those in Oedheim-Degmarn, Neckarwestheim and others (Figure 9), whose relationship and formal similarity with Großeibstadt has already been pointed out several times (Koch 2014, 229–30; Löhlein 1998, 206–07; Matuschik 2009, 85–86). Some of them are definitely funerary monuments, for the rest this can be assumed with high probability.

In the area of a large-scale rescue excavation in a gypsum quarry near Burgbernheim (Figure 2.6), a small post-built ground plan has recently come to light, which can be compared to some of these south-west German structures in terms of shape and size (Figure 9.1; location: Figure 10.2). Although there was no verifiable burial, the small amounts of bone fragments and a few cremation splinters from the area of the complex could perhaps serve as an indication of the site's possible function within burial events. Two stone cists of megalithic design from Gaubüttelbrunn, district of Würzburg (location: Figure 10.3), which have hitherto only been published as short notes (Bayerisches Landesamt für Denkmalpflege 1986, 40; 2006, 232) and whose further scientific study is eagerly awaited, could possibly also be seen in this context. Therefore, in northern Bavaria at the end of the fourth millennium, there are several finds that offer a glimpse as to the otherwise hard to characterise burial system of this time, albeit with some reservations and without being able to definitely elucidate their function.

Things do not look much better in terms of settlements. The most prominent place is of course the Altenberg near Burgerroth (Figures 2–3), which T. Link covers in detail in his article in this volume, together with the few more informative sites in northern Bavaria. Another settlement feature was discovered a few years ago just a few kilometres east of Burgerroth during the development of a commercial area near Gollhofen (Figure 2.4). It is a small ring palisade (Figure 11) with four square pit huts of Late Neolithic type (see Link, this volume). This is currently the only fully excavated Late Neolithic settlement from northern Bavaria (Beigel and Nadler 2014; Nadler 2019a, 704–05). Due to its special nature, the enclosure, and especially the pit huts, were examined and documented

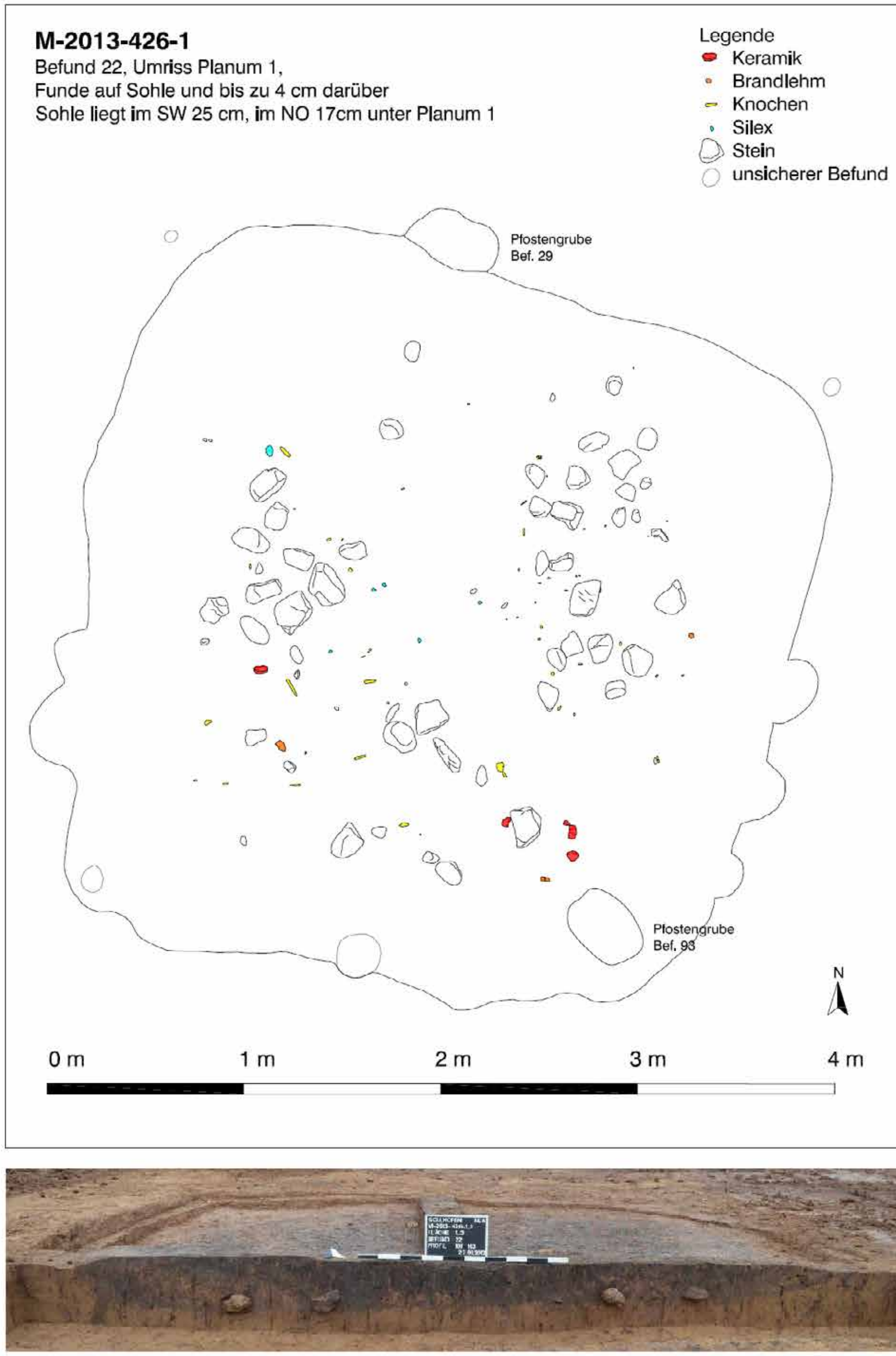

Figure 12. Gollhofen, district of Neustadt a.d. Aisch-Bad Windsheim. Pit hut no. 22 from the Late Neolithic palisade enclosure with depiction of the finds from the floor (drawing: R. Beigel).

in as much detail as possible (Figure 12). On the whole, they resembled the well-known feature from Schwanfeld (Lüning 1999). Despite the greatest care, the number of finds remained extremely low (Figure 13a–b), causing problems for the typo-chronological assessment. The pierced canid tooth (Figure 13b.2), the small bone chisel (Figure 13b.1), individual sherds with broom-roughened surface (Figure 13b.5) or the flint implements made mainly of tabular chert (*Plattenhornstein*) (Figure 13a) can be regarded as typical of the time. A large part of the flint tools were made on Arnhofen and especially Baiersdorf variants from the Danube region near Kelheim. The barrel-shaped vessel (Figure 13b.3) fits into the range of pottery found at Schwanfeld and Burgerroth (Lüning 1999; Spennemann 1985). Comparisons for the cup (Figure 13b.4) can be found in nearby Thuringia, for example in the Bernburg complex of Großobringen (Walter 1991, fig. 7.2).

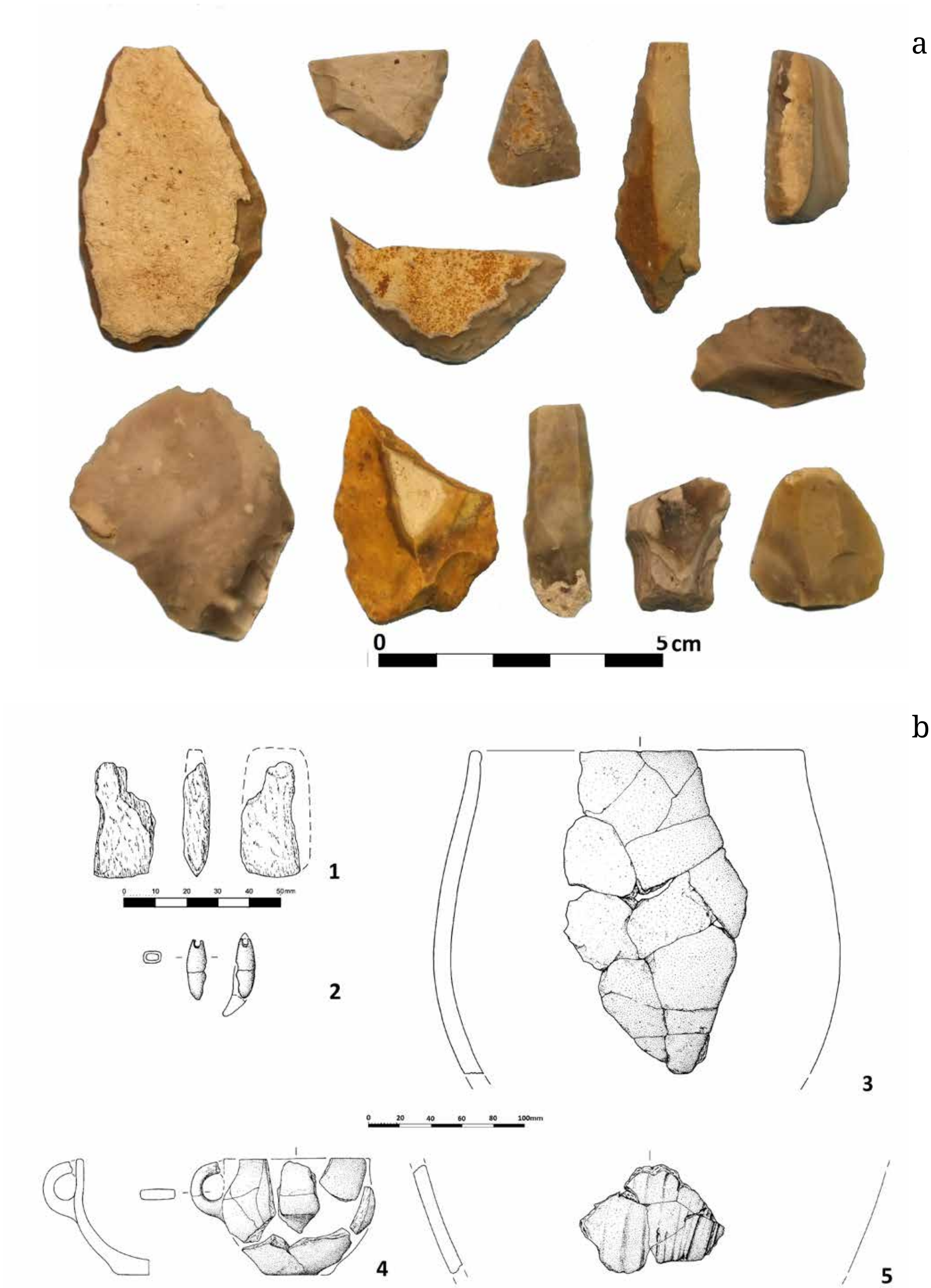

Figure 13. Gollhofen, district of Neustadt a.d. Aisch-Bad Windsheim; Late Neolithic palisade enclosure. a) flint artefacts (photo: M. Nadler); b) the most important finds from the pit huts: 1 bone, 2 teeth, 3–5 pottery (drawings: Y. Duan).

Since the chronology of the find material could be only roughly established through typological means, the only way out was to determine the age scientifically. In order not to sacrifice the few classifiable botanical remains, ^{14}C dates were obtained on charcoal, with samples in each hut taken from the infill and directly from the floor or the shallow hollows which, similar to Schwanfeld (Lüning 1999), were found in the side walls of two huts. However, these are not centrally located rounded depressions, as often documented elsewhere (see Link, this volume). There was also no evidence of a fireplace. A few shallow traces of posts at the edges or just outside the outline of the pit are likely to be from a light, tent-like superstructure.

Fortunately, despite the limitations of charcoal dates, the results from the four huts show a fairly coherent picture (Figure 14). Even if the dates fall on a known plateau in the calibration curve, and also considering the dates from Burgerroth, one could cautiously suggest that such hut structures were built in the region for at least

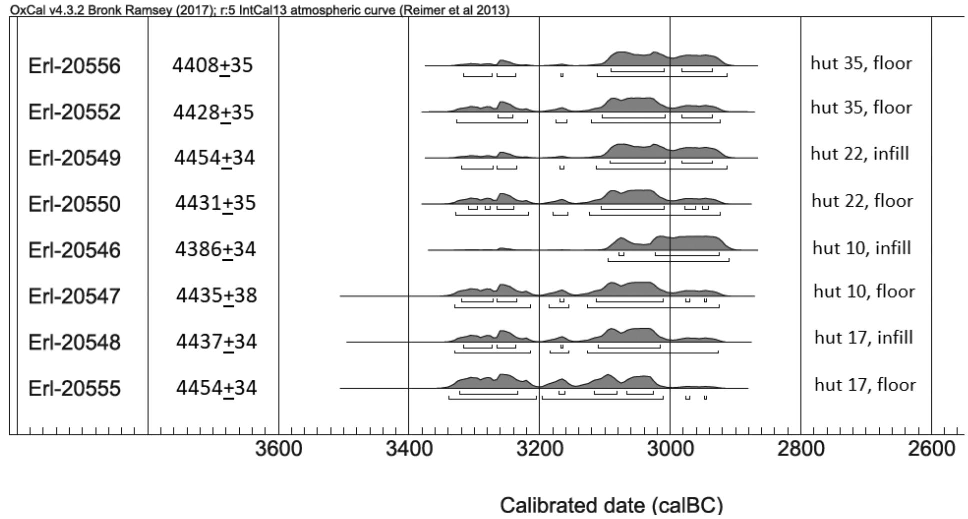

Figure 14. Gollhofen, district of Neustadt a.d. Aisch-Bad Windsheim. Radiocarbon dates from the pit huts of the Late Neolithic palisade enclosure, 2σ range (chart: R. Beigel).

half a millennium (see Link, this volume). The question of whether the four huts at Gollhofen were in use at the same time or were created in the course of repeated use naturally remains unanswered.

Similarly, the function or purpose of the Gollhofen pit huts also remains unclear. They seem rather unsuitable to form the main dwellings or storage features of societies practising a broad-based agricultural economy, especially since no storage or animal penning is possible or recognisable in these small buildings, a circumstance that G. Bersu already pointed out when presenting the Goldberg houses (Bersu 1937, 157). In my opinion, these are probably outbuildings for a variety of craft functions or activities in the area of a larger farmstead.

In this context, the southern interior of the palisade complex at Gollhofen is interesting, as a number of small post traces could be recognised, examined and documented by the excavators. However, given their rudimentary preservation and difficulties of identification, they were interpreted very cautiously. For the present author, it now seems reasonably certain that these are the remains of a building of light construction and with a trapezoidal layout (Figure 11) (Nadler 2019a, 705). There is no directly comparable ground plan, but there is a certain similarity to the somewhat younger Bell Beaker period houses from Klobikau, Saalekreis (Balfanz *et al.* 2015) and other sites in Saxony-Anhalt (Fröhlich 2019). Particularly similar light constructions have been documented for five house plans from the Schleenhain open-cast mine, which are tentatively attributed to the Bell Beaker complex (Conrad *et al.* 2018, 43).

For the chronologically closer sphere of the Corded Ware culture, a whole series of ground plans have been presented in recent years, including in central Germany, which show a completely different layout with a complex internal structure and changing numbers of bays within the building (as summarised in Friederich 2019). In order to bring more clarity to the formal structural development of this period, it will probably be worthwhile to look through older excavation plans lying dormant in the archives for possible building structures that have been overlooked up to now.

It should also be taken into account that in this period, construction methods that require no or only minor soil interventions are quite common. As examples, one can mention the contemporary houses and settlements of the south-west German Goldberg III group, which are only recognisable thanks to their preservation in wetlands (Schlichtherle 1999, 36–37), or the house locations in the Cham period settlement of Dietfurt an der Altmühl, which were determined only indirectly from the distribution of finds and hearths (Gohlisch 2001, 26–27).

The Gollhofen complex could therefore be something like an enclosed farmstead with one (or more?) main buildings and several functional outbuildings (namely the pit huts). However, the pronounced lack of finds indicates a rather short-term, marginal use, possibly as a seasonal, temporary base for a mobile, (partially) nomadic or transhumant population group. This is also indicated by the rather inconspicuous enclosure, which in its light and improvised appearance serves less as a fortification than as a cattle kraal, which was protected against wild animals by a fence made of thin sticks or brushwood.

Interestingly, its dimensions correspond to a number of small enclosures from the area of the southern Bavarian Cham culture, which have a comparable size and inner surface (Figure 15). Without being able to conclusively prove this at the current state of research, one could suggest that all these sites may have had a similar purpose as places of periodic and short-term use. Whether the Late Neolithic, presumably contemporary, fortified hilltop settlements such as Burgerroth, Goldberg and so on (see Link, this volume) are the corresponding central, permanently and densely populated places is

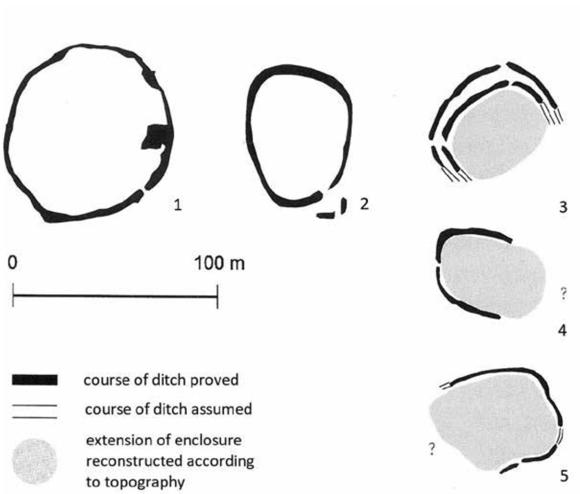

Figure 15. Small circular enclosures of the Cham culture. 1 Köfering-Scharwerkbreite; 2 Ergolding-Headham; 3 Hienheim; 4 Oberschneiding; 5 Obertraubling-Piesenkofen (after Nadler 2023a, fig. 17).

ultimately unclear, because the sometimes substantial accumulation of huts and other features in their interior may well be a palimpsest that reflects an unknown number of occupation phases.

As the situation in Burgerroth shows (see Link, this volume), Corded Ware elements are evidently adopted without any discernible cultural break. The new era manifests itself above all in the practice of the new, uniform, gender-differentiated single-grave custom. Groups of graves and regular grave areas (most recently Schussmann 2016) could be an indication of a stronger attachment to place.

Interestingly, quite a number of the few settlements in northern Bavaria that are definitely known to be Corded Ware are in defendable landscape positions or at higher altitudes (Nadler 2019a, 708). This is remarkable insofar as from the second half of the third millennium, with the increased appearance of the Bell Beaker complex, a structurally completely different settlement pattern emerges, which leads to the single farm structure of the Early Bronze Age, increasingly well documented at least for southern Germany. Obviously, at that time there was no longer any need or necessity to protect the farms and settlements in a conspicuous way (Nadler 2001, 45). Heights and sheltered locations are no longer chosen for settlement, and fortifications or other enclosures apparently no longer built — apart from the possibility of archaeologically undetectable markings or structural elements such as hedges, plants, and so on. Settlement activity has clearly shifted to the larger river valleys. On the extensive sandy areas in the foothills of the northern Franconian Jura, Bell Beaker sherds often indicate a pioneer occupation. Sites seem to reference the natural communication routes, as indicated by their location on the lower slopes and on the edges of lower terraces. A system of individual farmsteads with an associated group of graves is established. There were apparently no larger settlements, most of the sites are only indicated by a few surface finds.

As this article has shown, based on a few selected finds and features, the transition from the fourth to the third millennium BC in northern Bavaria is characterised by pronounced cross-regional connections in almost all spheres of life. These networks are likely to have significantly prepared and favoured the universal adoption and establishment of Corded Ware culture elements.

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Long barrows, causewayed enclosures and the long term spiritual continuity in ritual landscape around Mount Říp in Bohemia (Czech Republic)*

Jan Turek, Petr Krištuf and Ondřej Švejcar

** The authors dedicate this study to the memory of the outstanding scholar Ladislav Šmejda, who left us prematurely on 27th November 2022.*

Abstract

In two recent projects we focused on the possibilities of reconstruction of the ritual landscape and settlement areas in relation to Late Neolithic cemeteries and ancestral monuments, such as causewayed enclosures. Death as a social event was never isolated from other dimensions of the social, economic and symbolic life of farming communities. The ceremonial level of funerary events connected to ancestral worship is reflected in the landscape by a variety of monuments and their intra- and extra-territorial relations. The ritual landscape was constructed following a symbolic system of very early pedigree. The cultural landscape of prehistoric farmers was divided and structured in a continuous diachronic development and the archetypes of landscape divisions and monuments (enclosures; hilltop sites; long barrows) as landmarks were part of the cosmological legacy for generations. In this way, some monuments, seemingly isolated, fit into a much wider spatio-temporal structure of prehistoric community areas. This study presents selected case studies of the fifth and fourth millennium BC from the territory between the confluence of biggest Bohemian rivers and the mythical Mount Říp.

Keywords: Neolithic, ritual landscape, causewayed enclosures, long barrows, Bohemia

In this paper we try to reconstruct Neolithic ancestral worship and the representation of communal and personal identities in the monumental landscape of central/north Bohemia. Recently we have been focusing on causewayed enclosures (4300–3900 BC) and

In D. Hofmann, D. Mischka and S. Scharl (eds) 2025. *The eve of destruction? Local groups and large-scale networks during the late fourth and early third millennium BC in central Europe*, 173–188. Leiden: Sidestone Press.

long barrows (3900–3500 BC). We will demonstrate how Late Neolithic (Proto-Eneolithic and Early Eneolithic, in the Czech terminology) monumental constructions were re-used and incorporated in the development of new patterns of developing ritual landscapes in central/north Bohemia. Enclosures as well as long barrows have been commonly interpreted as religious and funerary sites, perhaps constructed as part of a system of ancestral cult. They can also be perceived as territorial markers delineating the areas controlled by different farming communities and seen as landmarks of previous habitation enduring for millennia after their construction (Andersen 1997; Bertemes 1991; Eckert 1990; Geschwinde and Raetzel-Fabian 2009; Kuna 2002; Neustupný 2006; Seidel 2008; Vencl 1997; 2002; Zápotocký 2000). In our view, Neolithic long barrows were not only funerary structures but also important ancestral monuments structuring prehistoric ritual landscapes over a long period of time.

Monuments in the landscape and monumental landscapes

The cultural landscape of prehistoric farmers was divided and structured in a continuous diachronic development and according to the earliest agricultural colonisation archetypes (in Bohemia for instance settlement preference of fertile lowlands along the major rivers and funerary areas on elevated terraces) of landscape divisions and monumentality. Neolithic enclosures and long barrows acted as landmarks and elements of the cosmological legacy for generations (Neustupný 2006; Turek 2012). We attempt to study the palimpsest of funerary and ceremonial land use in order to reconstruct the long-term perception of the farmers' world and its structure. In this approach some monuments, seemingly isolated, fit into a much wider spatio-temporal structure of prehistoric community areas. Micro-regional case studies will be presented from territories of central/north Bohemia covering the fifth to fourth millennium BC.

Causewayed enclosures

The ditched enclosures of the earliest Late Neolithic period, the so-called causewayed enclosures (*unterbrochene Erdwerke* in German), occurred in a vast area of central and north-western Europe, including Britain and Ireland, after the mid-fifth millennium BC. Regardless of the regional variability of archaeological cultures, there is an apparent phenomenon unifying culturally and geographically very distant regions. This fairly orthodoxly replicated form of monument is obviously related to a shared cosmological concept that has allowed the rapid spread of this phenomenon across continental Europe, southern Scandinavia, Britain and Ireland (Andersen 1993; Cassen and Boujot 1990; Hubert 1971; Mercer 1990; Mordant and Mordant 1972; Seidel 2008).

The real nature of rituals and social interactions that were taking place within these enclosed areas has been disputed amongst archaeologists for a long time. A significant factor influencing the spread of these monuments to the northern and western peripheries of Neolithic Europe was the Neolithisation process. Both in Britain and Ireland and in modern-day Denmark and southern Sweden, this is equated with the spread of agriculture (for example Andersen 1993). The builders of these enclosures were the first farmers to settle the previously purely Mesolithic environment. The original Mesolithic population had a subsistence and cosmology different from that of settled farmers, with a close bond with nature (Tilley 1989). In contrast, Neolithic farmers exploit nature and, through their culture and subsistence strategy, separate themselves from nature and actively transform it. Enclosure monuments are therefore part of the demonstration of cultural diversity and part of the establishment of the new order of the world.

In continental Europe, ditched enclosures appear in already established Neolithic communities, based on the thousand-year-long sequence of landscape domestication and sedentary thinking. Here, the first contact of Mesolithic (including pottery-producing foragers like the Limburg and La Hoguette groups) and Neolithic communities took place much earlier, in the mid-sixth millennium BC. After the mid-fifth millennium, this first stage of Neolithisation is followed by the Late Neolithic, a time of progressive changes in agricultural production, social structure and the application of the earliest copper metallurgy in Europe. At this time of the so-called secondary products revolution (Sherratt 1981), there were also certain changes in ritual concepts, which continued to be based on the principles of agricultural communities, but with increasing emphasis on the symbolism of bovine animals and masculine warfare symbols (battle axes). In Bohemia, ditched enclosures appear in the context of the later phase of the Jordansmühl (or Jordanów) culture. The ceramics found in some causewayed enclosures also feature elements of the Schussenried culture, as well as the oldest phase of the Michelsberg culture. This development is indicative of the chronological continuity of this type of enclosures regardless of the formal changes in the style of ceramic production. The latest of the earliest Late Neolithic causewayed enclosures in Bohemia is the one in Kly (Mělník district). This site has exclusively yielded ceramics of phase II of the Michelsberg culture.

If we evaluate the geographic position of the earliest Late Neolithic causewayed enclosures in Bohemia, most of them are located on river terraces. A similar situation was observed in Germany, where most sites are in locations with open flat landscapes and are enclosed by ditch circuits of oval shape, sometimes several hundred meters long. In

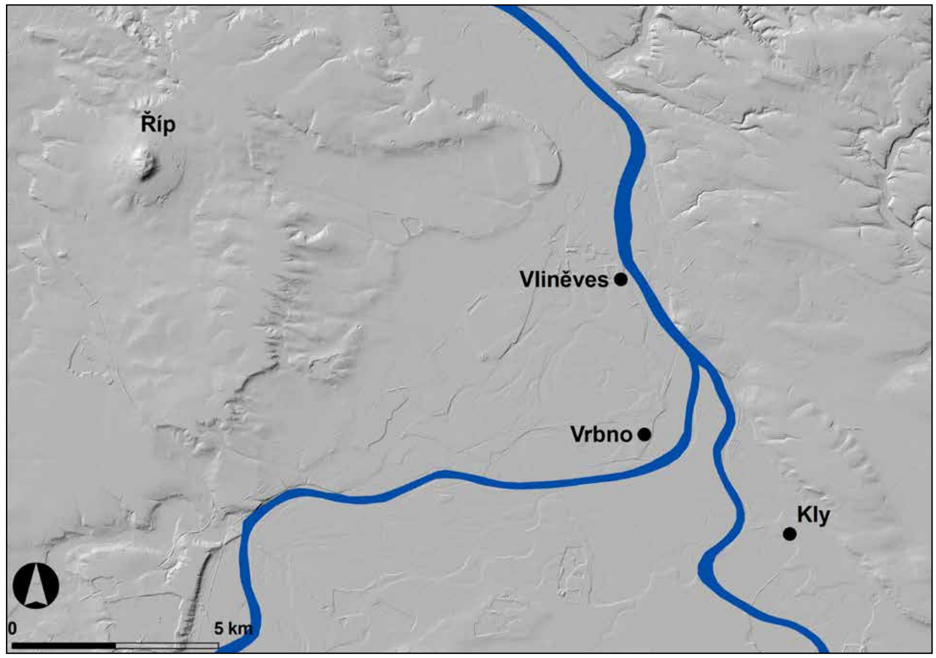

Figure 1. Map of the Late Neolithic enclosures around the confluence of the Elbe and Vltava rivers (edited by Petr Krištuf).

most cases, the geomorphological setting encloses the site only partially or not at all. An important phenomenon in the Czech Republic is the preference of flat areas near the main watercourses, even in cases where there are significant geomorphological formations nearby (such as hilltop sites used in later periods to build fortifications and fortified settlements). This is also the case for a trio of enclosures (Vliněves, Kly and Vrbno) at the confluence of the Vltava and the Elbe rivers, close to the dominant ridge stretching between Všetaty and Mělník with an important fortified early medieval site on its northern edge. Despite these landscape features, locations on the first terrace of the Vltava and the Elbe river were preferred for all three earliest Late Neolithic causewayed enclosures. All three of them are located just a few metres above the floodplain. Although these locations provided long-term protection against flooding, they are undoubtedly not the most strategically advantageous locations with fortification potential within the surrounding landscape. Rather, the trio of earliest Late Neolithic enclosures at the confluence of the largest Czech rivers are located on the divide between the open flat agricultural landscape of the area around Mount Říp (with the natural dominating feature of Říp) in the west and the rugged landscape of the Kokořín region in the north-east, which forms a wild hilly counterpart to the plain surrounding Říp. Mount Říp (the Czech mythical mountain) was in direct sight of all three enclosures, and it is likely that this circumstance played a significant role in their spiritual exploitation.

The significant concentration of three earliest Late Neolithic sites in the relatively small confluence area of the Labe and Vltava rivers leads us to re-consider the contemporaneity and the density of these sites in the landscape (Figure 1). Given the size of the causewayed enclosures, it can be assumed that the enclosures exceeded the needs of one community area and they probably served the activities of several communities within a wider region. The enclosures might have even maintained inter-regional social interaction. The fact that this enclosure concentration is located at the confluence of large rivers is certainly crucial. The Labe and Vltava rivers represented important landscape boundaries, but they also served as important communication corridors. At this point we have to discuss why three earliest Late Neolithic enclosures were created in such a limited space. The answer can perhaps be found in the chronological sequence of sites. The relatively short usage time, which is documented in Vrbno and Kly, and can also be assumed in the case of Vliněves, suggests that these constructions might have been built with the purpose of serving a particular ritual or series of rituals, not with the intention of stable long-term use. An interpretation of the successive establishment of these sites therefore seems plausible. Especially the enclosure at Kly (Figures 2–3) seems to be chronologically later and this is reflected also in a different style of material culture. Transferred into the terms of a living culture, one can suppose that after some time of upkeep by one community, a similar enclosure was built within another settlement area of this distinctive communication region, and thus a chronological sequence of inter-communal gathering monuments was established (Krištuf *et al.* 2019, 274–76).

Figure 2. Aerial view of the Michelsberg enclosure at Kly (photograph: M. Gojda).

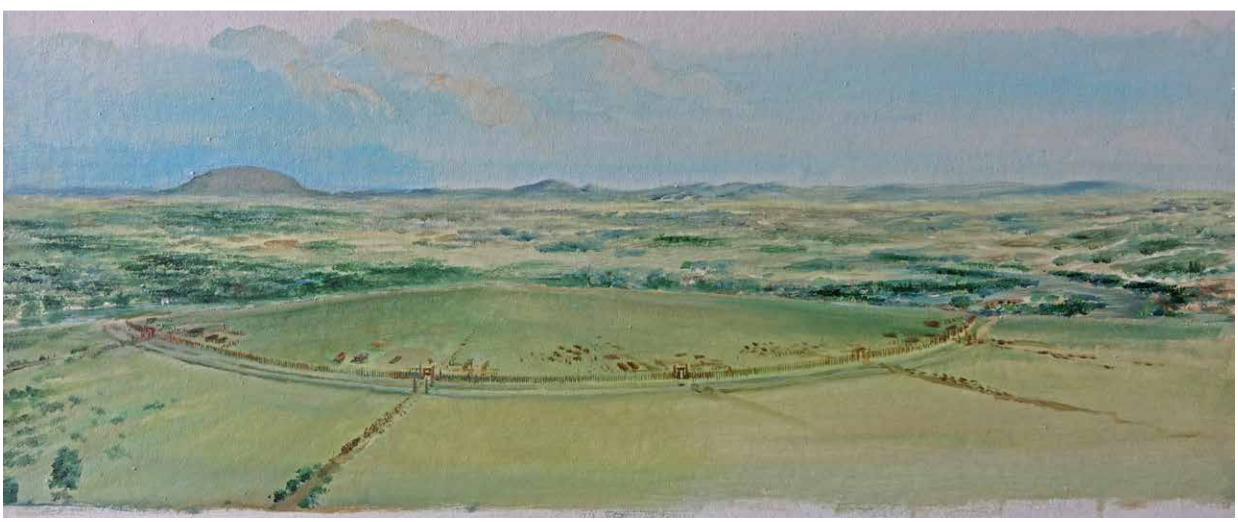

Figure 3. Reconstruction of the Kly causewayed enclosure on the bank of the Elbe river, with Mount Říp in the background (drawing by Jiří Svoboda).

Especially if we consider the funerary significance of the enclosures, it is also necessary to consider the spiritual significance of the place where the waters run from different parts of the country and where people, perhaps from distant regions, gathered for funerary ceremonies. Local communities within the mythical confluence landscape (ritual landscape) would thus be a sort of steward of a far-reaching, sacred district, in particular given that evidence of causewayed enclosures is generally scarce in other parts of central and north Bohemia. There are 15 sites in total, usually located in isolated positions (see the map in Dobeš *et al*. 2016, fig. 34). The only currently known cluster of causewayed enclosures was recorded in the aforementioned confluence area. In this respect, it would be interesting to relate the location of the enclosures to contemporary settlements. Unfortunately, the evidence from the nearby earliest Late Neolithic settlement of Mělník is rather scarce. In addition to the three enclosures, only 15 sites have been documented; most of them belong to the early Jordansmühl culture and three to the later phase of the Michelsberg culture. Earliest Late Neolithic settlement in the area of Mělník is clearly linked to both large watercourses (Elbe and Vltava river) and concentrates in Kralupy nad Vltavou and Neratovice. However, this picture may be only due to the state of research and the concentration of current construction activity. Nevertheless, while the evidence for earliest Late Neolithic settlement was recorded mainly near the Elbe and Vltava rivers, in the immediate vicinity of their confluence only the three enclosures are known (Krištuf *et al.* 2019, 276–77).

Although there are formal differences between the sites we studied, they can be considered as one category of constructions covering a similar area. When we talk about enclosures as monuments, one should bear in mind that, especially in a flat landscape, the banks of no more than 1.5 m in height did not create any monumental impression. Seen in the terrain, they optically rather merged with the surroundings. The palisade was not a monumental structure either and the posts erected at the entrances were probably part of a light construction rather than a structure in the form of fortification gates (Krištuf *et al.* 2019, 277). However, the monumentality of the causewayed enclosures is undoubtedly based in the length of their perimeter and the extent of the area covered. Thus, the monumental was mainly the impression of a large interior area intended for the gathering of a large number of people and perhaps even animals at a time of repeated (?) ceremonies (Krištuf *et al.* 2019, 278).

So what kind of activities took place in these enclosures? Given the nature of archaeological and pedological evidence, the method of construction of enclosures, their location and the presumed character of Neolithic warfare (as described by Neustupný 1996), we do not assume any residential or defensive functions. In line with a number of publications (e.g. Andersen 1997) evaluating the purpose of the earliest Late Neolithic enclosures, we rather consider a relatively wide range of ceremonial activities associated with the use of these monuments. It is well possible that these sites actually served as a space for a variety of ceremonial activities, ranging from drinking festivals, ceremonial exchange of goods and livestock, astronomical observations linked to the ritual and agricultural cycle to funerary ceremonies and ancestor veneration (Krištuf *et al.* 2019, 278).

Drinking festivals as formalised rituals, astronomic orientations and ancestral cults

Drinking festivals played an important social role within European agricultural communities at least from the beginning of the Late Neolithic period (Turek 2020). Also, some finds of drinking vessels (a variety of beakers, jugs and cups) inside the enclosure ditches suggest the possible connection of drinking ceremonies with these super-community sites. Feasts and drinking rituals, as well as ceremonial exchange, played an important role in social communication within and between communities. Such ceremonies helped to reinforce communal identity, as well as establishing communication and external relations with neighbouring communities (Dietler 1990; Dietler and Hayden 2001; Turek 2020). We consider the link between drinking ceremonies and enclosed areas as highly probable. Cyclical repetition of ceremonies can perhaps be assumed at Chleby. The four entrances of this enclosure are relatively precisely oriented to the cardinal points. The remaining eight entrances were regularly distributed, with two in each quadrant of the enclosure ditch. It is therefore possible that each gap was associated with the observation and worship of the sun in the various phases of the solar cycle. The number of twelve entrances is apparently not random and could be connected with the astronomical significance of the monument. The astronomical orientation of Late Neolithic enclosures is well documented in henge monuments in Britain and Ireland (Gibson 2005, with further references), but has also been discussed in the case of a rectangular TRB ditched enclosure at Makotřasy (Pleslová-Štiková 1985; Pleslová-Štiková *et al.* 1980). An astronomical orientation tied to the observation of sunset and sunrise is suggested for earlier Neolithic roundels (e.g. Goseck, Saxony Anhalt; Bertemes and Northe 2007). The focus on the solar cycle assumed for some enclosures, along with the worshipping of bucrania (such as at Bruchsal-Aue, Reiter 2005), perhaps represent two essential cornerstones of Late Neolithic religion. These symbols represent the basic subsistence prerequisites of prehistoric farmers, the vegetation cycle of cultivated plants and the management of cattle herds, and could therefore be seen as an integral part of the central sacred sites.

As cult places, enclosures could also be sought for the sacred legitimation of a wide range of economic and social interactions. The third and perhaps most significant aspect of Late Neolithic religion was the cult of ancestors, and its possible traces can also be identified in the earliest Late Neolithic enclosures. It is clear that the treatment of the remains of the deceased was amongst the ceremonial activities that took place in the earliest Late Neolithic enclosures, both in Bohemia, such as at Vliněves (Dobeš *et al.* 2016) or Chleby, and in Germany (e.g. Untergrombach-Michelsberg, see Nickel 1998; Bruchsal-Aue, see Reiter 2005) or Britain (Pietrzak 2014). In many cases, not only the burial of the deceased was documented, but also the manipulation of human remains, often even a long time after a person's death (Midgley 1992, 448–49). These practices seem to illustrate the role of enclosures in ancestral veneration, documented in agricultural communities since the beginning of the Neolithic period.

Undoubtedly, this is not the only burial practice in the earliest Late Neolithic. At that time, the dead were also buried in long barrows, whose genesis may have its roots already in the Early Neolithic in central Europe (Turek 2005). There seem to be two main ways of burial, either inside the house of the dead, that is a long barrow, which is a symbolic reflection of a small, closed social

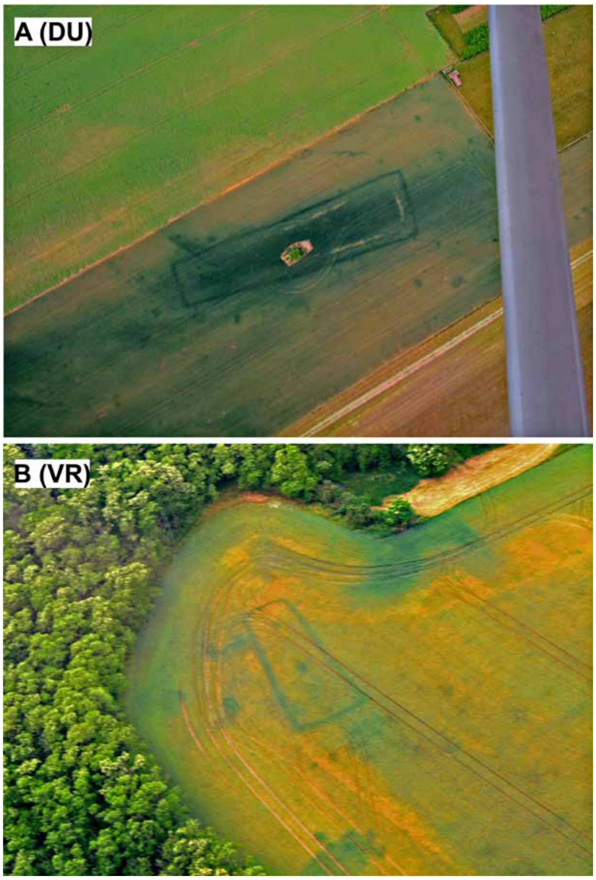

Figure 4. Aerial photographs of long barrows in Dušníky (A) and Vražkov (B) (photograph: Martin Gojda).

group (household/family) particularly emphasising local ties, or a public way of burial within the super-communal ritual space, emphasising a broader, shared cultural identity. Given the present state of knowledge of earliest Late Neolithic burial rites, we are not able to unambiguously identify the principles on the basis of which individuals or communities chose a person's place and manner of burial. The spectrum of treatment of human remains in the earliest Late Neolithic reflects considerable variability. There are inhumations in a crouched position, inhumations within settlement sites, skeletons or their parts in enclosure ditches, as well as cremation burials.

Despite this considerable variability, the archaeological record of earliest Late Neolithic burials is very scarce and it is obvious that the majority of the population was buried in an archaeologically invisible way. It is possible that some form of excarnation was common, and it is also conceivable that such funerary ceremonies may have taken place in the central super-communal areas, perhaps within the causewayed enclosures presented in this study. If this assumption is correct, then the skeletons and their fragments found in the enclosure ditches and pits are just the tip of the iceberg of a much more common funerary practice. Therefore, in the present state of knowledge, the most likely interpretation of causewayed enclosures is as super-community sanctuaries of death and ancestors that accumulated further social functions.

Long barrows as ancestral shrines — long-term spiritual traditions and legacies

Long barrows in Bohemia date between 4000–3300 BC (Neustupný 2008). Unlike the burials in contemporary enclosures, the barrows usually contain single burials, particularly emphasizing the familial local ties and more private and intimate relationships towards ancestors. The barrow recently excavated at Dušníky (Figure 4) is 86 m long and oriented east–west. Its width is 26 m at the eastern and 17 m at the western end. The mound was constructed of dark earth dug from alongside the barrow. Its current height is still around 1 m in the ploughed field. The barrow was built over a timber burial chamber containing remains of an eleven-year-old child. The chamber was made of wooden planks and contained a small jug (dating to the Baalberge phase of the TRB culture) and a flint arrowhead. After the primary burial and the completion of the barrow construction, the site probably served as an ancestral shrine. The evidence of sacrificial activity consists of several broken ceramic vessels near the eastern façade. Such ceremonial activity lasted up to 100 years.

The end of use of this sanctuary was manifested by the ditch surrounding the mound. It symbolically closes off the entire area of the monument. The sand extracted from the ditch covered the remains of the ritual place. After a certain period of time the mound was abandoned as a sanctuary and ritual activities moved elsewhere. According to radiocarbon dates, the mound or shrine was in use sometime during the thirty-seventh century BC. We have no records of any subsequent activities or further burials in the mound. It was not until around 600 BC, i.e. in the Iron Age, that an inhumation burial was inserted into the mound, the remains of which were discovered at the interface between the present plough-zone topsoil and the subsoil, just some 35 cm below the present surface.

A similar situation is recorded at the nearby site of Vražkov (Figure 4). The mound here is only 31 m long and significantly less well preserved. The mound cover has been completely destroyed. Nevertheless, we believe that its purpose was similar to that of the Dušníky mound. In addition to the primary grave, which is related to the construction of the mound, there is a second grave in the rear narrow part of the monument. The mound was again surrounded by a ditch, into which some of the earth from the mound, which was again black earth, gradually sedimented. The remains of a tulip beaker of the late phase of the Michelsberg culture were discovered in the centre of the eastern ditch. This is again evidence of ritual

Figure 5. Mythical landscape between the Mělník confluence and Mount Říp (photograph: Jiří Jiroušek).

activity in the area of the eastern forecourt and also an important clue for dating the structure. In addition, from this site we have no evidence of the use of the monument in the following centuries. This, however, changed in the Early Bronze Age, when a second burial was inserted into the mound. Its significantly shallower depth suggests that it was placed into the then surviving mound cover. Contemporary with this Únětice culture burial in the western end of the barrow, a hoard of 100 copper rib-bars was deposited into the north-east corner of the partially infilled ditch.

The most recently excavated mound in the Říp area, that at Račiněves, was of a different construction than the previous ones. It was rectangular and was not surrounded by a ditch. Its mound was reinforced with a wooden palisade. The barrow was over 120 m long and oriented east–west. In the eastern, entrance part of the mound we discovered the foundations of a building, sometimes referred to as house of the dead (Socha 2015). This is a remarkable and for us largely unexpected discovery. No such mound had ever been found in our region before.

Two burials were uncovered in this barrow. We know from the artefacts that the remains are from two different Neolithic periods. The main burial in the mound dates to the Funnel Beaker culture, around 3800 BC. We are not yet able to determine the sex of the deceased, as investigation is ongoing. The body was buried on its left side, head to the west. At this time, people did not distinguish the position of men and women in the burial ritual. What might give us a clue is the remarkable archery equipment. The deceased was carrying twelve flint arrowheads, which in the Late Neolithic period was usually tied to the gender role of the male. At this point, therefore, we assume that this was more likely the burial of an important man, a warrior, an archer.

A thousand years later in the Corded Ware culture, a woman was buried in the same mound, equipped with two jugs and a small sickle blade made of flint. She was laid on her left side, facing east, a typical position for female burials at that time. She was placed in an already abandoned mound, which was still clearly visible on the surface after thousands of years and which reminded the inhabitants of the area around Říp that their ancestors had lived there before them. Even a thousand years later, they understood the importance of the monument as a sacred place.

Re-use of monuments and long-term spiritual traditions

The archaeological evidence of human ritual behaviour recorded in the prehistoric cultural landscape suggests a great degree of palimpsest, the re-use of monuments and the keeping of *longue durée* patterns in the creation and continuity of ritual space. In what follows, we present some case studies of such transformation of the spiritual archetypes in terms of re-use and re-creations of Late Neolithic monuments in different prehistoric periods.

Elbe and Vltava confluence: chronological sequence of causewayed enclosures

Earlier in this text we have mentioned the concentration of enclosures in the area around Mělník, at the confluence of the Vltava and Elbe rivers (Figure 5). In this context, the rivers are the most important landscape element. Not only are they important thoroughfares connecting even widely separated regions, but on a symbolic and ritual level they are one of the conditions for the establishment of sacred enclosures. In the case of all three enclosures near Mělník, the watercourses can be considered as part of the enclosure of the entire sacred area. The rivers probably played an important divine role in this respect and may have been part of funerary and sacrificial rituals. The three enclosures were not contemporary. A relatively short time of use, which is documented in Vrbno and Kly, can be assumed also in the case of Vliněves (Dobeš *et al.* 2016). This suggests that these constructions could have been built with the purpose of serving a particular ritual or series of rituals, not with the intention of stable long-term use.

Figure 6. Aerial photograph of the Late Neolithic enclosure at Vrbno with three ditches and indication of the 2015 excavation (edited by Petr Krištuf).

Figure 7. Section through one of the Late Neolithic ditches of the enclosure at Vrbno (photograph: Ladislav Rytíř).

Therefore, the sites probably represent three subsequently built sacred complexes fulfilling the same functions and used by a larger number of communities. It seems as if the communities living near the confluence of the major rivers took turns in preparing the sacred area for a great trans-regional ritual. The oldest enclosure is the one in Vliněves (Jordansmühl culture), followed by the one in Vrbno (Jordansmühl culture) and finally the youngest one in Kly (Michelsberg culture).

Following this line of thought, we would be faced with the re-use of the ceremonial landscape near the sacred confluence of the great rivers. The temporal continuity suggests that people focused on this region as a crucial part of their beliefs and mythology. Within this sacred area along the holy rivers, the local inhabitants potentially hosted pilgrims from a much wider region. Gradually, they created at least three sacred districts which, one after another, served to maintain the cult and rituals important for the agricultural population of Bohemia at that time. This possible reading should in the future be backed up by additional evidence.

Vrbno — re-use of the causewayed enclosure

At the site of Vrbno (Figure 6) three ditch circuits were recorded (Krištuf *et al.* 2019, 160–70). The individual ditches appeared to be filled with mixed sandy clay and sunk into the gravel-sand subsoil. The outer ditch (1004) was U-shaped in cross section, 144–148 cm wide and dug only 34 cm deep into the subsoil. The ditch was filled with only one layer, consisting of light ochre-brown silty sand with pebbles (1005). Two fragments of pottery and a fragment of daub came from this layer. On the outer side of the trench was a gravel layer at most 18 cm thick, which directly overlay the subsoil. This layer was not identified anywhere else in the test trench and we suggest that it may represent material displaced during the excavation of the ditch. The maximum width of the middle ditch ranged between 110 and 190 cm, but quickly narrowed to 72 cm. The depth of the ditch ranged from 76–102 cm. The V-shaped open ditch thus became a trough with almost perpendicular walls. The fill consisted of a sandy clay layer and yielded three fragments of pottery and two fragments of animal bone. In the western profile the fill consisted of seven layers, which were deposited horizontally on top of each other.

The shape of the inner ditch followed the shape of the middle ditch (Figure 7). Its maximum width varied between 80–120 cm, however, in the eastern part of the test trench it was already visible in the subsoil and here its width reached 162 cm. Its depth was 100–108 cm and again it quickly narrowed to a trough-like shape with almost perpendicular walls. The fill consisted of sandy loam, gravel and sand. It yielded four fragments of pottery, two fragments of daub, two fragments of animal bone and two pieces of charcoal.

The general appearance and the macroscopically observed nature of the fills of each ditch led us to consider in the field whether the outer line of the enclosure might be chronologically different from the other two ditches. These differ from the outer ditch in size, shape and nature of the fill. The composition of the individual layers in the central and inner ditches indicates their relatively dynamic silting.

Also of interest is the evidence of a gravel layer entirely outside the enclosure with only a connection to the outer ditch. Pottery sherds, stone artefacts, animal bones and small charcoal fragments were recovered from the site during the course of the investigation. However, the assemblage is relatively poor and comes mainly from the ditch fills.

Pottery

In all layers of the middle ditch, there are fragments that are well above the assemblage average in size and weight. The size distribution of the sherds shows the distinctness of the outer and middle ditch fills. While the fill of the outer ditch has the character of a cultural layer with very fragmentary pottery, which was probably exposed to the elements for a long time, the much larger sherds of the middle ditch indicate either deliberate deposition or that material from a cultural layer was washed in without moving around for a long time. The pottery in the inner ditch is more akin to that of the outer ditch in its fragmentary nature, but sherds here were only found in the upper part of the fill. Shapeless small fragments of greywacke were identified in the topsoil and subsoil, as well as the outer ditch fill (SJ 1005) and in the upper layer of the inner ditch fill (SU 1008). In the lower parts of the ditches, the daub was not identified and does not appear to be related to ditch construction, but washed into the fills secondarily. Its origin may be seen in activities that took place on the site after the original function of the enclosure had ceased and the ditches had been partially filled in.

In our opinion, the finds from the lower layers of the inner and middle ditches are crucial for dating the ditches or the enclosure. As we have already noted, however, these layers are very poor in finds. Only two diagnostic ceramic fragments were recovered that would allow chronological classification of the site. These are a tunnel lug from the spout of an amphora, which was discovered in the lower part of the inner ditch. This can be tentatively placed in the early Late Neolithic. Far more reliable is the discovery of part of the higher neck of a jug with a broken-off handle from the lower part of the fill of the middle ditch. Between the neck and shoulder, there is an engraved decoration in the form of a horizontal ladder, followed by diagonally hatched triangles. The profiles and decoration of the jugs are typical of the later phase of the Jordansmühl culture. We therefore place the formation of the lower layers of both ditches into this culture. Other ceramic finds do not exclude this classification. Only one radiocarbon date has been recovered from the site. The dating of a charcoal sample was carried out by the laboratory in Kiel. The date obtained (KIA51306: 5318±34 BP, 4260–4044 calBC at 2σ) supports the classification of this enclosure site as earliest Late Neolithic, specifically the later phase of the Jordansmühl culture.

Pedological evidence

Since the quantity and nature of the archaeological finds and features do not allow a more detailed interpretation of the purpose of the enclosure and reconstruction of the activities carried out, we sought to obtain further information by means of pedological analyses of the fills of all three sections by Klement Rejšek (Krištuf *et al.* 2019, 160–69). The concentration of elements that show the presence of humans or could indicate the use of the ditches and enclosures for burials was analysed. Several basic questions were thus addressed. What led to the creation of these features? Is there evidence of human habitation or cattle rearing inside the enclosure? Were these features related to burial or were they spaces used only for occasional rituals?

In terms of distinguishing the nature of the fill and dating the outer ditch, it is important that elevated levels of manganese have been identified in layer 1005. Analytically, this is important data because the soil manganese content — just like copper, lead and zinc — remains stable in the soil over the long term due to both adsorption on the clay surface and the formation of insoluble sulphates and carbonates.

At the Vrbno site there is a limit of 500 $mg.kg^{-1}$ dry weight (limit = the value of the natural contents in the soil), which is exceeded by the topsoil layers and the fill of feature 1004 (layer 1005). Copper has a significant soil limit of 17 $mg.kg^{-1}$ dry weight, lead has a significant soil limit of 16 $mg.kg^{-1}$ dry weight and tin, which is used in bronze production, has a significant soil limit of 2 $mg.kg^{-1}$ dry weight. At the Vrbno site, the values of all three are again exceeded in the topsoil and in layer 1005 in feature 1004. The data obtained for tin, copper, lead and manganese indicate that the real source of their presence in the topsoil is intensive agriculture in the 1970s and 1980s. However, the situation in the outer ditch fill, which is also enriched in these elements, is interesting. This may be explained as a result of prehistoric metallurgy carried out in the vicinity of the ditch, which would suggest a Final Bronze Age date for the ditch.

The research carried out, despite its small areal extent, brings some interesting findings about the enclosure under study and also contributes to the interpretation of the purpose of these sites in general. First of all, the chronological classification of the site should be noted. The modest finds of pottery, especially a fragment of a jug, suggest a cultural affiliation of the enclosure to the later phase of the Jordansmühl culture. This classification is supported by the radiocarbon date. However, there were probably only two ditches at this time. These were relatively quickly filled in to about half their depth by erosion, and this was still the case during the earliest Late Neolithic use of the ditch.

Thereafter, both ditches stabilised and no further infilling took place. This state lasted at least until the Late Bronze Age, when the outer ditch was probably excavated in such a way that its course, shape and dimensions followed those of the already partially filled Late Neolithic ditches. The upper fills of the inner ditches and the entire fill of the outer ditch contain material from the Štítary phase of the Knovíz culture and the presence of metal elements related to Bronze Age metallurgy has been detected. Pedological analyses suggest that the use of the site was not very intensive in the earliest Late Neolithic, or that there was not a large accumulation of waste. A residential purpose for the enclosure is therefore highly unlikely.

The enclosure at Vrbno shows us that the traces of earliest Late Neolithic enclosures were often visible on the surface for hundreds to thousands of years and were perceived by many later generations. It seems that the monumental construction of the enclosure was well visible until the modern era, including elevated parts of the banks. It is therefore well possible that the sacred place of the enclosure remained in people's memory for millennia after its abandonment. Over most of the third millennium BC, people did not create or re-use ditched enclosures, but since the Early Bronze Age we can see a certain level of re-introduction of enclosures into the cultural landscape. The site of Vrbno was probably repeatedly re-used, including in the Final Bronze Age (c. 950–800 BC), more than three thousand years after its construction.

Re-use of long barrows

For all mounds we have examined in the Říp region (Figures 8–9), a similar pattern of use was discovered. They were built some time between the thirty-ninth and thirty-seventh centuries BC. These are always structures built above the burial of a single individual with different social status (child, adult warrior). The eastern end of the mounds served as a ritual place for some time, but there is no evidence of further burials added to the mound by its builders. Thus, these are not collective family tombs, as some have previously suggested (Midgley 2005; Neustupný 2001, 204–05), but rather ancestral shrines built to mark the death of a selected member of the community. Although the artefacts suggest that these shrines were

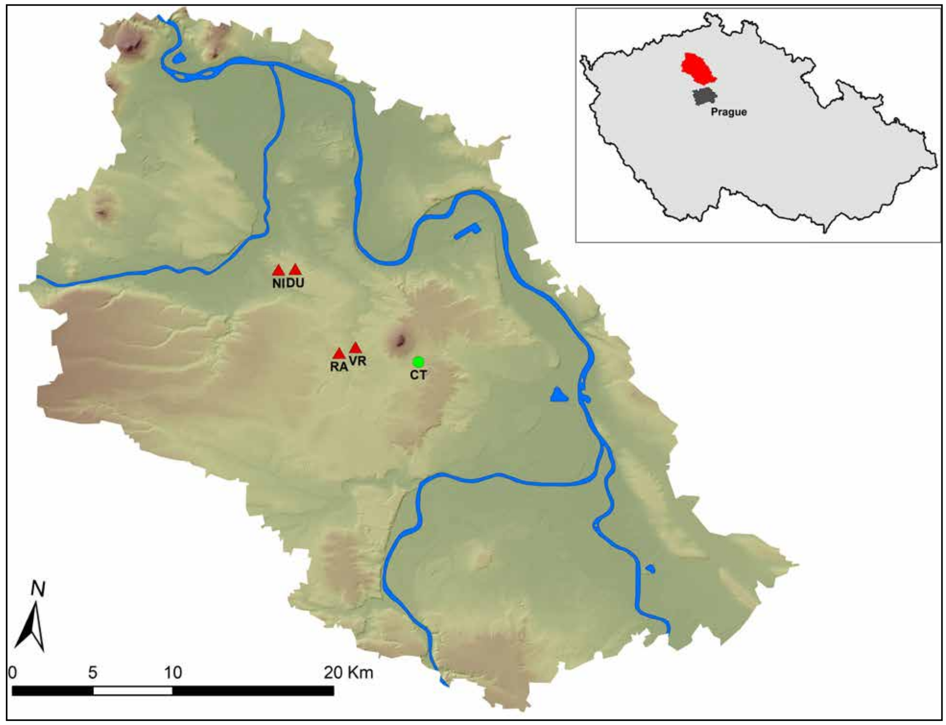

Figure 8. Map of the long barrows of the Funnel Beaker culture (DU – Dušníky; NI – Nížebohy; RA – Račiněves; VR - Vražkov) and the Globular Amphora culture (CT - Ctiněves) in the Mount Říp region.

Figure 9. Superposition of a shrine in the eastern part of the Funnel Beaker culture long barrow at Račiněves and a grave of the Corded Ware period (in the middle of the photograph), inserted c. 1000 years later (photograph: Martin Mykiska).

Figure 10. Foundations of the shrine in the eastern façade of the Funnel Beaker culture long barrow at Račiněves, with Mount Říp in the background (photograph: Jan Turek).

only used for a limited period of time, and some were then ritually enclosed by ditches, we have indications that they remained spiritually significant over several millennia. Chemical analyses of the soil around the long barrows show that these areas were not used for everyday activities such as inhabitation or agriculture even thousands of years after the mounds were built (Krištuf *et al.*, unpublished results of current project). Although the mound builders did not use them for subsequent burials, their later successors did (Figure 9). In all excavated mounds later secondary use in form of additional burials was recorded, but this is separated from the initial construction period of the mound by at least 1000 years, sometimes even 3000 years. Long barrows seem to have been an important part of the cultural landscape for a long time, structuring its perception. Mound builders and their immediate followers perceived the site as sacred, associated with ancestor worship, but adding more burials was perhaps taboo. Over time, however, the perception of the mound changed. After a certain period of time, the direct link and memory of the ancestors who built the mound was lost and only the mound itself, and in some cases the surrounding ditches, remained visible. It was perceived by many cultures as the burial place of important ancestors, and these ancestral monuments were re-used for burial purposes by other cultures, some of which also buried their dead under barrows (Krištuf and Švejcar 2013; Turek 2021).

Most long barrows have one primary burial for which they were built. The more sites we have explored, the more our conviction grows that these were not just simple tombs, but that they served as memorials to the communities that built them for a long time. People went there to worship and commune with the souls of their ancestors. We imagine these places were frequently visited and votive offerings were repeatedly deposited here. People gathered there at certain times of the year and held celebrations there (for example at the solstice). We have found remains of pottery vessels, animal bones and so on testifying to such use.

Mount Říp plays a quite exceptional role in the whole region (Figure 10). It is a kind of landmark, a place that structures the landscape, showing the way to central and northern Bohemia. It is located between two important confluences, that of the Elbe with the Vltava and of the Elbe with the Ohře. There is less evidence of long-term settlement, but a number of burial mounds and burial sites as such have been found in the area. It seems that this hill, which much later became the mythical mountain of the Czech nation, already attracted the attention of people in prehistoric times and was sacred to them. It is not surprising that shrines and tombs were built near Říp, which may have been a deity in its own right and where many ceremonies and rituals probably took place.

Conclusion

Death as a social event was never isolated from other dimensions of the social, economic and symbolic life of farming communities. The ceremonial level of funerary events connected to ancestral worship is reflected in our case study area through the variety of monuments and their intra- and extra-regional relations. In our ongoing project we investigate the dynamics and duration of the monumental traditions in Bohemia represented by the sequence of ancestral worship and its changing forms. The crucial three stages that create a distinctive cosmological continuity can be summarised as follows:

4300–3800 BC: causewayed enclosures. These represent a public way of burial within the super-communal ritual space emphasising a broader shared cultural identity. As we mentioned above, these monumental enclosures served several communities from a fairly large region, with significant connection to main river courses. Big rivers were not only the means of people's mobility, bringing worshippers together during collective ceremonial festivals, but were often perceived as sacred themselves. The funerary function was not the only, nor the primary function of enclosures, but the manipulation of ancestral relics was an important part of the ceremonial activities practised there. Despite the limited time of periodical use of enclosures, their sacred legacy was sustained for a very long time. More than three millennia after their abandonment, we can see the evidence of re-use of the sacred area for ceremonial purposes.

4000–3300 BC: long barrows. These burials particularly emphasise the familial local ties and more private and intimate relationships towards ancestors. The long barrows in fact served only for burials of a very limited number of persons in the community. In most long barrows in Bohemia, only burials of single individuals were recorded, with no sign of any collective funerary use of the monument. However, long barrows with initial burial of an important community representative were used as collective monuments of ancestral worship by people expressing their relationship with this clan/familial identity. Long barrows are important landmarks in the prehistoric ritual landscape, structuring the perception of space and carrying the memory and legacy of deceased ancestors. Thanks to their visibility in the landscape, awareness of the dead ancestors persisted for millennia. As such, long barrows are good examples of artefactual memory (Neustupný 2010, 195–96). These monuments are material reminders of important events in the past and carry the memory of dead ancestors.

2900–2300 BC: individual burials and natural shrines. Single burials under round barrows of the Corded Ware and Bell Beaker cultures emphasise personal identity (such as gender) and social differentiation. The tradition of ancestral shrines was terminated in the Corded Ware period and we can see a new trend towards creating natural shrines with evidence of ancestral worship in the form of offerings (Turek 2022a). New discoveries of Bell Beaker ritual structures suggest a possible return to some kind of ancestral shrines, possibly referring to the ancestral sacrificial function of the earlier long barrow sanctuaries (Turek 2022b).

The archaeological evidence of the Late Neolithic and later developments of ritual behaviour in the landscape suggest the existence of *longue durée* processes and archetypes of human spirituality.

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The third millennium BC in the German lower mountain ranges: are social ties falling apart?

Clara Drummer

Abstract

In the light of recent discussion on migrations and aDNA, the example of the German lower mountain ranges during the transition from the fourth to the third millennium BC will be used to examine the extent to which migrations are visible in the archaeological material and how social connections changed during this transitional phase. To achieve this, findings on changes in pottery decorations and pottery use will be presented, as well as studies on personal ornaments as a means of expressing social roles. Furthermore, social networks are reconstructed on the basis of these ornaments and their development explained. Additional observations, such as changes in aDNA, technological changes and the increasing representation of weapons and warriors, are drawn upon to explain how the expression of social identity changed during the Final Neolithic. It is argued that social ties did not dissolve, but that the focus shifted to the social status of individuals and their importance for social networks.

Keywords: central Europe, German lower mountain ranges, Corded Ware culture, social networks, third millennium BC, social transformations, migration debate

Old ideas in new guises: aDNA studies and the migration debate

The spread of Indo-European languages has often been interpreted as the consequence of massive migrations from the north Pontic steppe to central Europe during the Final Neolithic. This has been tied to Yamnaya and Corded Ware graves because of their similarities in burial practices and grave architecture. The uniformity of the Corded Ware across Europe and Eurasia, as well as its connections to Yamnaya graves, had already been linked to linguistic developments by various researchers at the end of the nineteenth century and consistently since, amongst them G. Kossinna, M. Gimbutas, J.P. Mallory, D.W. Anthony and K. Kristiansen (Drummer 2022, 27–28; Kaiser 2017, 193–94, 198, 202, 214–15).

This historic debate of archaeologists and linguists has been reignited by the aDNA-studies of the last decades. The papers by M. Allentoft and colleagues (2015) and W. Haak

In D. Hofmann, D. Mischka and S. Scharl (eds) 2025. *The eve of destruction? Local groups and large-scale networks during the late fourth and early third millennium BC in central Europe*, 189–208. Leiden: Sidestone Press.

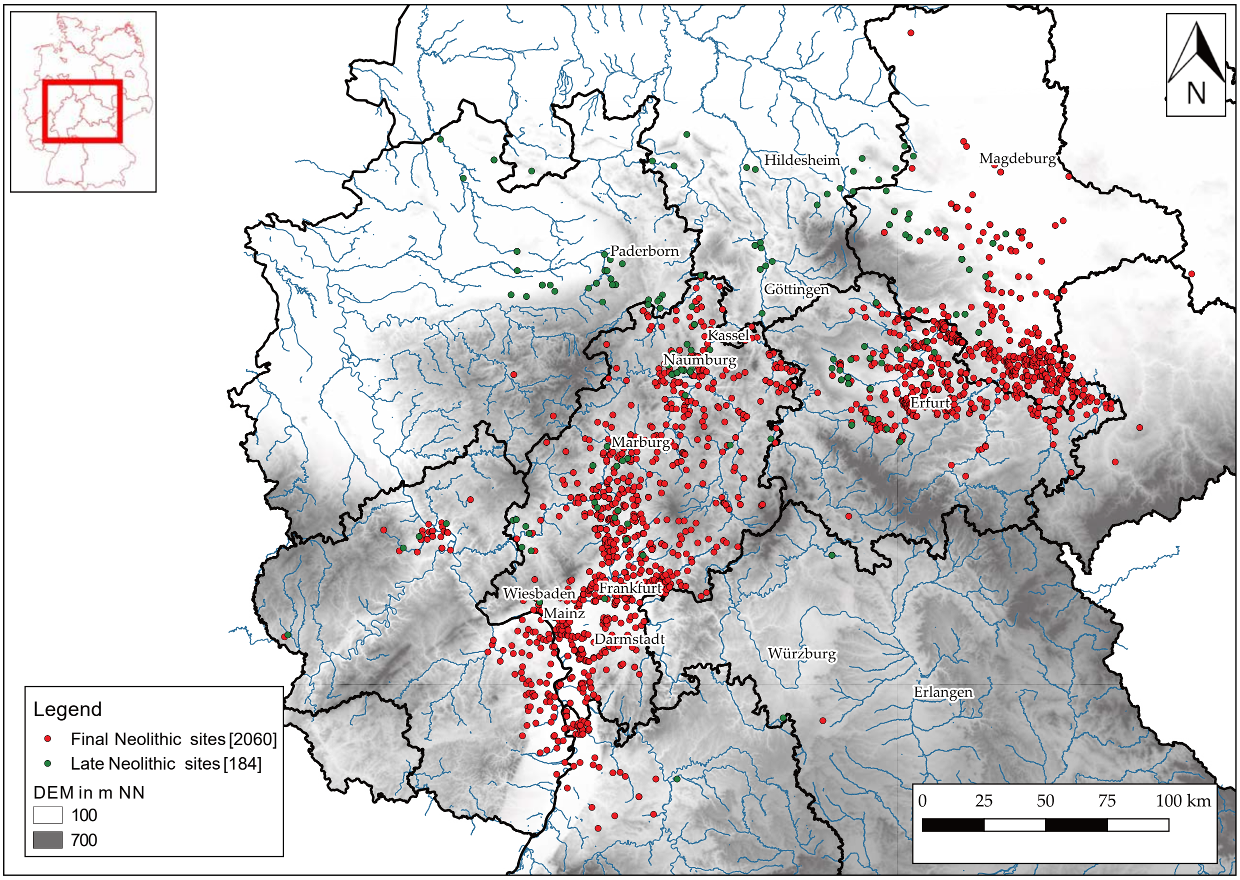

Figure 1. Investigated sites dating between 3500–2200 BC (based on Drummer 2022).

and colleagues (2015) suggested that the pan-European spread of Corded Ware groups was caused by massive migrations from the north Pontic steppe, based on the similarities of aDNA between regions. In spite of criticism of an overall generalisation and the lack of integrating local and regional studies (e.g. Furholt 2018; Kleijn *et al.* 2017), less emphasis had been laid on the social relations of the involved groups and how they may have been affected by migrations (Drummer 2022, 24–30, 209–22).

Therefore, the question of how the social relations of groups were influenced during the transition from the Late Neolithic to the Corded Ware culture is a focus of this paper, which aims to provide insights into what kind of formation of new group identities can be seen in the archaeological record. To this end, it combines different lines of evidence, such as pottery styles, indicators for migrations and results from aDNA studies. The main focus are personal ornaments as grave goods and the reconstruction of social networks based on their appearance in Late and Final Neolithic graves in the central German lower mountain ranges. Before this, a short introduction to the area of research and the local pottery groups is provided.

The third millennium BC in the German lower mountain ranges

There are now several regions where links between Corded Ware sites and local predecessors have been documented in the archaeological record. One of these is the central German lower mountain ranges (=GLMR), including the Main Valley near Frankfurt (with the Upper Rhine plain and the Wetterau region) and the surrounding hills in the centre of Germany (Figure 1). The western hills and mountains are the Westerwald, Rhenish massif and Rothaar mountains. In the centre of the study area are the East and West Hesse highlands, with the West Hesse depression. Next to the East Hesse highlands are the Knüll and the Vogelsberg mountains. In these topographically heterogeneous regions, local Late Neolithic groups are defined by different pottery styles. Amongst them is the local Wartberg pottery group, which is partly contemporary to Funnel Beaker or Pitted Ware groups in the northern parts of Europe and to southern German and circum-Alpine pottery styles such as Horgen and Cham (Figure 2).

The Late Neolithic archaeological record in the GLMR is dominated by grave finds. The Late Neolithic

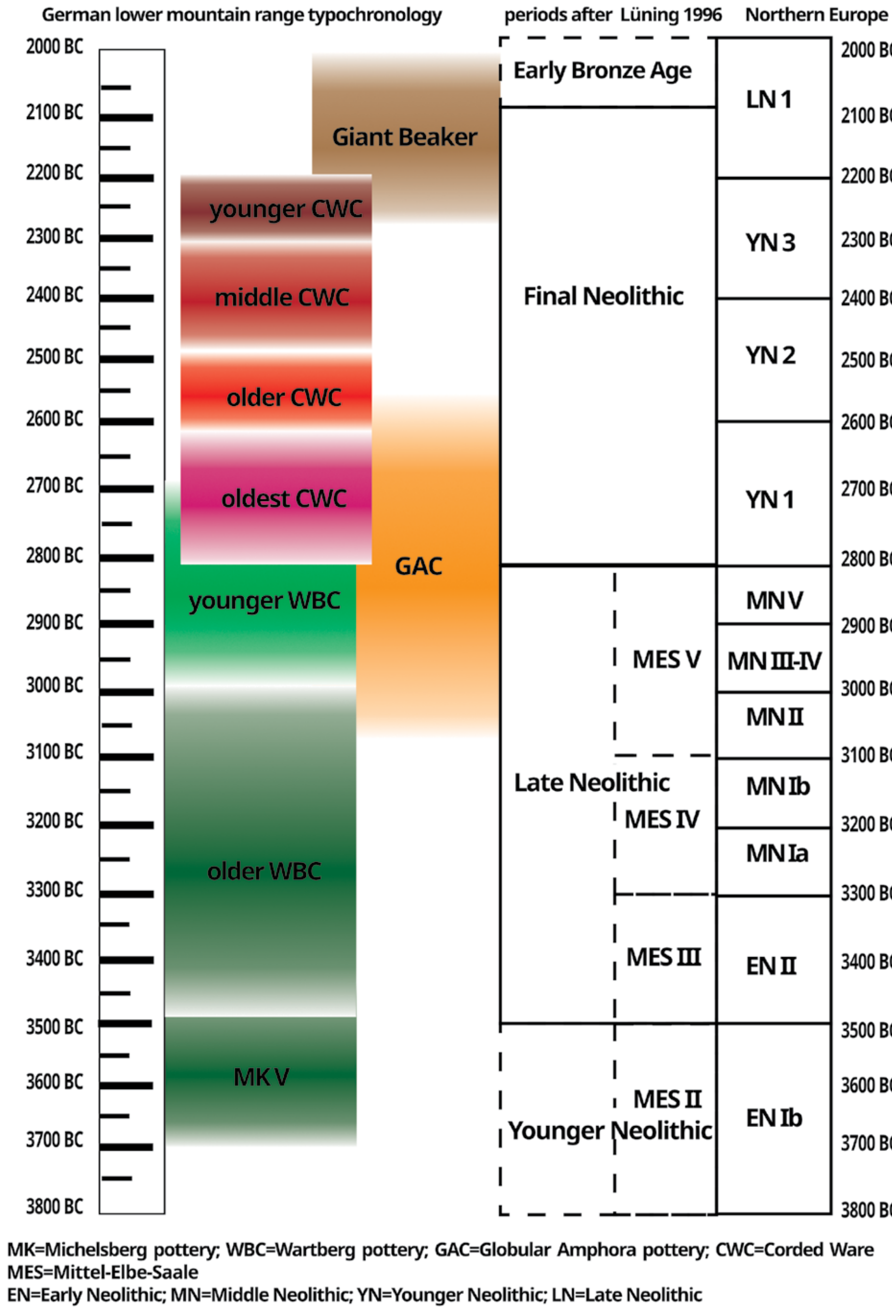

Figure 2. Typochronological development in the German lower mountain ranges (WBC and MK after Raetzel-Fabian 2000, 173–75; GAC after Furholt 2003, 16 tab. 2.54; Woidich 2014, 172–73; CWC after Großmann 2016, 112 fig. 5.27; Giant Beaker after Hartz and Müller 2017, 36–37; periods for northern Europe: Kirleis *et al*. 2012, 222 fig. 45).

Wartberg and Bernburg pottery styles are mostly found in collective graves (Figure 2). In some of these graves remains of Globular Amphora and Corded Ware pottery and axes were found, which raised the question of a transition period between the Late and Final Neolithic (Raetzel-Fabian 2002a).

The Late Neolithic groups, here in particular the Wartberg group, are mainly characterised by their megalithic collective graves and undecorated pottery (Raetzel-Fabian 2002b, 6–8 fig. 1). These collective graves contain the remains of up to several hundred human individuals, as well as mostly undecorated coarse ware and cups (Schierhold 2012, 65–66, 75–78, 153–54). The few known settlements (n=24) with Wartberg pottery are poorly preserved and therefore less is known about settlement structures (Drummer 2022, 39 fig. 6; Pollmann 2007, 46; Schierhold 2012, 152). Pit structures have occasionally been found and interpreted as houses (Dirks 2000, 99; Schierhold 2012, 152–59). Their locations vary from lowland settings (e.g. Wittelsberg; Fiedler 1991, 26) to hilltop settlements (Pollmann 2007, 46; Schierhold 2012, 152). In contrast, Final Neolithic sites concentrate in the lower-lying areas near Frankfurt as well as in the eastern part of the research area and consist mainly of single burials associated with beaker pottery (Wiermann 2004, 46–50 fig. 2).

Typical for the Corded Ware culture are single graves under burial mounds with flexed inhumations in gender-differentiated positions, and with grave goods such as beakers and personal ornaments (Furholt 2019, 4 fig. 1). Females are generally placed in a flexed position on their left side with their heads to the east and looking south, while males are laid on their right side with head to the west and looking south. Their orientation is along the west–east axis (Wiermann 2004, 49). In total more than 1500 graves are recorded for the Final Neolithic, while only 25 settlements are known (Drummer 2022, 60 fig. 15). As with the Late Neolithic sites, their preservation, which is influenced by soil conditions and erosion, hinders the interpretation of internal settlement structures (Hecht 2007, 245; Hille 2012, 69; Wiermann 2004, 50).

The Globular Amphora culture (=GAC) is a pottery style which is found in Late and Final Neolithic contexts in this region. Given the ^{14}C-calibration plateaus, this pottery group can only be roughly placed around 3100 to 2600 calBC (Figure 2). The characteristic pottery, decorated amphorae, is found in graves and settlements (Woidich 2014, 12–35) and sometimes appears together with other pottery styles. The GAC has been referred to as an own group based on its wide distribution and regional differences. Usually burials with GAC pottery consist of single graves with stone cists, but multiple burials and cremations are also known (Müller 2001, 193; Szmyt 2002, 210; Woidich 2014, 107).

In addition to human burials, cattle were famously also buried in graves across the wider region of central Germany (Montag 1994, 220). The finds of cremations and cattle burials can be seen as one reason to treat the GAC as an own social group with a different burial practice instead of interpreting it as simply a specific pottery style at the end of the Neolithic (Szmyt 2003, 401, 431; Woidich 2014, 89–95, 214).

The changes in burial practices from collective graves to single graves with gender differentiation, alongside the change from coarse undecorated pottery to decorated beakers, are some of the reasons why the Final Neolithic is referred to as a substantial change in the archaeological material (Quiles 2017, 210–11; Raetzel-Fabian 2002a, 1–2, 12). However, this region has so far not been included in large-scale aDNA studies, despite these transformations and the geographical proximity to famous sites such as Eulau (Schroeder *et al.* 2019) and other graves from which samples were taken (amongst them: Esperstedt, Quedlinburg [Haak *et al.* 2015] and Halberstadt [Lipson *et al.* 2017]). Although not every burial can be considered for aDNA sampling because of preservation and simply costs, a region where Corded Ware and local Late Neolithic groups co-occur should be included in the debate surrounding the changes at the end of the third millennium BC. A possible reason that this has not happened lies in the research history of the central German lower mountain ranges, which will be briefly introduced next.

Local research history and new approaches

The study of pottery styles in this region has a long research history going back to the discovery of the megalithic graves in the eighteenth and nineteenth century and with a peak in the early twentieth century (Schierhold 2012, 6–7). The first description of Corded Ware pottery in central Germany was already published in 1884 (Großmann 2016, 33). These early discoveries were paired with attempts at placing them into the typological development of pottery styles, which was not yet established at this time. Naturally, chronological and stylistic developments were the focus of researchers and with the advent of more advanced dating methods the refinement of chronologies was emphasised (Großmann 2016, 36). Socio-cultural questions became more important (for example Müller 2001) along with the increasing criticism of archaeological cultures, followed by questions on social structures (Drummer 2019, 46). Although new excavations and finds were published, research which focused on the social transformation between Late and Final Neolithic in this region was lacking (Drummer 2019, 46).

In the attempt, some challenges had to be overcome. The first challenge was the distinction between Late and Final Neolithic sites per se, as this differentiation is based on the different pottery decorations and systematic comparisons between Late and Final Neolithic groups were not made. Traditionally, scholars focused only on the distinction of pottery decoration between Late and Final Neolithic sites and assumed that these reflected distinct social or cultural groups. In contrast, in this work, neither were definitions of social groups based solely on pottery decorations, nor was a distinction in the sense of a chronological break made between Late and Final Neolithic. Instead, ceramic plurality was considered as one possibly contemporary mixture of styles with local differences, where different styles may have different regional and chronological distribution foci (Drummer 2022).

The second challenge was that building an absolute chronology is hampered by the ^{14}C-calibration plateau, so that an exact chronological development cannot be reconstructed for the transitional phase based on ^{14}C-dates. ^{14}C-dating cannot per se distinguish between the re-use of a Late Neolithic site after a break, or a smooth transition at the same site (Drummer 2022, 63–65). Every date, even if it did not fit the expectation, was included in this study (except for those exhibiting sample quality issues, such as insufficient data quality and failed control tests).

Although the use of a different pottery decoration was often seen as the only necessary indication of different group identity (Bernbeck 1997, 231–50; Jones 1997, 110–12; Sackett 1977, 377–79; Schortmann 1989, 56; Zeeb-Lanz 2003, 246–47), in this article it was considered as only one possible part of expressing social group identity. Groups can perform their identity through different media, and not all groups necessarily use the same medium (Drummer 2022, 17–20).

As an attempt to investigate if some pottery decorations were preferred or neglected in the study area and to see if there are geographic differences that could indicate different group identities, the amount of different pottery decorations per site and their association to a pottery style were researched. It could be observed that choices were made depending on the kind of site (settlement or grave) and also between local and non-local pottery styles in different regions.

The distribution of different pottery decorations (Bernburg, Elb-Havel, Globular Amphora and Corded Ware pottery) in Late Neolithic sites shows that some sites contain non-local pottery, such as Bernburg pottery in typical Wartberg graves. While the local Late Neolithic pottery (Wartberg or Bernburg) dominates in the material of typical Wartberg or Bernburg graves, the respective other, non-local style was also present in some of the collective graves (Table 1). Because the total sum of pottery cannot be counted based on publications and existing catalogues, the counts of non-local pottery in relation to the unknown amount (=99) of local pottery were given. But always a few non-local pottery decorations are found in both contexts — graves and settlements (Table 1).

While non-local Late Neolithic pottery decorations (Wartberg or Bernburg) are commonly found in settlement contexts, Corded Ware is absent in Late Neolithic settlements, but mainly found in Late Neolithic grave contexts. Globular Amphora decoration is found in both graves and settlement contexts. This can be interpreted as a distinction between burial practices and settlement activities (Drummer 2022, 77–78), as it appears that choices regarding preferences for certain pottery decorations were made depending on the context. It supports the argument that Corded Ware activities in collective graves are more widespread than previously stated (Raetzel-Fabian 2002a, 11 fig. 7), thus underlining the existence of a transitional phase, where Corded Ware decorations on pottery were used in Late Neolithic collective graves.

Site type	Site name	WBC	BBC	EHC	GAC	CWC
Collective grave	Altendorf	99				4
	Warburg I	99				2
	Henglarn II	99				1
	Rimbeck	99				1
	Wewelsburg I	99			6	1
	Hiddingsen	99			1	
	Hohenwepel	99			1	
	Lohra	99	1	1		
	Muschenheim	99				5
	Niedertiefenbach	99				1
	Züschen I	99				6
	Börnecke		99			1
	Ditfurt		99			1
	Frohndorf		99	1		
	Gotha		99	1		
	Latdorf		99			1
	Mittelhausen		99	1		
	Niederbösa		99			1
	Schönstedt	1	99			
	Wandersleben		99	1		
Sum for graves without 99	**40**	**1**	**1**	**5**	**8**	**25**
Settlement	Bürgel bei Gudensberg	99	15	8	4	1
	Wartberg bei Kirchberg	99	8	1	2	
	Güntersberg	99	7		2	
	Hasenberg bei Lohne	99	5	2	1	1
	Wittelsberg	99	1	1		
	Hungen-Inheiden	99				
	Calden	99				
	Odenberg					
	Lich					
	Wiesbaden Hebenkies					
Sum for settlements without 99	**59**		**36**	**12**	**9**	**2**

Table 1. Number of decorated sherds of a given style in graves and settlements in the study region. WBC = Wartberg pottery; BBC = Bernburg pottery; EHC= Elb-Havel pottery; GAC = Globular Amphora pottery; CWC=Corded Ware pottery; 99 = indefinite number (data after Drummer 2022, 76 tabs 13–14).

Regional case study for social transformations

Since Final Neolithic pottery styles occur in Late Neolithic contexts, the question arises if these reflect two different group identities or if this is one group that changed its identity expression over time. For the investigation of group identities, burial contexts are considered good sources, because a burial of a deceased person is an important social event for a group (Gramsch 2010, 11). Therefore, graves are the place and occasion where a group can reaffirm its shared identity during the burial (Gramsch 2015, 346; Veit 2008, 49, 51).

In this case, comparing collective graves with single burials and comparing undecorated pottery with decorated pottery would be comparing apples and oranges. Instead, grave goods with a possible social significance were chosen, in this case personal ornaments such as perforated animal tooth pendants, shells, boar tusks, small copper artefacts and amber. A large amount of such ornaments were found in both grave types (Drummer 2022, sup. 14, 15). Ethnoarchaeological studies document that personal ornaments serve multiple functions, amongst them holding symbolic meanings (Geßner 2005, 3; or the Turkana example: Wiessner 1989; Williams 1987, 37). For example, while belt buckles have a functional purpose, aesthetic choices were also made during production, such as the chosen material and decorations. Some of these elements can also have religious, magical, therapeutic or apotropaic meanings (Geßner 2005, 2–3; Volz-Kinzler 1969, 10–19; 78–85). As an archaeological find, personal ornaments open the possibility to study social meaning, because they function as non-verbal group communication and can express group identity (Geßner 2005, 1, 3–4; Mühlmann 1985, 19; Taylor 2016, 40).

Especially adornments on clothes often function as a medium to express social roles based on age/gender (Roach and Eicher 1965, 58), such as the tooth pendants in this case. Animal teeth can be found in large quantities in Late and Final Neolithic graves, predominantly perforated canine teeth. Sometimes the teeth were also imitated in bone. The imitation of these teeth and the repairs of some actual canine teeth can be seen as evidence of the high social value of these goods (Deschler-Erb *et al.* 2002, 311–13; Geßner 2004, 20). A considerable amount of time was invested to create these ornaments, in particular taking into account the large numbers of pieces. In addition, animal teeth had to be distributed and shared amongst people (Drummer 2022, 102–04). Consequently, personal ornaments were chosen as a test case to establish the relation between different social groups. First, groups based on age/gender are reconstructed for Late and Final Neolithic graves separately, then the reconstruction of social networks is presented.

For the Late Neolithic, the association of personal ornaments with individuals in collective graves is problematic given the repeated manipulation of inhumations in these graves. There were only five graves in which it was possible to associate personal ornaments with a total of 24 individuals (Drummer 2022, sup. 14). Therefore, the results for age/gender groups are neither conclusive nor representative for the Late Neolithic graves.

Based on the catalogue of ornaments by K. Geßner (2004), some conclusion on social roles can be drawn. Gender was determined by the body position of the inhumation burials. In total, the gender and age of a deceased individual could be determined in 145 out of 159 graves (Drummer 2022, 109 fig. 37). In the next step, the frequency of personal ornaments with certain genders/ages was investigated (Drummer 2022, 109–18). Ornaments such as boar tusks or bone pins are often personal items of male adult or mature individuals. Adult female and juvenile individuals often received other animal teeth, shell and amber objects. Younger individuals (juveniles, infants) had copper artefacts and beads as grave goods (Drummer 2022, 117–18).

In some cases, the biological sex or age derived from physical anthropology did not correspond with these rules. This suggests that a personal ornament was not used to express the individuality of the deceased but rather the assignment of this individual to specific social roles (Bücke *et al.* 1989, 83; Drummer 2022, 118; Geßner 2005, 6). Based on these findings, the social roles of elderly men, adult and subadult females and children seem to be associated with specific personal ornaments. This tradition of formal grave good sets continues into the Bronze Age and serves as an important medium for expressing social roles (Drummer 2022, 118). Moreover, based on the personal ornaments, the social relations between buried individuals can now be studied based on the reconstruction of their networks (Drummer 2022, 149).

Social networks based on personal ornaments

By studying social networks with the help of social network analysis, the focus is not on the objects but on their relation to each other (Terrell 2013, 19). This enables the reconstruction of social networks based on archaeological material. This case study concerns relations of grave goods (personal ornaments), which do not mirror the actual social status of a living individual but represent a display of their social importance as a deceased individual (Drummer 2022, 149–50).

As a methodological approach, the objects and their types were defined by the associated archaeological culture name; ^{14}C-dates were preferred for their

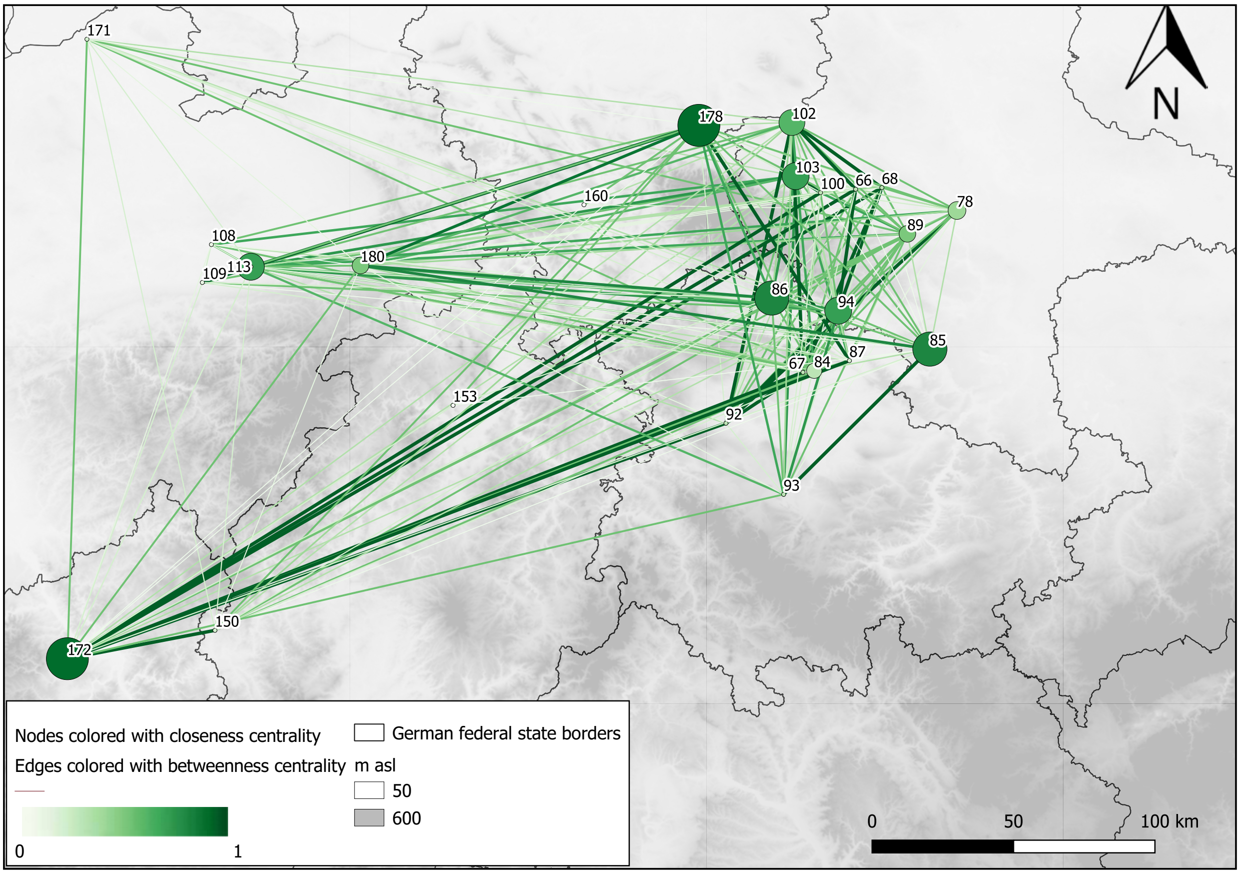

Figure 3. Graph of social network of personal ornaments for phase 1 from 3500–3000 BC.

chronological differentiation. If not available, the pottery style was used to assign the grave. Where the ^{14}C-date is younger than the archaeological pottery style, for instance where a Late Neolithic collective grave has a ^{14}C-date consistent with a Corded Ware attribution, both archaeological groups were considered as possible. This was done to open the archaeological group definitions, and in order to indicate the transition phase often represented in collective graves (Drummer 2022, 150; Rinne *et al.* 2019). Due to the shape of the ^{14}C-calibration curve and the plateaus, as well as typochronological issues, the phases do not have the same time interval and therefore may not represent smaller or short-term developments. However, larger developments and especially possible large-scale social changes may be made visible with this method.

The reconstructed social networks were investigated by analysing the centrality and connectiveness between the nodes (in this case the graves). Changes and shifts in different phases were interpreted according to the following questions:

- Do these changes indicate different social meanings in the funeral contexts?
- Is there a discernible "destruction" of Late Neolithic group identity?
- If so, is a new Final Neolithic group identity discernible, which is distinct from the previous one?
- How is the transitional phase from Late to Final Neolithic reflected in the social networks of graves?

The personal ornaments are sorted by grave, as it was not possible to associate them with single individuals in every case. The total quantity as a percentage of the object category and amount per grave was used to sort ornaments on the basis of a similarity matrix using the Jaccard-coefficient. This coefficient is suitable for large datasets where some information is missing (Jaccard 1912, 42–45), for example where the total number of animal teeth is unknown. The social network graphs are undirected, and each node is one grave. None of the nodes were filtered or edited. In addition to the graphs, the following centrality values were used for further investigation:

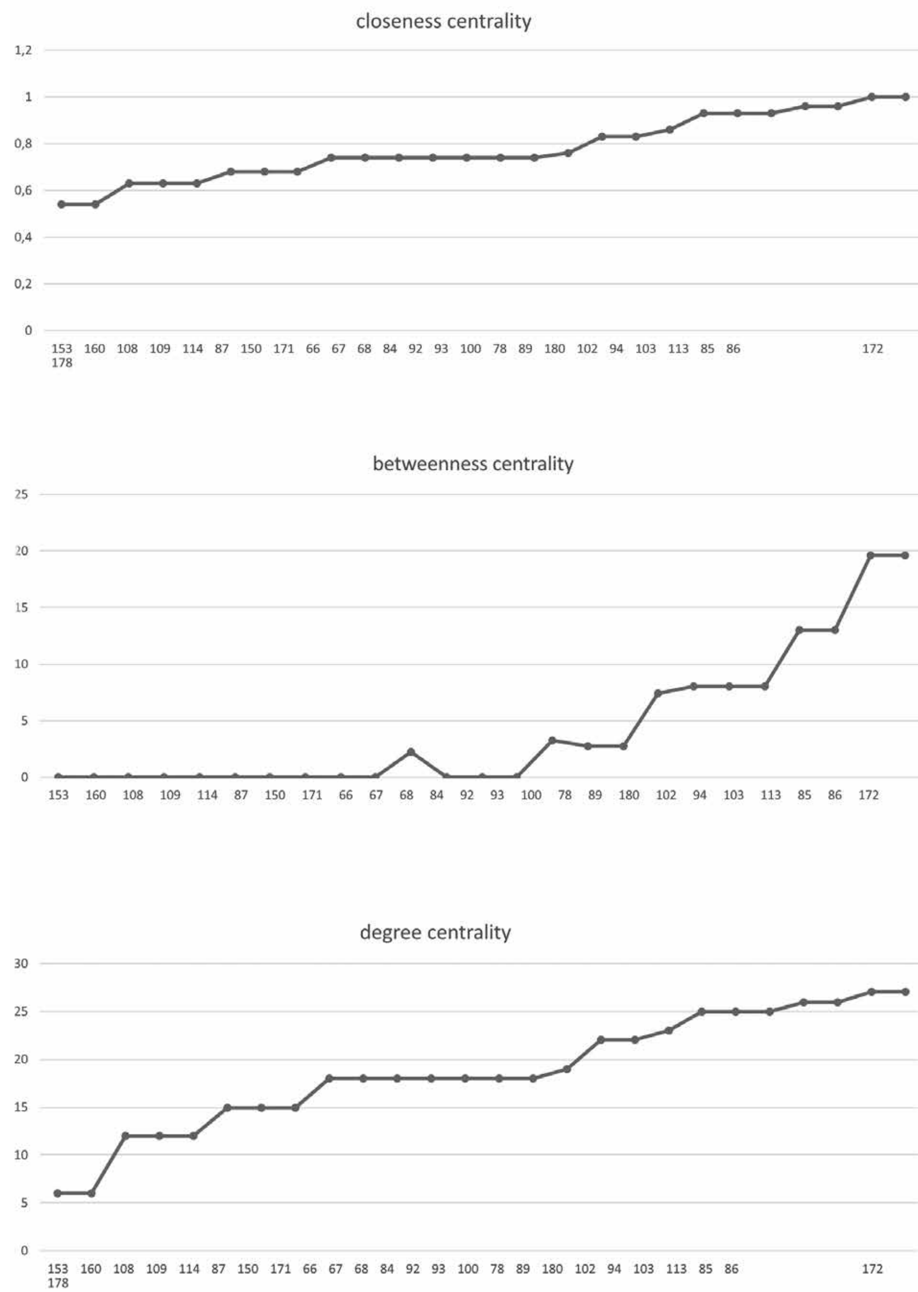

Figure 4. Centrality values for phase 1 from 3500–3000 BC.

Degree of centrality: total amount of direct connections of a node to all other nodes. A value of 0 means that all nodes have the same number of direct connections, while 1 means that one node is the centre of the network and all other nodes have only one direct connection to this node (Schweizer 1996, 183–86).

Closeness centrality: shows the shortest path between nodes and reflects the effectiveness and dependency between nodes. The normalised average distance between the single nodes is used (Brandes 2001, 163–77; Isaksen 2013, 61–63; Schweizer 1996, 183–86, 188).

Betweenness centrality: shows the indirect connections between nodes and reflects to which extent two nodes are connected via another node which has control over this link. Here, the shortest path between two nodes is calculated with the possibility that a node lies in between them (Brandes 2001, 163–77; Isaksen 2013, 61–63; Schweizer 1996, 183–86, 188).

These values provide information about which nodes are important due to their connections within the network, but also about the influence of every individual node within the network. Not only can the

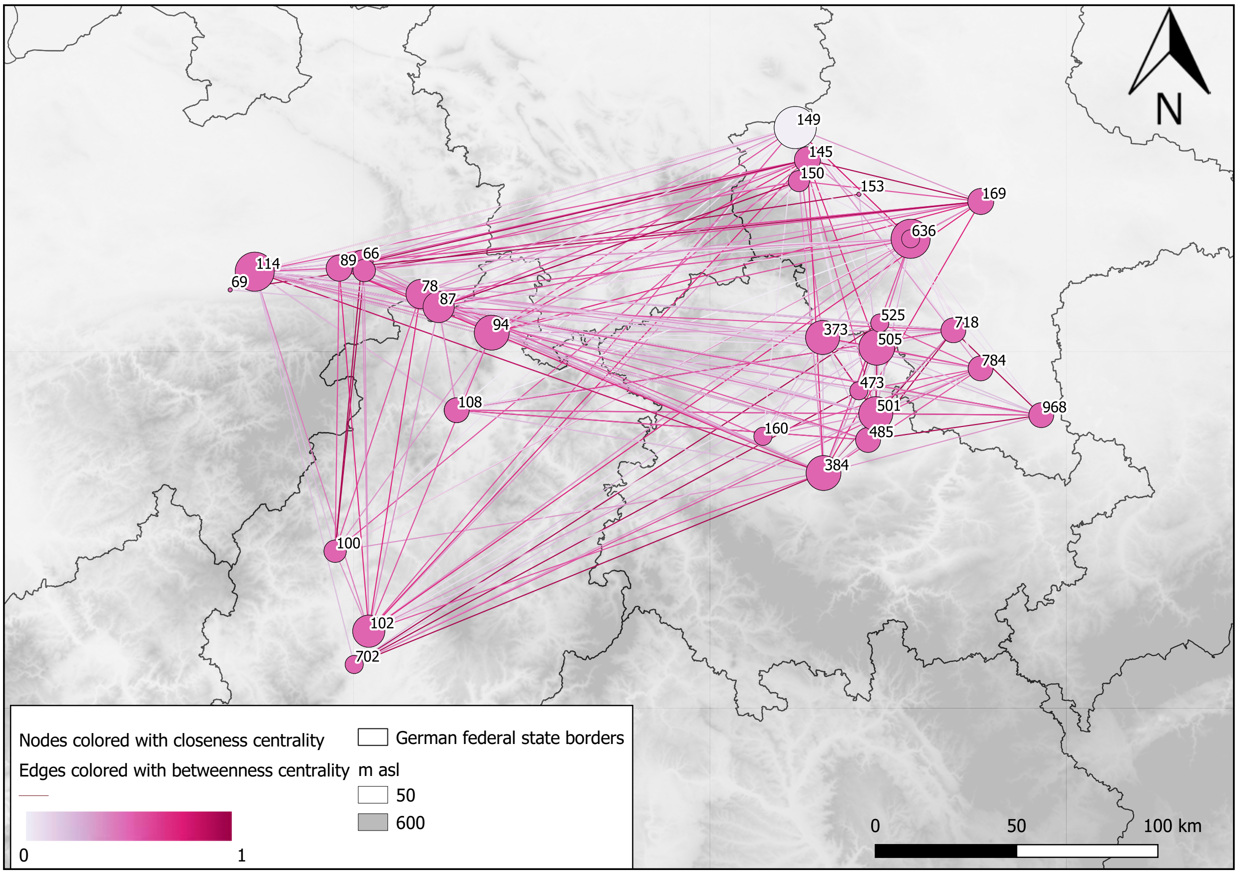

Figure 5. Graph of social network of personal ornaments for phase 2a from 3000–2600 BC.

overall network connectiveness and its structure be studied and interpreted, but structural changes can also be detected by comparing the temporal development of the network in different phases.

Social network analysis

A total of 155 personal ornaments from 24 Late Neolithic burial contexts and 16,252 from 266 Final Neolithic burial contexts were used to calculate similarity matrices for four different chronological phases. These will now be presented phase by phase.

Phase 1: 3500–3000 BC

Geographically, the social network of the first phase covers the whole research area with its centre in the eastern part. Regional subgroups are not visually prominent, but the betweenness centrality suggests some regional subgroups. For example, the group of nodes nr. 108, 109, 113 can be considered as a small regional subgroup (Figure 3).

The connections between nodes are independent of their betweenness centrality, meaning even nodes with a low betweenness centrality do not have fewer connections to other nodes than nodes with high betweenness centralities. The degree of centrality ranges from 6 to 27.3, with most between 13.1 and 20.2. This can thus be considered as a not highly centralised network.

The distributions of closeness centrality show a similar pattern, with values between 0.5–1.0. The majority of values are between 0.7 and 0.87, reflecting the close and direct connection of most of the nodes with very little variation. Therefore, the network in phase 1 is characterised by direct connections between nodes and only a few nodes control the connection between other nodes based on the betweenness centralities (Figure 4).

Phase 2a: 3000–2600 BC

In the next phase, the whole network and its density shrink because the distant nodes are now absent. Some Final Neolithic graves appear as nodes, but Late Neolithic nodes are also still part of the network. The centre continues to be in the geographically eastern part of the research area (Figure 5).

The closeness and betweenness centralities become more homogeneous, with one exception (Nr. 149). None of the nodes has an exceptionally high centrality value. Among the nodes with higher values are Late Neolithic

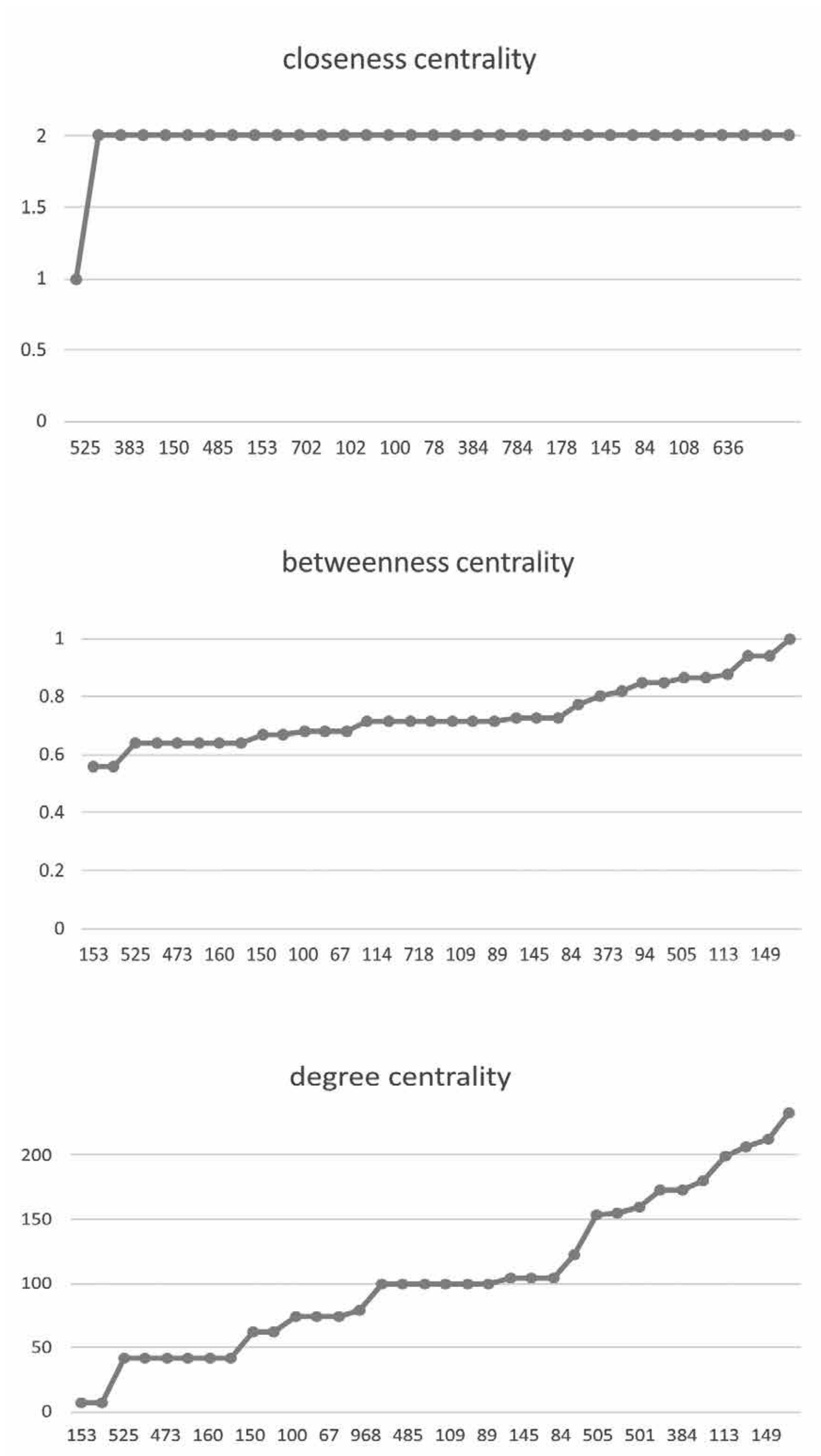

Figure 6. Centrality values for phase 2a from 3000–2600 BC. X-axis corresponds to the node number and y-axis to its centrality value.

	Averaged degree of centrality	Network density	Averaged cluster coefficient*
Late Neolithic	46.269	0.701	0.866
Final Neolithic	116.555	0.416	0.913

Table 2. Comparison of overall network values. * cluster coefficient after Latapy (2008).

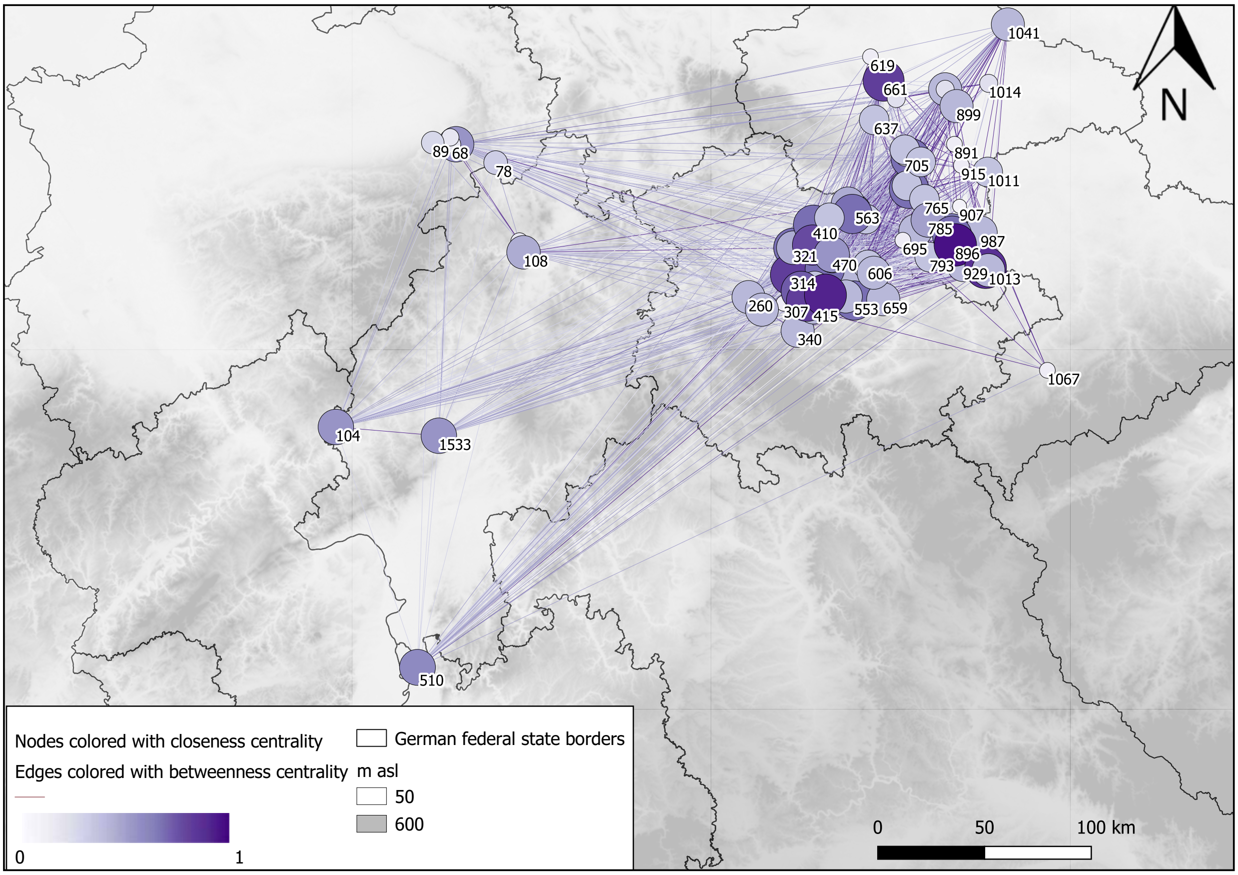

Figure 7. Graph of social network of personal ornaments for phase 2b from 2600–2500 BC.

(Nr. 94, 113, 149, 178) as well as Final Neolithic ones (Nr. 373, 384, 501, 505). No disruption in the social network is discernible, as no gaps or disconnections are evident (Figure 6).

Phase 2b: 2600–2500 BC

Again, the network's centre is in the eastern part of the study area. However, clusters of nodes now appear, and the centrality values vary: overall, the network becomes denser because there are many nodes with low closeness centralities. The nodes in the eastern part that stand out are those with higher betweenness centralities due to their many connections (Figure 7).

Many of the nodes become more centralised based on their high degree of centrality and betweenness centrality values. The distribution of closeness centrality is split into two groups. One group has low closeness centralities and another, larger group has values in the middle range. Single nodes stand out due to their higher betweenness centralities and therefore influence the network more than the other nodes. This can be seen as the beginning of a centralisation of the network, where single nodes become more important (Figure 8).

In their late phases of use, collective graves (Nr. 68, 78, 89) have high degrees of centrality, while some (Nr. 60, 66, 68, 78, 89, 92) also have a higher betweenness centrality. However, they are not ruling over the network, i.e. they have more connections but do not dominate over other nodes. Among the Final Neolithic graves, nodes 415, 469, 929 and 1041 are more centralised based on their centrality degree, but do not have many connections based on their closeness centrality. A change within the network becomes visible, characterised by some nodes having more connections, while other nodes have a greater impact on the network. This is regardless of their assignment to the Late or Final Neolithic.

Phase 3: 2500–2300 BC

In the last phase, the Late Neolithic graves are located north of the mountain range. In addition, the development of many nodes with homogeneous closeness centralities and single nodes with higher betweenness centralities continues. This is also reflected in all of the values (Figures 9–10).

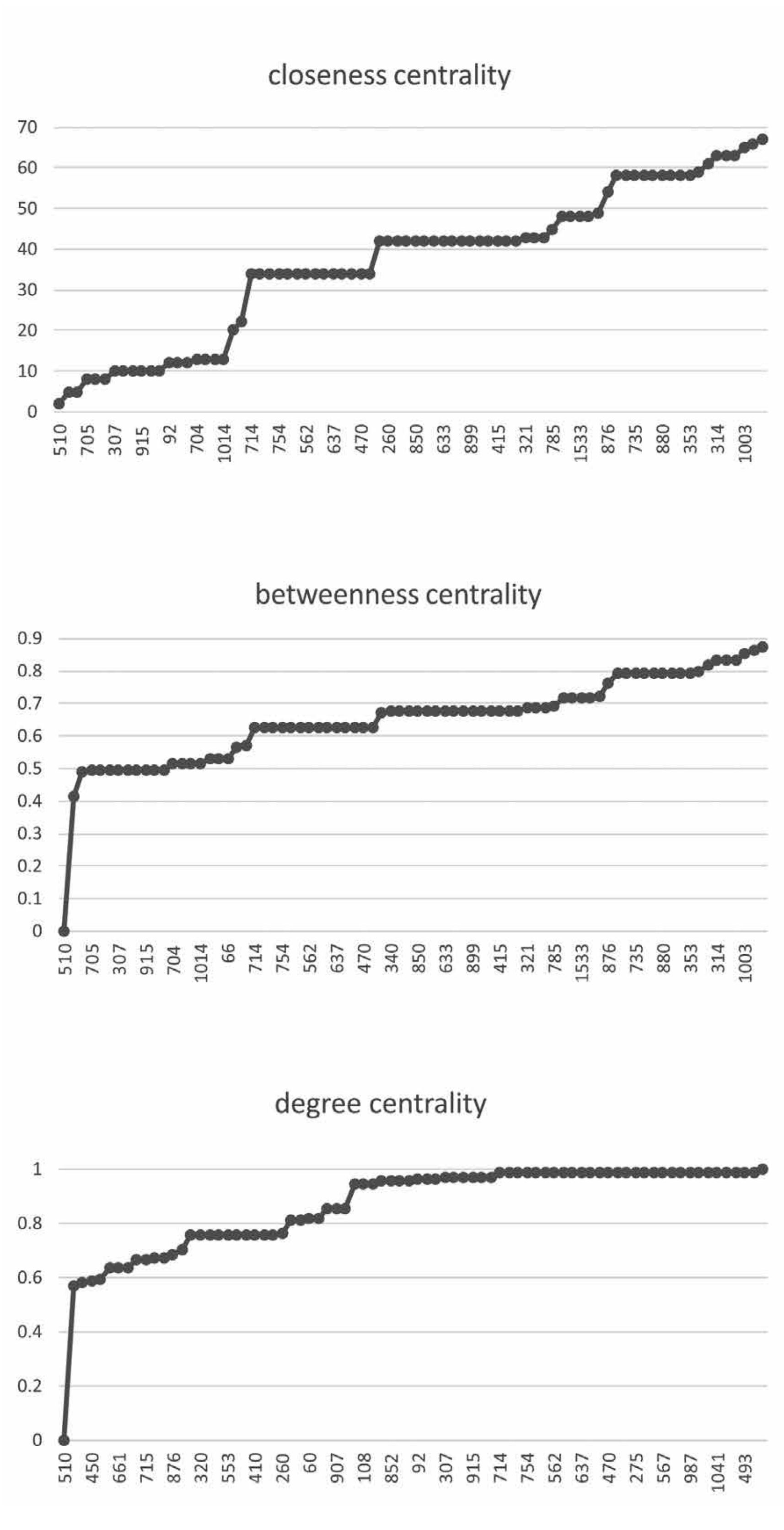

Figure 8. Centrality values for phase 2b from 2600–2500 BC. X-axis corresponds to the node number and y-axis to its centrality value.

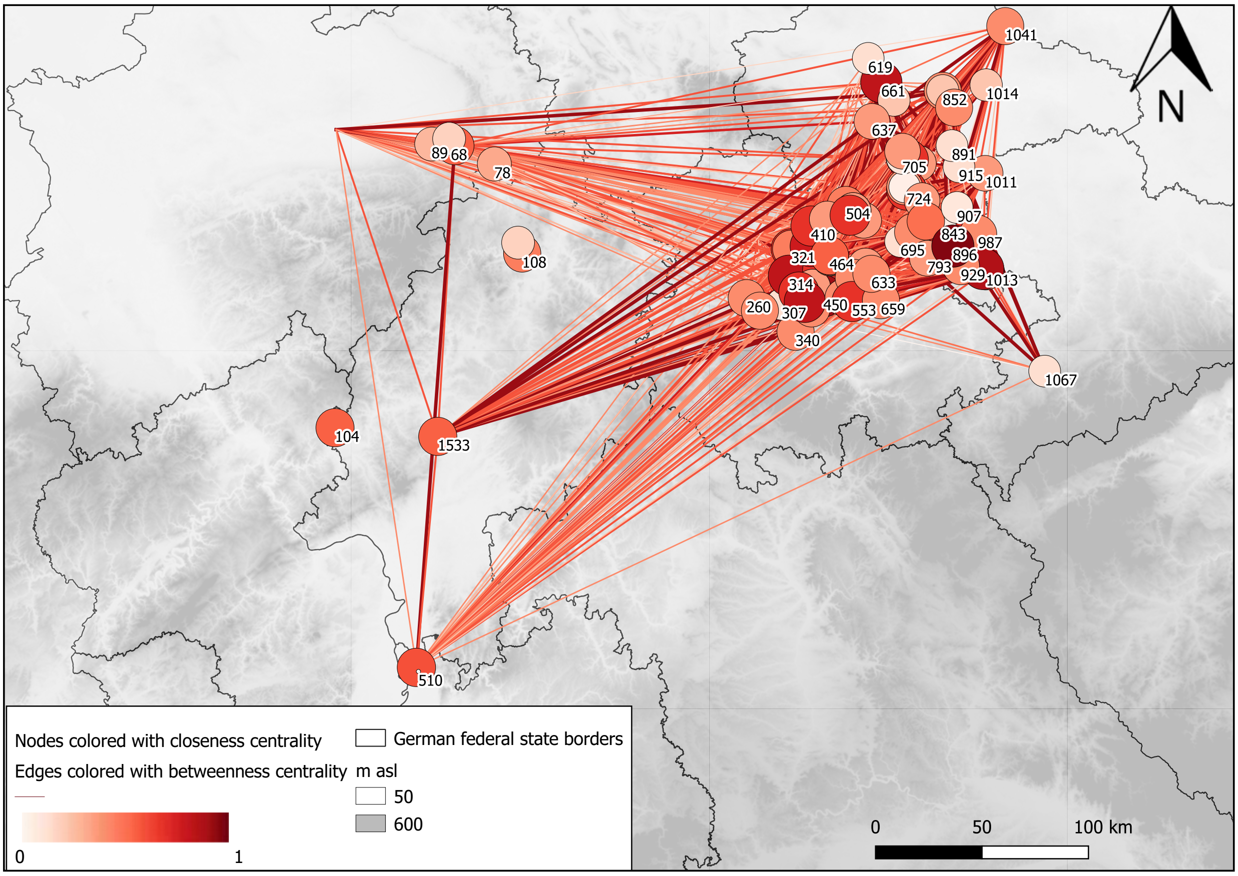

Figure 9. Graph of social network of personal ornaments for phase 3 from 2500–2300 BC.

Comparison of overall network values

The trend that single nodes become more dominant in the network based on their betweenness centrality can be confirmed by the overall network values. The average centrality value in phases 1 and 2a is comparable, with values between 17.6 and 18.7 (Table 2). In phase 2b, this value drops significantly to 7.0 and reaches its maximum in phase 3 with 36.9.

This can be explained as a dissolution of the network structure in phase 2b, i.e. between 2600–2500 BC. This process already began in phase 2a with a decrease in the network's centrality and a sparser network density. The latter starts to increase in phase 2b, and the grouping of nodes begins to cluster and become more centralised through direct connections. In phase 3, the network reaches its lowest density, while the clusters of nodes become increasingly dominant. This can also be seen in the averaged cluster coefficients of the different phases. In phase 2b the lowest point is reached and in phase 3 the peak. This effect is described as a small-world-effect, in which the nodes are only indirectly connected via individual nodes that act as "communication hubs". In this case, the dominant nodes from phase 2b also dominate in phase 3, for example in the case of Late Neolithic graves 60, 68, 78, 79 and 91, to which nodes 104 and 108 are added in phase 3. In phase 2b, Final Neolithic graves are the nodes with higher closeness and betweenness centralities and these graves become even more dominant in phase 3. These findings can now be interpreted in terms of the social relations during the transitional phase at the end of Neolithic.

Shape of social ties through the third millennium BC

The social relations based on the network of personal ornaments as grave goods indicate a decline between 2600 and 2500 BC (phase 2b). This was at a time when the Corded Ware had already appeared in this region. It can therefore be concluded that the Corded Ware was not the trigger for these changes. In addition, collective graves are also part of the social network at this time and some of these collective graves have strong evidence for Corded Ware presence, for example at Altendorf (Drummer 2023; Rinne *et al.* 2019, 81–83).

This is followed by a phase characterised by increasing centralisation. Clusters and single nodes emerge, which hold the indirect connections of the network and thus

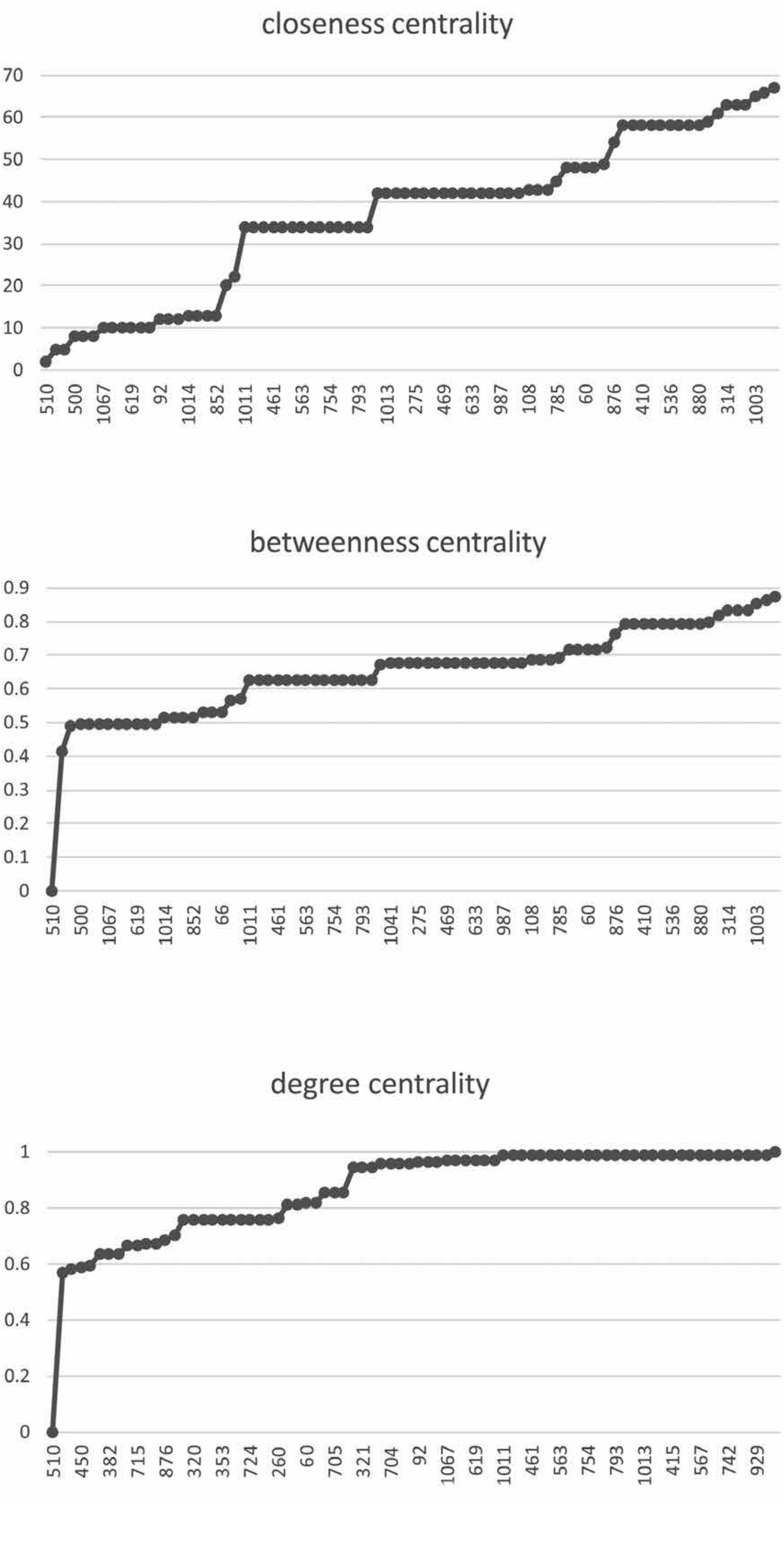

Figure 10. Centrality values for phase 3 from 2500–2300 BC. X-axis corresponds to the node number and y-axis to its centrality value.

dominate it. The nodes are graves both from the Late and Final Neolithic, and some of the nodes with a dominance of the network maintain their position also in phase 3.

This shows that the network does not change completely but transforms through a defragmentation and clustering process, where social ties had fallen apart completely. Instead, local and direct connections transform into a network of supra-regional hubs, which are connected by prominent nodes of the network.

In terms of the archaeological interpretation of the changes in the third millennium BC, the developments based on the social networks allow us to draw some new conclusions. Firstly, the Late and Final Neolithic graves together form a social network. They cannot be divided into two separate groups, since during the transitional phases (phase 2a and 2b) graves from both archaeological units form the network. This is supported by the fact that the graves which dominate the network do not come from only one archaeological classification unit. Secondly, the social decline takes place chronologically after the first introduction of the Corded Ware in this region. There must have been a coexistence of Late and Final Neolithic elements which did not immediately lead to social conflict. Thirdly, the phases after 2500 BC can be described as an increasing centralisation of social networks, while Late Neolithic graves were still in use. It can be argued that the conflict was resolved without abandoning all former graves and thus neglecting the past. It seems more likely that regional and local developments disappeared in the supra-regional elements of what archaeologists associate with the Corded Ware and Final Neolithic. This phenomenon will now be examined in more detail.

Discussion: local and supra-regional phenomena of the third millennium BC

As in the case of Altendorf (Rinne *et al.* 2019) some of the Late Neolithic collective graves show traces of Final Neolithic activities. These activities include archaeological finds such as axes, rock art or Corded Ware pottery and are additionally evidenced in ^{14}C-dates on human remains, such as possible Corded Ware burials in collective graves (Drummer 2022, 225–28). This has been known for a long time and is often referred to as a re-use of collective graves. However, the character of the re-use was uncertain, as it was not known whether it was an appropriation of former graves or whether they were actually used as Final Neolithic graves. With the case of Altendorf and the extensive ^{14}C-dating of human remains, it has been demonstrated that this re-use was connected to funerary activities and lasted far longer than previously thought.

This does not mean that every Late Neolithic collective grave has the same long-term use. Instead, the ^{14}C-dates on the human remains from the collective grave at Niedertiefenbach indicate intensive use of the grave in different phases between 3200 and 3100 calBC (Meadows *et al.* 2020, 20). Here, different local practices appear and need to be taken into consideration. Similarly, preliminary aDNA results of collective graves from this region also show local differences.

The aDNA analyses from Niedertiefenbach show close kinship relations between individuals and across different phases of grave use (Immel *et al.* 2019). The genetic makeup of these humans based on their haplogroups includes a strong component of individuals with so-called “hunter-gatherer” signatures, instead of an expected predominance of what is generally called “Neolithic” ancestry. Haplogroups associated with people from the north Pontic steppe and referred to as “Yamnaya” are also missing.

In comparison, the preliminary results for the individuals from Altendorf show a different genetic make-up: they are mostly characterised by haplogroups that have not so far been linked to specific archaeological events or time periods, in the way some haplogroups are for example “typical” for the so-called Early Farmer populations and associated with the spread of the Neolithic lifestyle in central Europe (Drummer 2022, 197–201). However, “Neolithic” components absent in Niedertiefenbach are present at Altendorf. This shows local differences between the collective graves in terms of the genetic make-up of the buried individuals, but also in the temporal depth of grave use (Drummer 2022, 201–02).

Coming back to the question of migrations from the north Pontic steppe, recent aDNA studies provide a deeper understanding of possible migrations. The aforementioned steppe component in the aDNA is visible in Y-chromosome haplogroup R (Haak *et al.* 2015, 208). Certain subgroups of this haplogroup (R1b1a1b1b for the marker R-M269 and R1a1a1b2 for marker R-M41, after Borges 2019) have been linked to a possible migration from the north Pontic steppe. By using open-access databases, 38 samples with matching R-subgroups were found, of which 12 samples originate from three German sites in close proximity to the research area (Drummer 2022, 217–19 fig. 91). The oldest of these samples dates to the Younger Neolithic and comes from a Baalberge burial in Quedlinburg (Drummer 2022, 220–21). This echoes the results of aDNA studies on burials from south-east and central Europe, where a steppe component was detected in the middle of the fifth millennium BC in two individuals from Bulgaria (Varna I and Smyadovo) (Mathieson *et al.* 2018, 4). Therefore, the first appearance outside the north Pontic steppes occurred before the third millennium BC and the highest peak was not reached until the Bronze Age (Haak *et al.* 2015, 208; Mathieson *et al.* 2018, 4). This shows that massive migration may not have been the reason for the spread of these haplogroups during the Final Neolithic in central Europe. An increase of the specific haplogroups seems to happen during the

Weapons in Corded Ware burials	Oldest	Older	Middle	Sum
Axe	3	60	72	135
Adze	10	59	131	200
Arrow	1	1	31	33
Dagger	0	1	0	1
Wrist-guard/bracer	0	0	7	7
Other	0	1	1	2
Sum	14	122	242	378

Table 3. Corded Ware burials with weapons as grave goods (after Großmann 2016). Typochronological phases of Corded Ware after Figure 2.

Neolithic, where multiple migrations or movements of people from different locations may have contributed to these genetic trends. The history seems rather complex and needs further research (Wang *et al.* 2019).

Nevertheless, migrations did take place and had an influence on social ties and group identities during the Final Neolithic. Therefore, some possible indicators for migrations in the archaeological material will now be presented. This is based on D. Anthony's (1990, 900–05) work on forms of migrations and their possible evidence in the archaeological material.

For example, imported goods or transferred technologies can be an indicator of migrations. In the case of pottery, some Corded Ware decorations from the German lower mountain ranges have been compared with Yamnaya pottery (Shishlina 2008, 60–68, esp. 68 fig. 43), however the typical round base of Yamnaya pottery is not found in the GLMR during the Late and Final Neolithic. Cord impression on pottery already occurs in Late Neolithic contexts, but not in large numbers. This could be interpreted as migrations of single individuals and/or smaller groups who brought their pottery (or technology) with them.

Copper artefacts, in particular the change from flat axes to adzes during the Final Neolithic, can be considered a second indicator for migration. Interestingly, some studies argue for a west–east technology transfer, but focus on the Baltic Sea (Libera *et al.* 2009). Also, an increase of copper finds has been observed for the German lower mountain ranges, but only in parts of the region during specific times (Drummer 2022, 146). This makes it difficult to interpret them as traces of migrations, because it is unclear whether this distribution pattern is due to preservation, or to copper as a new material being neglected. If migrating groups introduced copper finds, they would only be locally distributed in the GLMR.

A third aspect could be the changes in social organisation, such as the emergence of age/gender roles and the introduction of warrior stelae. Given the pan-European scale of distribution of these monuments, a large-scale effect caused by long-distance migrations is implied. This contradicts all the other indicators, which point to local or smaller scales of migrations with regional differences (Drummer 2022, 212).

The strongest parallel between the central European material and Yamnaya sites is seen in burial practices, as both comprise single graves located under burial mounds. The biggest difference in burial practices is the lack of gender-specific deposition rules for the deceased in Yamnaya graves (Häusler 1992, 344). Ochre is also missing in Corded Ware burials (Kaiser and Schier 2009, 21; Shishlina 2008, 44, 47), as are organic remains that could be compared with the Yamnaya finds (Furholt 2014, 82; Heyd 2016, 56–65; Morgunova and Turetskij 2016, 141).

All of these results do not show strong evidence for large-scale migrations, but rather that migrations of smaller groups may have taken place and that this may have been the case even before the Corded Ware emerged. This means that an aggressive intrusion of foreign people replacing indigenous cultural traditions is not visible at the beginning of the Corded Ware in the German lower mountain ranges. There is neither a strict distinction between Late and Final Neolithic graves, nor does the aDNA indicate replacement by a dominant haplogroup. Moreover, the social network shows a decline long after the first appearance of Final Neolithic finds. After this decline, the social network transforms more and more into a centralised network. This can be described as a transformation in the sense of a transition from A to B rather than an abrupt cut-off point followed by a replacement with something completely new and foreign.

Another aspect contributes to this conclusion of a transformation instead of a sudden replacement: among the Final Neolithic grave goods are weapons, especially arrowheads and axes, which can be seen as indicators of tense relations and conflicts. The distribution of weapons according to the relative typochronology shows that the majority do not date to the first phases of the Corded Ware culture (Table 3). This means that the practice of using weapons as grave goods came later and seems to be more a reflection of status and dominance around 2600 BC. This fits into the development of the social networks, where single outstanding nodes dominate the social network and had a stronger impact and therefore higher status within the network.

This becomes even more relevant when one considers that there are gender- and age-specific rules for personal ornaments in graves. It is important to note that these rules seem to be connected to the representation of the social category to which an individual belonged, which does not necessarily reflect the reality of their life. For example, boar tusks were grave goods for older male individuals, but some child burials were also found to have such grave goods. These findings are important for the interpretation of social ties based on grave goods, both for the weapons and the personal ornaments (Drummer 2022, 116–18).

The display shown in Final Neolithic graves begins to highlight single individuals and their social (imagined) roles within their societies. Based on social networks, single graves had a stronger influence on the networks. Therefore it seems logical that the focus of social expression within burial practices falls more and more on single individuals, who had more influence on the networks than others based on their grave goods, which were given to them by their social group (Drummer 2022, 225–27). This phenomenon is also reflected in the anthropomorphic stelae and warrior representations (Drummer 2022, 128–29; Robb 2009, 174–77; 2015, 647–48). It is not actual conflict or aggression that is shown, but its increasing social importance.

This is in contrast to previous, collective burial practices, where single individuals did not stand out within the burial collective. This is a profound change of burial practices, where social groups no longer reaffirm their identity by expressing their collectiveness, but rather accord social importance to the individual deceased. But as shown here, it was a change that evolved over decades and centuries. While supra-regional phenomena such as Corded Ware pottery, single burials under mounds, weapons and warrior representations appear everywhere, studies of local technologies and regional differences point strongly to local continuities and heterogeneous developments in various regions (Drummer 2022, 223–36).

Social transformation in the German lower mountain ranges during the third millennium BC

Instead of a horizon of destruction in the Final Neolithic, the social network in the German lower mountain ranges during the fourth to the third millennium BC shows profound social changes, leading to centralisation over time. Funerary modes of expression shift from a focus on the collective to a focus on outstanding individuals and their social roles within the group. Based on gender-specific deposition rules for grave goods, it could be shown that the social role of the individual was emphasised in Final Neolithic single burials. This fits with the trend of single graves beginning to dominate social networks and with the increasing representation of warriors through weapon finds in Final Neolithic graves and supra-regional phenomena such as warrior stelae. But these supra-regional phenomena appear differently in each local context and were adapted differently. Therefore, it has been argued here that social ties had changed profoundly without falling apart completely. In the process, a new mode of social expression emerged out of the earlier context; this is the focus on the social role of an individual and their status within the networks. However, earlier burial practices, such as the use of collective graves, were not completely abandoned. This case study shows the complexity of social developments during this time, which cannot be explained by one single massive migration event.

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Lithics, Lousberg axes and no settlements

In search of the late fourth millennium BC in the Lower Rhine area

Silviane Scharl and Ingrid Koch

Abstract

Compared to the preceding Neolithic phases, the Late Neolithic in the Rhineland is barely known due to a highly patchy archaeological record. So far, this has been explained with a population decrease during this period. We hypothesise, however, that the lack of evidence is rather due to a lack of knowledge on what the archaeological record looks like. Therefore, in a first part, we describe proxies that can be used for the identification of Late Neolithic sites. While pottery is only rarely preserved and exhibits hardly any diagnostic features, we can describe a set of specific types of lithic tools and certain types of lithic raw material which characterise the Late Neolithic sites known so far. Based on this, in a second part we compile potential Late Neolithic sites in order to obtain information on further characteristics of these sites and thus contribute to a better knowledge of this so far badly understood period.

Keywords: Late Neolithic, Rhineland, lithics, settlements

Introduction

The archaeological record of the Late Neolithic (c. 3500–2800 BC) in the Rhineland is sparse (Richter 1997). For a long time, this was ascribed to a local population decrease during this period (Zimmermann *et al.* 2006, 55). However, there are indications that the lack of evidence is due to a lack of knowledge on what the archaeological record from this period looks like, rather than reflecting a lack of sources. Based on this, our article is divided into two parts. First we present our ideas on why we think the Late Neolithic in the Rhineland has barely been recognised so far and suggest how this could be improved. In a second part we take a closer look at the archaeological record of this period, in order to gain a more detailed understanding of how the Late Neolithic in the Rhineland is to be characterised.

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Figure 1. Lousberg flint axe (reworked after polishing) from the Rur valley near Koslar (photo: M. Thuns/LVR-ABR).

Identifying human presence during the Late Neolithic in the Rhineland

Indirect proxies for human activities

For a long time, only a handful of archaeological sites in the Rhineland could be ascribed to the Late Neolithic. However, indirect proxies like pollen archives and geoarchaeological archives reflect a further expansion of open land at that time (Meurers-Balke *et al.* 1999, 30–31). Pollen diagrams show an increase of oak and hazel, which hint at an increasing significance of animal husbandry (or more generally managed forests). Moreover, the increase of maple (*acer*), birch (*betula*) and narrowleaf plantain (*plantago lanceolata)* does not correspond to a natural vegetation but indicates human impact, too. Human impact is also reflected in the geoarchaeological archives. R. Gerlach and E. Eckmeier identified black carbon as a possible indicator for slash and burn agriculture in off-site features that mainly date to the fourth and third millennia BC (Gerlach and Eckmeier 2012, 110–11). Therefore, we would assume that the low number of known sites reflects low visibility rather than a real decline in settlement activity.

Direct proxies for human activities

This invisibility is amongst others due to the fact that characteristic archaeological finds from Late Neolithic contexts are hard to recognise. In particular pottery can be rather unspecific, as pots are usually not decorated and, except for an s-shaped profile and flat bases, the form does not exhibit any diagnostic features. Moreover, the quality is poor, probably due to rather low firing temperatures, which is why pottery is usually only preserved in tiny pieces. The only trait that could be used as a diagnostic feature is coarse tempering with quartz. However, this practice starts already in the late Michelsberg phase and is still in use in the Early Bronze Age, so quartz-tempered pottery on its own need not indicate Late Neolithic contexts.

There is, however, another proxy that can be used for identifying Late Neolithic contexts, namely the distribution of flint axes made from Lousberg flint. This medium- to coarse-grained tabular chert is characterised by a contrasting colour between the grey core and a brown band below the cortex (Figure 1). This is why it can be identified easily with the naked eye. It was mined in the area of what is now the city of Aachen (Schyle 2010; Weiner 1998). ^{14}C dates taken from short-lived material, namely antler artefacts from the mine, document intensive activities during the second half of the fourth millennium BC (Schyle 2010, 26–27, tab. 26, fig. 42). This corresponds to the very few finds of Lousberg axes known from stratified contexts. The only two documented *in situ* finds are from the Late Neolithic collective burial of Schmerlecke in Westphalia, which is attributed to the Wartberg culture (Baales *et al.* 2016).

So far, there has been no evidence for the use of Lousberg flint axes from Early Michelsberg or Final Neolithic stratified contexts. But one has to consider that Late Michelsberg sites (stage V in J. Lüning's 1967 periodisation) have not been recognised or documented in the Rhineland to date and the number of known sites from the Final Neolithic is quite low. It is therefore quite conceivable that mining on the Lousberg began slightly earlier than 3500 BC and was also in operation for longer than 2800 BC. Nevertheless, Lousberg axes currently represent the best proxy for human activity in the Rhineland during the Late Neolithic. Consequently, axe blades, axe blade fragments, production waste, flakes with a polished surface, or hammerstones made from Lousberg flint axe blades, to name just a few, at present might be taken as indicators for Late Neolithic activities.

Figure 2 shows all flint axes made from Lousberg flint documented so far. To date c. 400 sites are known among which c. 200 are situated in the Rhineland — apart from the two axe fragments from Schmerlecke in Westphalia, all finds come from surface collections. Based on this picture, Lousberg flint can be characterised as a raw material of mainly regional significance which according

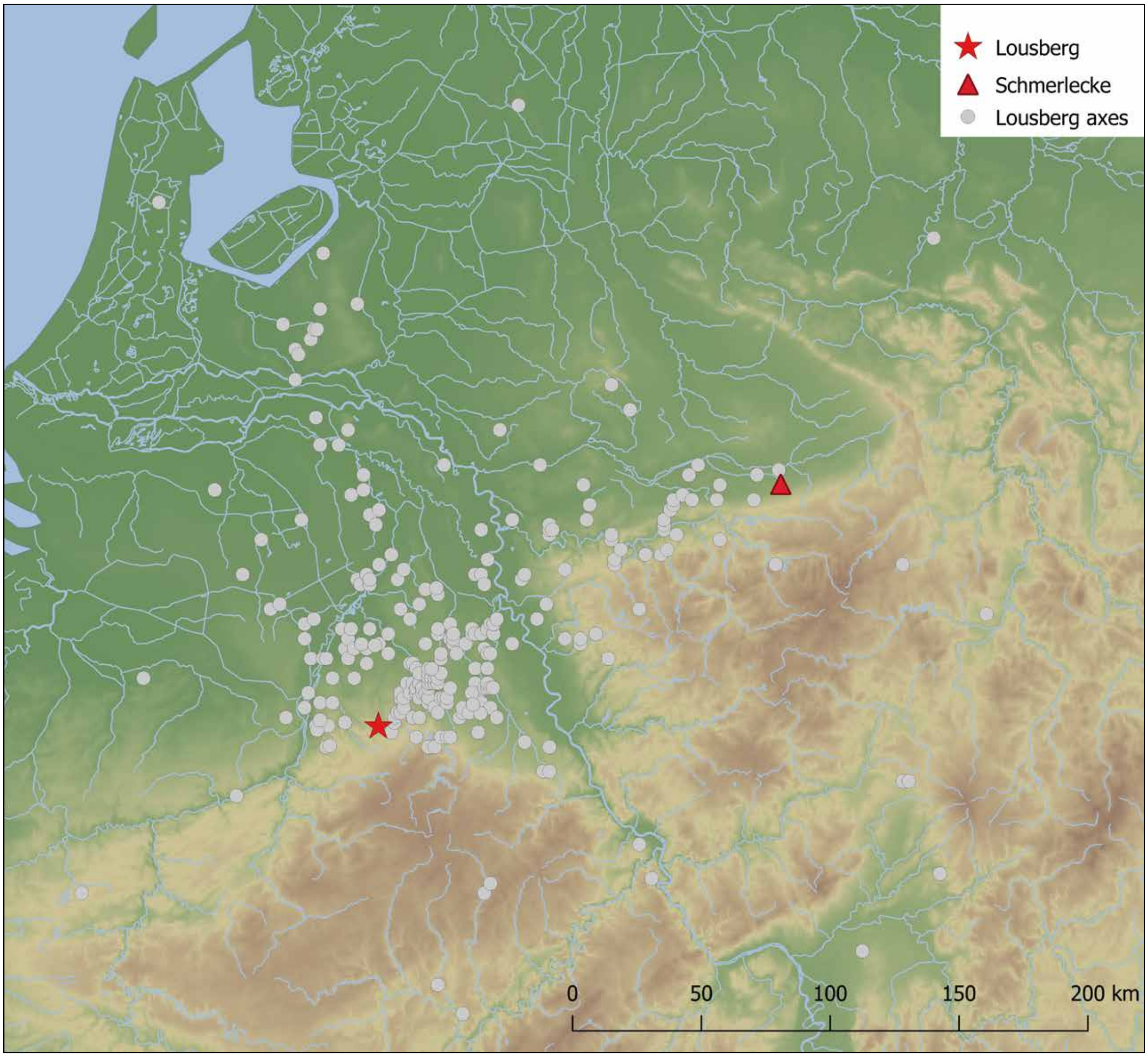


Figure 2. Distribution map of Lousberg axes (dots). Star: Lousberg/Aachen. Triangle: collective burial at Schmerlecke (map: S. Suhrbier and D. Schyle).

to D. Schyle (2010, 111) was distributed by down-the-line exchange networks. A similar distribution pattern has been documented for Late Neolithic axes made from silicates containing rock called "Wiedaer Slate", which occurs in Lower Saxony. These axes, too, are Late Neolithic and mainly documented in central Germany (Juergens 2018, 179, fig. 3).

If all finds of Lousberg axes mapped in Figure 2 are taken as evidence for Late Neolithic activities, settlement density and population density during this period must not be underestimated. This is emphasised by a rough estimate of production volume at the Lousberg flint mine. Based on excavation finds, an output of up to 300,000 axe blades is calculated for about 500 years of mining (= 600 axe blades per year; Schyle 2006, 42).

Alongside Lousberg axe blades, further diagnostic finds for the Late Neolithic have been documented in the Rhineland which we interpret as imports from neighbouring regions. There are, for instance, two sites (an excavated site at Euskirchen-Großbüllesheim and a surface site at Kerpen-Sindorf "Pferdbruchsfeld") that have yielded fragments of collared flasks, known e.g. from TRB contexts, which can also be dated to this period (Figures 3–4). And there are several sites with finds of very specific types of projectile points known from the Late Neolithic in neighbouring regions, for instance the Wartberg culture (see below). Finally, there are a few sites in the Rhineland with Late to Final Neolithic ^{14}C dates, like the Lousberg or Rheinbach-Taubenpfad. In addition,

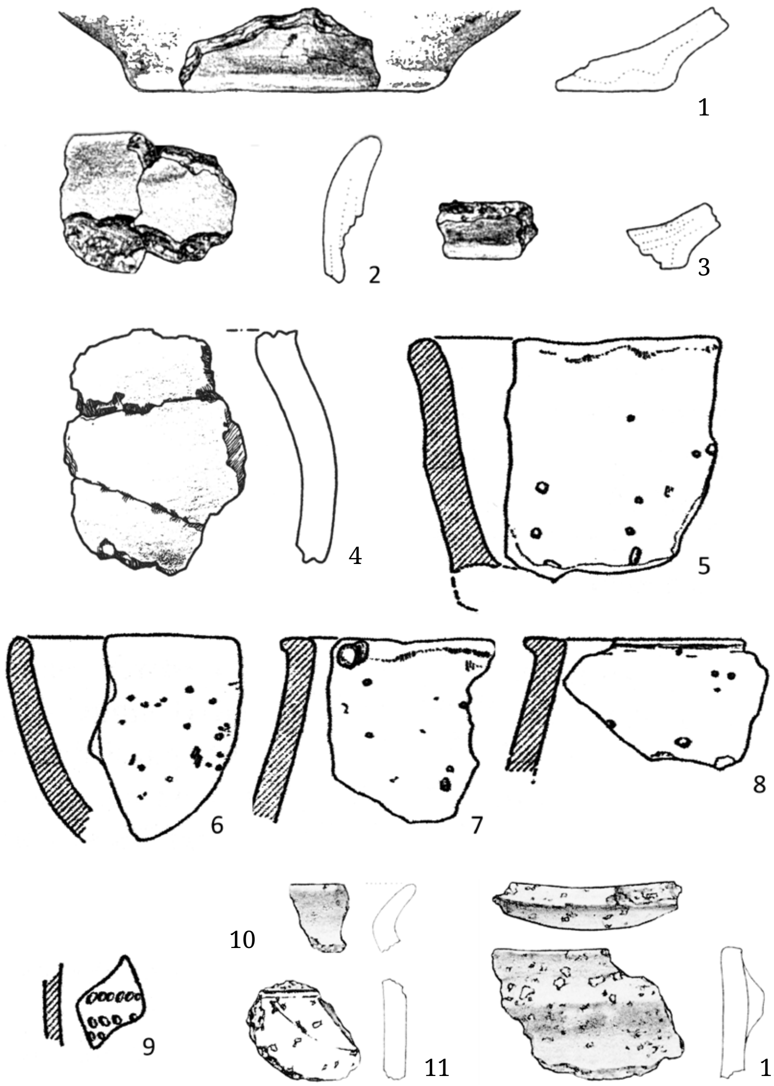


Figure 3. Diagnostic pottery from Late Neolithic contexts in the Rhineland (actual size): 1–3 Broichweiden 6b (modified after Boelicke *et al.* 1979a, 392 fig. 20.1–3); 4 Hambach 9 (modified after Boelicke *et al.* 1979b, 327 fig. 19); 5–9 Kirchberg in Morken (modified after Hinz 1969, 17 fig. 5.5–14); 10–12 Niedermerz 1b (modified after Kuper *et al.* 1974, 439 fig. 9.8–10). Graphics: S. Suhrbier.

all these sites have also yielded quartz-tempered pottery, which, however, cannot be used on its own as a clear indicator for a Late Neolithic date (see above). Taking all these diagnostic Late Neolithic finds together, we can use them to characterise the other finds from and the nature of these sites more precisely. This can then be used to identify further sites dating to this period.

In a first step, we had a look at the few Late Neolithic settlement sites that have been excavated so far (Figure 5). They are characterised by a small number of features, usually single pits (see below; recently Claßen *et al.* 2018), and few finds, usually lithic artefacts, while pottery is only rarely found. This might explain their archaeological invisibility, because these finds and features have often not been recognised as Late Neolithic (Koch *et al.* 2014; 2017). From this we can conclude that lithics are best suited for the identification of further Late Neolithic sites — surface sites in particular — since they constitute the major part of finds from this period. These lithic assemblages are dated to the Late Neolithic because of the presence of Lousberg flint in the form of axe blades, axe blade fragments, production waste, flakes with a polished surface, or hammerstones made from Lousberg flint axe blades. They differ markedly from those dating to the earlier Linear Pottery culture, the Middle Neolithic and the Michelsberg culture, and from artefacts dating to the succeeding Final Neolithic. A closer look allows us to identify further characteristics of Late Neolithic flint assemblages.

During the Linear Pottery culture and the Middle Neolithic, flint artefact production was focused on the production of blades. During the Michelsberg culture, blade production started to lose significance, but was still of relevance (Höhn 1997a, 408, 411). In contrast, during the Late Neolithic lithic assemblages mainly consist of flakes,

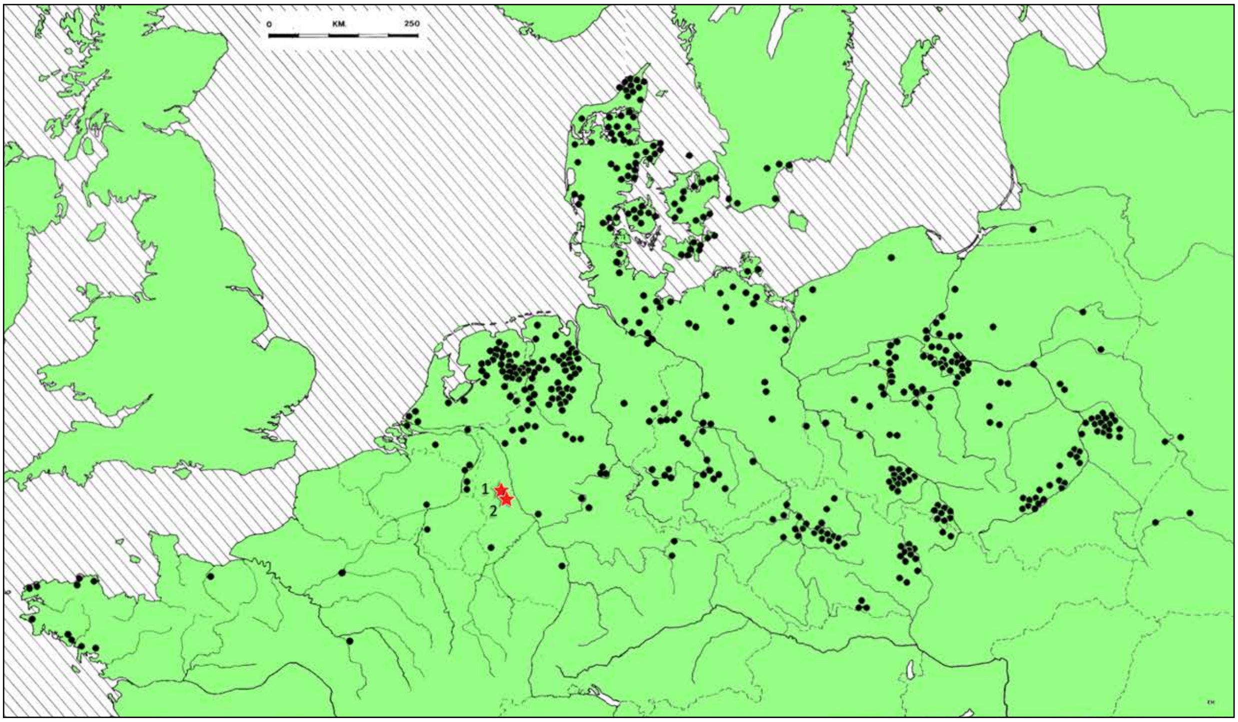


Figure 4. Distribution of collared flasks with the finds from Kerpen-Sindorf "Pferdbruchsfeld" (1) and Euskirchen-Großbüllesheim (2) shown as red stars (modified after Huysecom 1986; map: I. Koch).

not blades. These flakes can best be described as ad-hoc artefacts. Lithic analysis shows that they were produced without any systematic strategy of core reduction (e.g. Koch *et al.* 2017). Another transformation is reflected in the selection of raw materials used for artefact production. For the preceding stage of the Michelsberg culture, several lithic assemblages have been analysed (Koslar 10: Höhn 1997a; Inden 9: Höhn 1997b; Lich-Steinstrass: Hübert 2020; Eschweiler-Röhe: Roeder 2022). One example is the assemblage of Koslar 10, which dates to the early Michelsberg culture (Höhn 1997a). The assemblage comprises 918 artefacts. Of these, 58.4 % were made of Rijckholt flint, which was probably mined on slopes near what is now the city of Maastricht (De Grooth *et al.* 2011), located about 50 km west of the sites in the Rhineland. A further 26.5 % were made of flint from bench gravel of the river Old Maas (Weiner 1997), which can be found in layers near Koslar 10. A small number of artefacts were made of raw material like light grey Belgian flint/silex gris de Hesbaye, Rullen flint and Obourg flint from Belgium, Valkenburg flint from the Netherlands and Orsbach/Vetschau flint locally found in Aachen. Some pieces — however no axe blades, their fragments or related production waste — are of Lousberg flint. Another example is the assemblage of Inden 9, which yielded 1635 artefacts (Höhn 1997b, 544). The pottery from the site documents two phases of use: one during the later part of Lüning's phase Michelsberg II, the younger one during Michelsberg III/IV (Höhn 1997b, 559–60). As the analysis by B. Höhn (1997b, 547 fig. 49) shows, blades are still preferred for the production of modified artefacts (tools); 27.6 % of all (modified and unmodified) artefacts at Inden 9 are blades (Höhn 1997b, fig. 48). The raw material used mainly (c. 95 %) comes from Rijckholt. Compared to earlier Neolithic phases (Linear Pottery culture and Middle Neolithic), blanks are quite large and show a standardised size. They were for instance used for the production of laterally retouched blades, scrapers or pointed blades. In Koslar 10 and Inden 9 laterally retouched blades dominate the assemblages with c. 26 % and c. 33 % respectively, followed by splintered pieces with a proportion of 25 % (Höhn 1997a, 427 fig. 23). Rijckholt flint was also used for the production of axe blades during the Michelsberg period (Höhn 1997a, 427 fig. 23, 446). Arrowheads are characterised by surface retouch and a triangular shape with a straight or convex base, sometimes the base is slightly concave (e.g. Höhn 1997b, 553, pl. 9). In addition, leaf-shaped arrowheads have also been documented, for example at Koslar 10 (Höhn 1997a, 430).

During the Late Neolithic this changes markedly. This can be illustrated with the example of Tanneck (Koch *et al.* 2017), which can be dated to the Late Neolithic thanks to its lithic inventory consisting of Lousberg axe blade fragments, flakes with a polished surface, or hammerstones

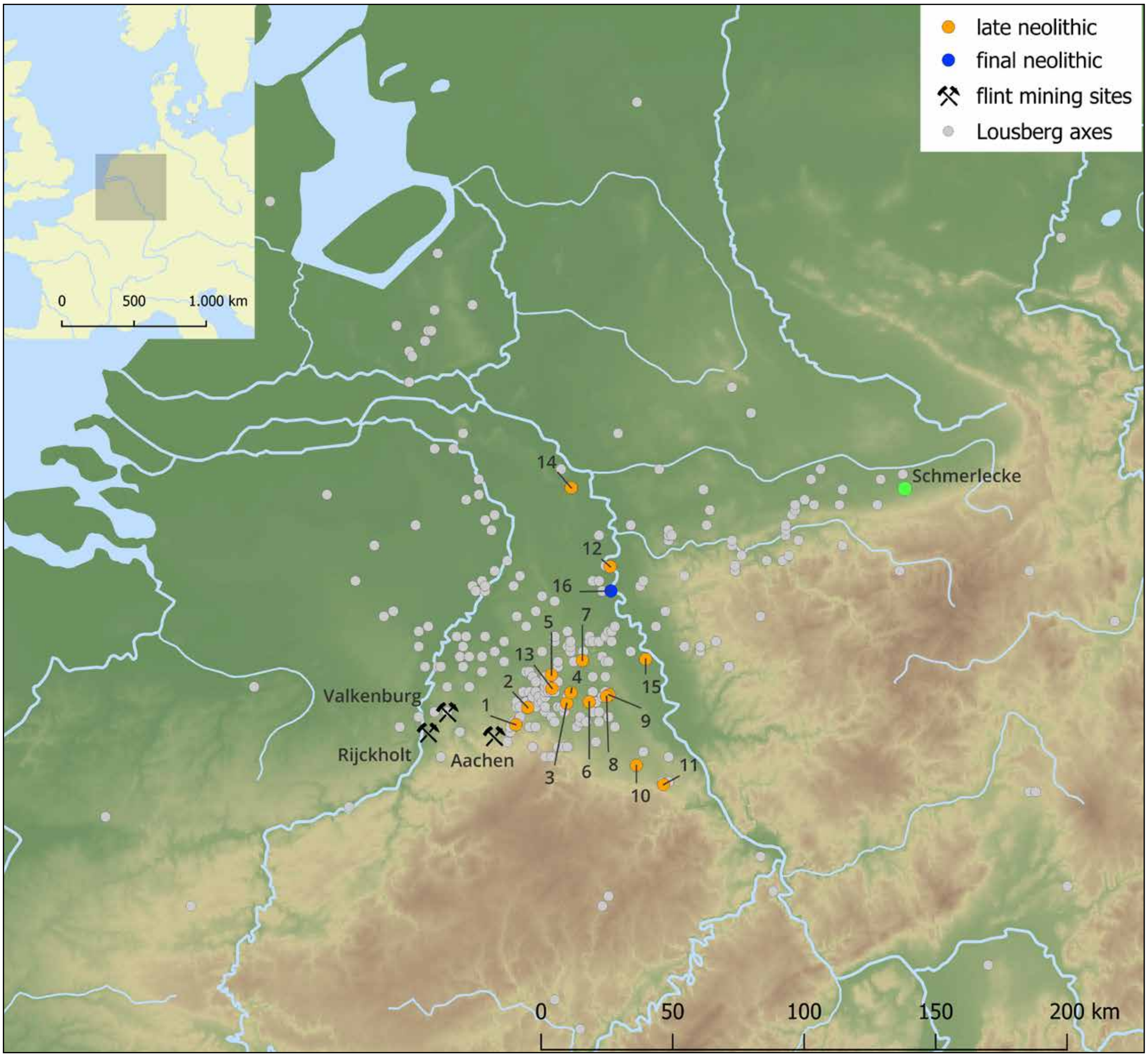


Figure 5. Late Neolithic sites in the Rhineland: 1 Broichweiden 6b (excavated in 1976); 2 Niedermerz 1b (excavated in 1972–74); 3 Hambach 9 (excavated in 1977); 4 Lich-Steinstraß (excavated in 1986–87); 5 Hasselsweiler (excavated in 1976–80); 6 Tanneck (surface site); 7 Kirchberg in Morken (excavated in 1955–56); 8 Kerpen-Sindorf "Pferdbruchsfeld" (surface site); 9 Sindorf "Zuckerberg" (surface site); 10 Euskirchen-Großbüllesheim (excavated in 2013); 11 Rheinbach-Taubenpfad (excavated in 2017); 12 Serm-Hasselberg (surface site); 13 Stetternich (surface site); 14 Veen (excavated in 1962/1965); 15 Worringer Bruch (surface site); 16 Schmerlecke (gallery grave, excavated 2008–2013); 17 Neuss-Büderich (surface site). Map: S. Suhrbier, I. Koch and S. Scharl.

made from Lousberg flint axe blades.[1] The analysis of this surface site in the loess region around Jülich, with its assemblage of 1526 pieces of flint, shows that Rijckholt flint had lost significance. Its proportion decreases to 20 %. Instead, Lousberg flint gains importance, amounting to 23 %. The inventory is dominated by a grey flint with many inclusions of white fossil fragments and residual or slightly rolled cortex which accounts for 56 %. The source of this raw material may be located in the surroundings of Liège (Marjorie De Grooth, pers. comm.) or in the alluvial terraces of the Maas (Knippenberg 2016, 168). Blank production is now dominated by flakes (of 1085 determinable blanks 73.3 % were flakes and 12.2 % were blades). Cores and debris indicate that the raw material was worked within the settlement. The cores, however, do not show any systematic strategy of reduction. Moreover, artefacts are quite small compared to earlier periods. One third of

1 We would like to thank G.M. Pütz for collecting the finds at Tanneck and making them available for scientific analysis.

the whole assemblage consists of pieces shorter than 2 cm. Many artefacts are characterised by retouch that does not form a standardised implement, in contrast to the earlier Neolithic phases. Up to 14 % are splintered pieces, 24 % are laterally retouched flakes. If we differentiate the artefacts according to raw material used, c. 15.6 % of the pieces from Lousberg flint (n = 327) are axe blades or fragments of them. We could document 23 axe blades, of which six were used as hammerstones and 13 as cores, plus six unfinished axe blades and 22 flakes of axe blades defined by the remains of a polished surface. The "axe blade cores" were used for the production of tools like scrapers, laterally retouched or truncated pieces. The artefacts made from Rijckholt flint (n = 172) are mainly flakes (n = 86) but also a few blades. Out of 18 blades, nine can be characterised as large blades. That Rijckholt flint is still in use during the Late Neolithic — even if in small quantities — can be explained by the fact that the flint mine at Rijckholt is still active at that time (de Grooth *et al.* 2011, 81 fig. 3). This is confirmed by the finds from the Late Neolithic gallery grave of Schmerlecke, Westphalia, where several tools made of large Rijckholt blades were found (Schierhold 2015). When we look at the whole assemblage, however, our impression is that systematic production of blades as blanks for formal tool types continued to lose significance in the course of the Late Neolithic of the Rhineland.

In addition, there are a few formal types of arrowheads (about 5 %) and thumbnail scrapers (about 21 %) which seem to be typical for Late Neolithic lithic assemblages in the Rhineland. The arrowheads are mainly transverse arrowheads similar to what we know from Late Neolithic Vlaardingen-Stein contexts in the neighbouring Netherlands (Amkreutz *et al.* 2016). At Tanneck, 24 out of 31 pieces are transverse projectile points. The fragment of a tanged arrowhead with a pronounced "shaft tongue" and two opposite notches on the wings (a so-called "Wartberg point"; Koch *et al.* 2017, 81 fig. 3.3) is a characteristic type of the Late Neolithic Wartberg culture in Hesse (Schwellnus 1979).

Another lithic assemblage we would address as Late Neolithic comes from Serm-Hasselberg near Duisburg. The site is located directly on the banks of the river Rhine. Overall, 694 pieces have been documented during field surveys.[2] About one third (n = 225) represent local raw material like Baltic Morainic flint, Maas gravel flint and Meuse "eggs" flint, i.e. a Tertiary surf zone gravel flint reworked by the rivers Maas and Rhine. Around 12 % (n = 83) come from sources in modern-day Belgium, and 25 % (n = 174) were made of Rijckholt flint. However, the high amount of this raw material could be explained by two Michelsberg sites in the immediate vicinity, from which Late Neolithic people could have collected those pieces. Furthermore, 19 transverse arrowheads and two Lousberg flint axe blades, used as cores for artefact production, have been documented. Thirty-one small scrapers, 38 laterally retouched pieces and 105 splintered pieces complete the picture.

Final Neolithic settlement sites are rare in the Rhineland. So far, the only site of the so-called "Rhineland Beaker culture" (a local mixture of Corded Ware and Bell Beaker culture) that could be interpreted as settlement is Neuss-Buederich, due to the quantity and variety of ceramics (mainly corded ware) and lithics and a ^{14}C-date on the bone of a wild animal. It is situated on the banks of the river Rhine (Krull and Weiner 2001; Lenerz and Schyle 2008). The lithic inventory, comprising c. 1000 flint artefacts, shows that during the Final Neolithic in the Rhineland the proportion of blades in the lithic assemblages drops to almost zero and the raw material for artefact manufacture comes from local sources only. At Neuss-Buederich the artefacts are almost completely made from local bench gravel sources or morainic flint and one can observe an "ad hoc" blank production similar to the Late Neolithic. Tools are flakes with lateral retouches or some thumbnail scrapers. Furthermore, locally produced axes consist of small, black Devonian siliceous rock pebbles with polished cutting edges. The characteristic arrowheads of this period are bifacially retouched barbed and tanged triangular points. Mining products of supra-regional origin are represented by fragments of axe blades with a rectangular cross-section made from Baltic flint and particularly a few fragments of dagger blades made from Tertiary Paris Basin flint and Grand Pressigny flint (Lenerz and Schyle 2008, 55 fig. 56.5–7). The latter indicate that the site was integrated into the extensive Final Neolithic networks of northern and western Europe.

To sum up, there are only few sites which yielded absolute dates of the Late Neolithic period, such as the Lousberg flint mine in Aachen or Rheinbach-Taubenpfad. This has been used to argue for depopulation. However, the pollen diagrams as well as geoarchaeological archives hint at a more substantial population density during the Late Neolithic in the Rhineland. Using Lousberg axe blades and specific features of the lithic inventories, we can try to identify Late Neolithic assemblages.

Flint assemblages of the Michelsberg culture, dating from 4200 to 3800 BC are characterised by:

- a high proportion of Rijckholt flint (at Inden 9 even 95 %), which was also used for the production of axe blades
- a high proportion of blades (c. 30 %)
- the production of large blanks
- triangular or leaf-shaped arrowheads with surface retouch

2 We would like to thank Thomas van Lohuizen for collecting the finds at Serm-Hasselberg and making them available for scientific analysis.

In contrast, Late Neolithic assemblages are characterised by:

- axe blades of Lousberg flint, the presence of semi-finished products of Lousberg flint, fragments of Lousberg axe blades and their secondary use as cores, flakes and tools with polished surface
- supply with locally and regionally available raw materials which mainly comprise residual and gravel flint types
- a high proportion of unmodified flakes, and a low proportion of blades (c. 15 % or less)
- a small number of standardised tool types (e.g. transverse arrowheads, notched arrowheads with a "shaft tongue" tang, thumbnail scrapers, few large blades of Rijckholt flint)
- the lack of standardised core reduction and
- a high degree of "ad-hoc" domestic blank production

Based on this, and adding the Late Neolithic sites with diagnostic imported pieces or absolute dates (see above), in the second part of our article we try to develop a clearer idea of what the archaeological record of the Late Neolithic in the Rhineland looks like.

The current state of research on Late Neolithic sites in the Rhineland

Figure 5 shows sites that have been dated to the Late Neolithic, either because of the specific composition of their lithic assemblage or — in rare cases — by diagnostic pottery like collared flasks, or by absolute dates, as in the case of Rheinbach-Taubenpfad or the flint mine on the Lousberg. Also the flint mines at Valkenburg and Rijckholt in the neighbouring Netherlands show traces of Late Neolithic activities. We will leave aside the flint mines in our article and will focus on those sites that are interpreted as settlements.

Interestingly, they are situated in quite different geological settings. Rheinbach-Taubenpfad, Broichweiden 6b, Hasselsweiler, Lich-Steinstrass or Euskirchen-Großbüllesheim, for example, are situated on loess soils and elevated areas, often associated with features of the preceding Linear Pottery culture and the Middle Neolithic, which preferred these habitats. Hambach 9 lies on a terrace of the river Rur, the two sites at Kerpen-Sindorf (Pferdbruchsfeld and Zuckerberg) are situated in the meadow of the river Erft and Serm-Hasselberg is located directly on the banks of the river Rhine. Therefore, our patchy archaeological maps of the Late Neolithic are not simply caused by a settlement behaviour that focused on marginal areas, like meadows, where archaeological investigations are rare.

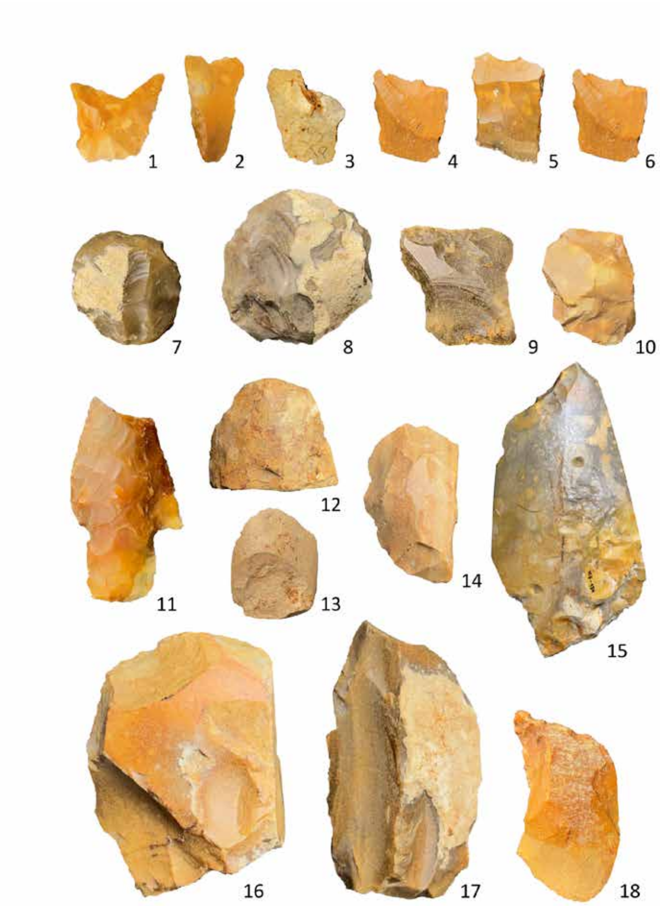
Often, sites have been identified in the course of large-scale excavations. This applies above all to the sites in loess areas, where for example the establishment of industry parks necessitated rescue excavations. These Late Neolithic sites are usually characterised by single pits or a small number of pits with diagnostic finds, interspersed between much more plentiful features of other periods. For example, the site of Euskirchen-Großbüllesheim was discovered in the context of a large-scale excavation of almost 1 ha. Here, one pit was identified as Late Neolithic, since it yielded a fragment of a collared flask (Tutlies *et al.* 2016). All other pits can be either dated to earlier Neolithic periods or to the Iron Age.

Another example is the Michelsberg enclosure of Lich-Steinstrass, which was excavated in the Rhenish lignite mining area. Here, over 5 ha have been investigated, mainly in order to document the enclosure. Two pits in the area east of the enclosure have been identified as Late Neolithic, as they yielded mainly Lousberg flint and some flakes made of Belgian Hesbaye flint. In addition, south of the enclosure, eight pits and several postholes have been interpreted as Late Neolithic features, since they also yielded Lousberg axe blades, thumbnail scrapers, transverse arrowheads and quartz-tempered pottery.

At Rheinbach-Taubenpfad more than 5 ha have been excavated in the course of rescue excavations. The area yielded pits and postholes of the Linear Pottery culture, the Middle Neolithic and the Late Neolithic. The latter was represented by three pits that hint at the remains of a settlement. The quartz-tempered pottery shows clear similarities to finds from the Vlaardingen culture. Two radiocarbon dates were taken on two pig bones from the upper and lower fill of pit 48. Both dates fall into the transition from Late Neolithic to Final Neolithic as defined by Lüning's scheme, they date between 2870 and 2570 calBC (Claßen *et al.* 2018). Correspondingly late radiocarbon dates have been obtained from settlements which — based on the pottery found there — were ascribed to the Late Neolithic Vlaardingen culture/Stein group in the Netherlands (e.g. Amkreutz 2013, 397 tab. 8.8; Van Hof *et al.* 2013, 80 tab. 7.3; Verhart 2010, 218 tab. 2). This chronological disaccord might be explained by the persistence of the Vlaardingen ceramic tradition (production process and pot types) well into the time of the beaker cultures, especially the Corded Ware culture, as recent research in the Netherlands shows (Kleijne and Huisman 2023; Kroon *et al.* 2019). This continuity in the material culture should also be considered as a possibility for ceramic traditions in the Dutch Limburg (Stein group) and the Rhineland, too.

All these sites and several more have been discovered only because large-scale excavations have been conducted. Therefore, except for the Lousberg in Aachen, Broichweiden 6b and Hambach 9, all Late Neolithic sites in the Rhineland have been discovered as "bycatch" in the context of other prehistoric periods. And all these sites are characterised by a small number of pits, sometimes only a single pit.

Looking at the archaeological finds, all these sites are moreover characterised by a low number of finds. In Lich-



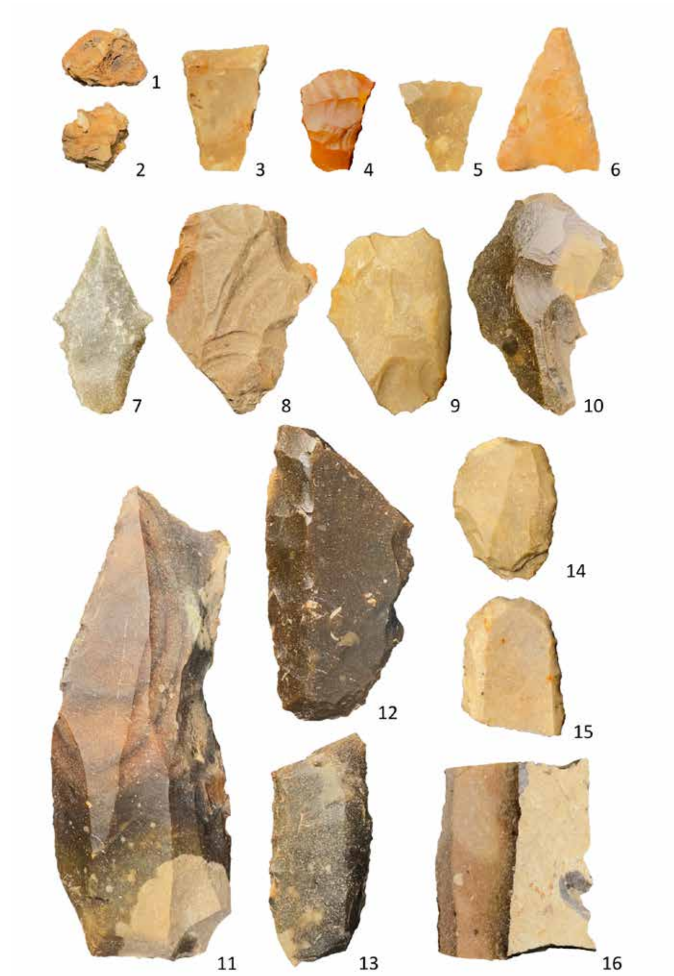


Figure 6. Diagnostic Late Neolithic lithic finds from Sindorf-Pferdbruchsfeld (1–11, 16–18 actual size, 12–15 at a scale of 1:2). 1–6 transverse arrowheads, brown colour caused by waterlogging; 1, 2, 5 silex de Hesbaye/gravel flint; 7–8 scrapers, 7 gravel flint, 8 light grey Belgian flint/silex de Hesbaye with traces of heat exposure; 9–10 splintered pieces, brown colour caused by waterlogging, 9 Rijckholt flint, 10 light grey Belgian flint/silex de Hesbaye; 11 tanged and short-winged arrowhead, brown colour caused by waterlogging; 12–14 axe blade fragments of Valkenburg flint; 15 axe blade fragment, light grey Belgian flint/silex de Hesbaye, traces of heat exposure and brown colour caused by waterlogging; 16 axe blade fragment used as a core; 17 butt of an axe blade; 18 flake from an axe blade, 16–18 Lousberg flint, brown colour caused by waterlogging (photos: I. Koch, A Kotitschke and S. Suhrbier).

Figure 7. Diagnostic Late Neolithic finds from Sindorf-Zuckerberg (actual size). 1–2 quartz-tempered pottery; 3–5 transverse arrowheads, silex de Hesbaye/gravel flint with brown colour caused by waterlogging; 6 triangular arrowhead with brown colour caused by waterlogging; 7 arrowhead with a "shaft-tongue" tang and two opposite notches, residual flint from the Liège region or Maas terraces; 8 flake of an axe blade, Lousberg flint; 9 flake of an axe blade, Rullen flint; 10 flake of an axe blade, Rijckholt flint partly with brown colour caused by waterlogging; 11 large blade with use retouch, Rijckholt flint, partly brown colour caused by waterlogging; 12 large sidescraper fragment, Rijckholt flint; 13 blade fragment with lateral retouch on both sides, Rijckholt flint, partly with brown colour caused by waterlogging; 14 scraper, Rijckholt flint, partly with brown colour caused by waterlogging; 15 scraper on a blade with lateral retouch, Rijckholt flint/gravel flint; 16 fragment of a large blade with lateral retouch, Rijckholt flint partly with brown colour caused by waterlogging (photos: I. Koch, A. Kotitschke and S. Suhrbier).

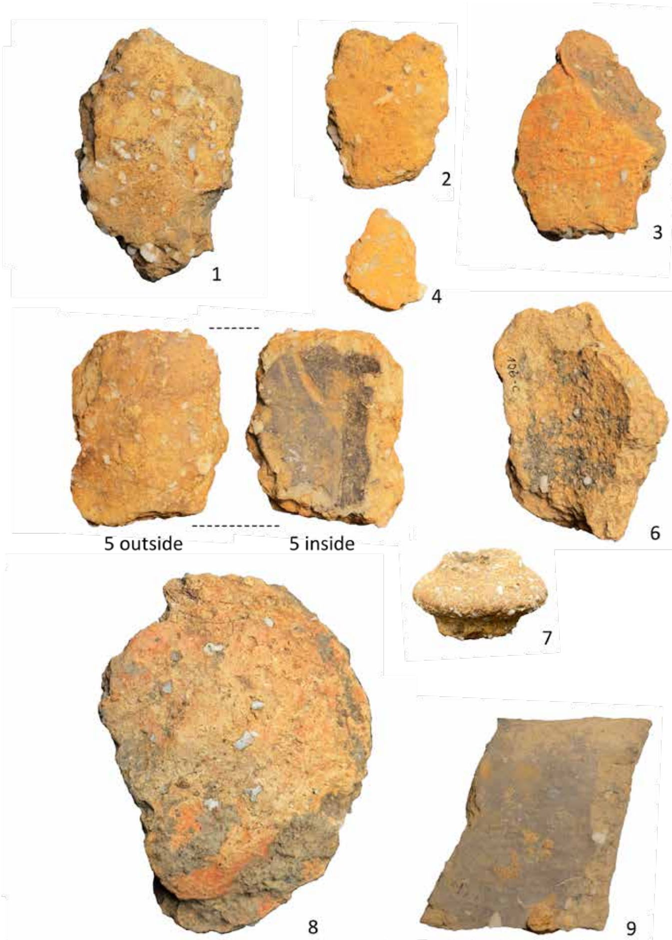


Figure 8. Diagnostic Late Neolithic pottery from Sindorf-Pferdbruchsfeld (actual size). 1–5 quartz-tempered pottery; 6 fragment of a flat base with parts of the profile; 7 fragment of the neck of a collared flask; 8 fragment of a flat base; 9 rim sherd (photos: I. Koch, A. Kotitschke and S. Suhrbier).

Steinstrass, for example, ten pits yielded diagnostic finds. T. Hübert, who has analysed the archaeological record for his MA thesis, ascribed 14 features to this period. For another twelve he considers a date in the Late Neolithic probable (Hübert 2020). To date this is one of the largest Late Neolithic sites we have in the Rhineland. Three pits yielded pottery, together 116 sherds, but they were tiny and badly preserved. The only more or less diagnostic piece is a fragment of a flat base with quartz temper. This fits into a Late Neolithic context, but might also be a bit earlier or a bit later. It is only the lithic artefacts which allowed him to assign this site more confidently to the Late Neolithic.

This also goes for the other sites that have been documented so far. If there is pottery, sherds are mostly tiny and badly preserved. These pieces usually do not exhibit any diagnostic features. Figure 3 shows a selection of diagnostic pieces of pottery we know so far from Late Neolithic sites in the Rhineland. These show flat bases, an s-shaped profile or a quartz-tempered matrix and sometimes fragments of collard flasks, as in Euskirchen-Großbüllesheim or Kerpen-Sindorf "Pferdbruchsfeld" (Figure 4). Since the pottery in most cases is only badly preserved, however, it is quite difficult to recognise these tiny pieces during fieldwalking surveys. Therefore, Tanneck and the two concentrations at Kerpen-Sindorf (Pferdbruchsfeld and Zuckerberg) were identified as Late Neolithic sites mainly because of the lithic assemblage we could collect there: Lousberg axe blades, Valkenburg axe blades,[3] thumbnail scrapers, transverse arrowheads, a single tanged and short-winged arrowhead (Figure 6; also known from Late and Final Neolithic contexts in western and central Europe), a single arrowhead with a "shaft tongue" tang and two opposite notches on the wings (Figure 7; also known from Late Neolithic contexts in France, Switzerland and the Wartberg culture in Hesse), raw material that is dominated by local and regional sources, Lousberg flint and a — compared to Michelsberg — lower amount of Rijckholt flint. In addition we found small pieces of quartz-tempered pottery (Figures 7–8).

Conclusion

The Late Neolithic in the Rhineland is definitely there, and based on specific characteristics of the pollen record, geoarchaeological archives and lithic assemblages we would posit that we have a more substantial human activity in this region during the second half of the fourth and the early third millennium BC than we thought ten or 15 years ago. Whether this human activity was discontinuous or not is an important question for future research. To clarify this, we need more absolute dates and therefore also more excavated sites, especially settlements.

Another point we want to make is that the Late Neolithic in the Rhineland is not only hard to recognise in the archaeological record, but it is also hard to delimit from neighbouring regions. What we see is a kind of mixture of what we would call local types, like the Lousberg axe blades, and supra-regionally distributed types like the collared flasks, which are also known from TRB, Vlaardingen or Wartberg contexts (Figure 4), or the s-shaped, flat-based pots (also known from contexts in the Netherlands, i.e. Vlaardingen and Stein), tanged and short-winged arrowheads (also known from Late and Final Neolithic contexts in western and central Europe) or notched arrowheads with a "shaft-tongue" tang also known from France, Switzerland and the Wartberg culture in Hesse. However, this admixture or spatial continuum is also recognisable in other regions, which is why it seems to be a more general characteristic of this period.

3 Since all radiocarbon dates from the extraction pits and workshops at the Valkenburg flint mine range between 3600 and 2600 calBC (Drenth and de Kruyck 2017, 131), axe blades from this raw material can also be taken as an indicator of Late Neolithic activity.

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In varietate concordia — united in diversity

Battle axes, coarse ware pottery and burial rituals during the Late Neolithic of western and central Europe and their meaning for the deconstruction of Final Neolithic narratives

Sebastian Schultrich

Abstract

During the Late Neolithic in western and central Europe, certain artefacts and behaviours appear that are quite similar. This concerns battle axes, burial rituals and a rather unspecific coarse ware pottery. These three attributes follow supra-regional rules, but the details are regionally distinct: *in varietate concordia*. By combining and critically re-evaluating these attributes, we can reconstruct the existence of a dynamic network and the development of an idealised worldview that focuses on individuals. Thus, we can trace classic features of the Final Neolithic cultures back to the Late Neolithic.

Keywords: battle axes, Late Neolithic, coarse ware pottery, warrior symbology, single graves, collective graves

Introduction

Single graves, gender differences, individual grave goods, warrior-related identities, violence, high mobility, supra-regional networks, supra-regionally shared symbols — all these buzzwords are attached to the archaeological cultures of the Final Neolithic (FN, c. 2800–2200 BC) and they are interdependent. Once established at the onset of the FN, many phenomena last for a long time. For example, the warrior is a certain social role we see in single graves with supra-regionally significant symbols. Allegedly, it enters the stage in the FN in many parts of Europe and remains present for thousands of years (e.g. Kristiansen *et al.* 2017; Vandkilde 2006). The genetic pool of central Europeans changes a few times during prehistory, however, with the FN the dynamic seemingly gets lost. FN individuals have similar genotypes to modern-day Europeans (Haak *et al.* 2015). Connected to this, many scholars propose that the forerunners of our modern European languages spread in this phase (Olander 2019, 19–24).

Recent aDNA studies have revitalised old narratives (e.g. those of Gimbutas 1956; Glob 1944, 242; Kossinna 1928) and resulted in simple scenarios of violence, domination and the movement of people (Kristiansen *et al.* 2017; critiqued e.g. in Furholt 2019).

In D. Hofmann, D. Mischka and S. Scharl (eds) 2025. *The eve of destruction? Local groups and large-scale networks during the late fourth and early third millennium BC in central Europe*, 221–242.
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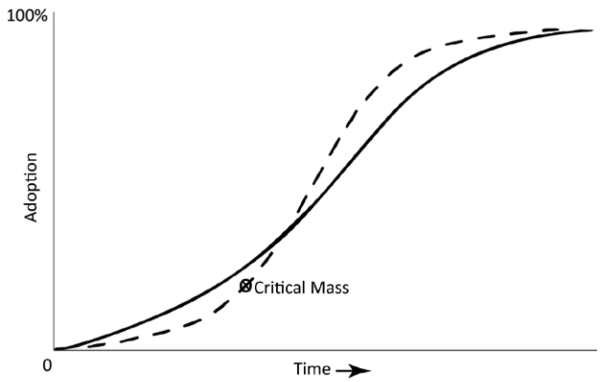

Figure 1. Model for the diffusion of innovations. The rate of adoption of an innovation changes when the tipping point is reached (after Fokkens 2012, 23).

However, discussions during the last years have shown that these processes were much more complicated (Furholt 2021; Papac *et al.* 2021; Włodarczak 2021). Sticking to the more simplistic narratives hinders a balanced evaluation of this period.

Similarly, for the Late Neolithic (LN c. 3500–2800 BC) narratives exist which also hinder a balanced assessment. Scholars often portray LN societies as acting in completely opposite ways to FN ones. They are said to be peaceful and group-oriented (Kristiansen *et al.* 2017, 342; Vandkilde 2004, 75). This is reflected by the erection and use of collective burials, causewayed enclosures and settlement agglomerations (Mischka and Furholt 2019; Müller 2019). On the basis of the graves, we can hardly reconstruct individual identities or gender differences. Also, the material culture, especially the pottery, is considered to be of much more local relevance (Ebbesen 2011, 301–06; Lorenz 2018). Then, with the onset of the FN, everything changes drastically — supposedly.

These assumptions, however, cannot be sustained. In this paper, I will investigate battle axes to show that supra-regionally shared signs existed during the LN. Moreover, I will critically re-evaluate what goes under the term collective grave and highlight regional differences. These differences help us to explore the potential for the reconstruction of certain social roles during the LN and thus tone down some of the narratives of the onset of the FN.

The beginning of the Corded Ware culture

The genetic evidence clearly shows that the early third millennium was a dynamic phase and new genes (esp. sub-haplotypes of R1a and R1b) reached central Europe (Haak *et al.* 2015; Papac *et al.* 2021). Some studies portray the spread of the Corded Ware culture (CWC) as a conquest, a monocausal process, and they imply that the archaeological culture itself had an agency (e.g. Kristiansen *et al.* 2017).

However, the spread of the CWC into its various regions was not one single process, nor was the CWC a homogeneous culture and there was no conquest-like mass migration — the CWC itself had no agency (Furholt 2019, 125; 2021; Papac *et al.* 2021). Moreover, the spread was not as fast as supposed. There is evidence for a distribution of pioneer graves of the so-called Kalbsrieth horizon which is consistent with leap-frog-like migration (Heyd 2021). However, the backbone of this pioneer horizon must be put into perspective (see below). Recently a study confirmed early CWC dates[1] in Bohemia (Papac *et al.* 2021, 10). In Switzerland, CWC symbols appear in the late twenty-eighth/early twenty-seventh century BC (Hafner and Suter 2003, 46; see also Włodarczak 2012, 130). Thus, the spread of the CWC lasts more than two centuries.

When we argue that CWC symbolism is an innovation, we should differentiate the term. Innovation can simply be a new artefact, material or way of production. However, it can be much more complex. CWC symbolism is a very specific way of expressing a certain supra-regional identity in the funerary domain through certain rules, arrangements and artefacts (Bourgeois and Kroon 2017; see also Barrett 2018, 18).

Often, the graph by E. Rogers (1995) is used to demonstrate the innovation process (Frieman 2021). Figure 1 shows that first, a minority accepts an innovation. After some time, more and more people accept it and the curve reaches a tipping point. Hereafter, this innovation is generally accepted in society. This simplified graph shows what many scholars see in their data: innovations are successful in pre-modern societies only when they become carefully embedded in existing cultural traditions (Bernbeck and Burmeister 2017, 7; Frieman 2021; Scharl 2019). This means that accepting an innovation takes some time.

The CWC did not spread by itself. The spread of innovations rests on communication and it is embedded in social contexts (Rogers 1995; see also Frieman 2021, 131; Scharl 2019). There is a certain meaning in burying someone according to specific rules. That the meaning is comprehensible for the executing societies requires socialisation within the narratological context (Ribeiro 2018, 114; see also Barrett 2018, 18). Accordingly, as CWC symbolism is widespread, a similar socialisation process must be present in all participating regions. Thus, by the time we as archaeologists can reconstruct the supra-regional "CWC package", supra-regional negotiation must already have happened. Consequently, the spread of the CWC as it appears in the archaeological

1 E.g. Vliněves (4225±81 bp, 3018–2901 calBC, Lab. Nr- CRL-9189, from long-bone), Stadice (4314±25 bp, 3010–2889 calBC, Lab. Nr-MAMS-45793, from skull) (Papac *et al.* 2021, tab. S3).

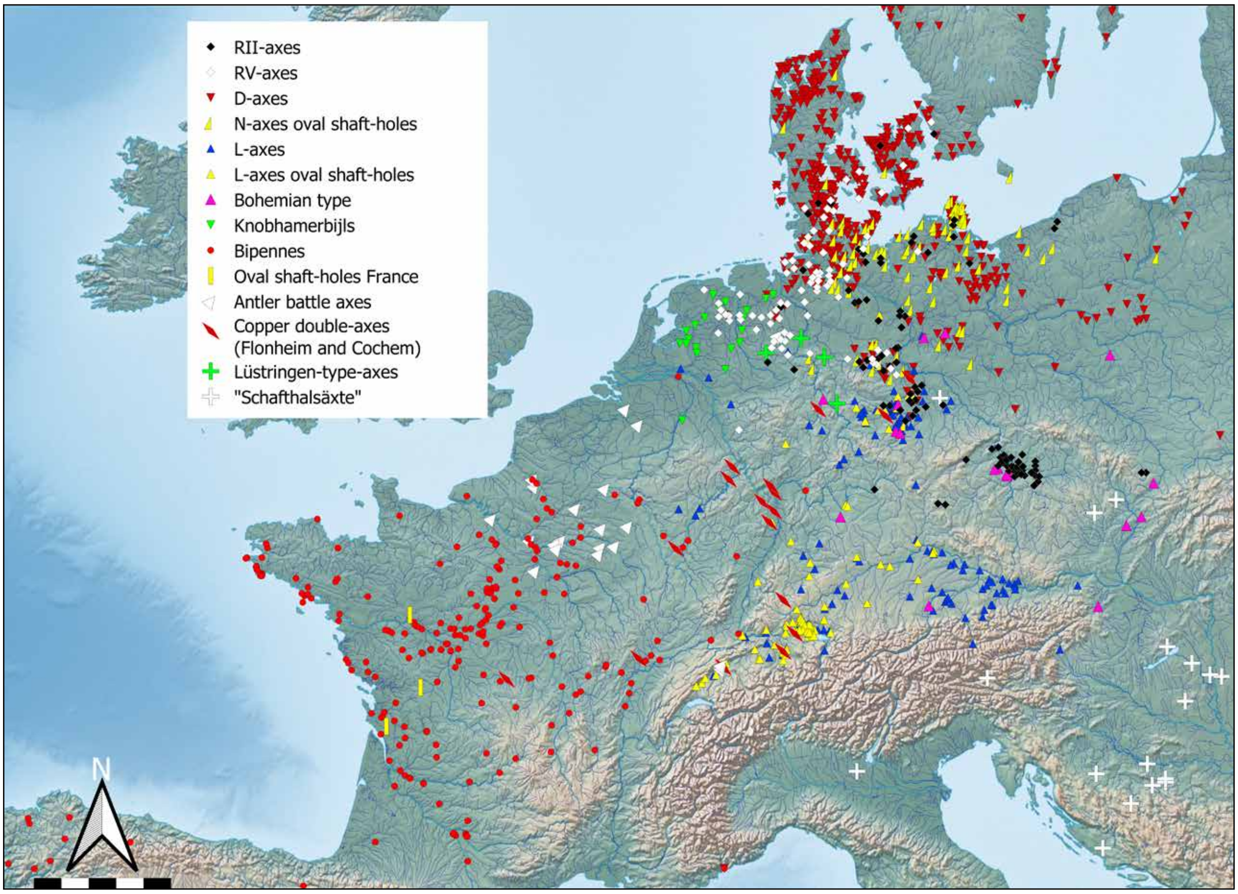

Figure 2. The LN battle axe types in western and central Europe addressed in this study (base map after Natural Earth, free vector and raster map data @ naturalearthdata.com).

record is not the time when new things are initiated. Rather it is the completed process we see — the tipping point in Rogers' (1995) curve.

If we do not think that mass migration was responsible for the changes at the onset of the FN, and when we consider the regional differences during the FN, we must look for a gradual process in our data on the LN. To show this, I will introduce the battle axe phenomenon. The battle axe is a highly symbolic object and key for reconstructing supra-regional networks during the fourth and third millennia BC. To reconstruct its symbolic function, I highlight its diverse appearance (stone, copper, depictions). Analysing these contexts reveals that important developments happened already during the LN, and not at the beginning of the FN. The growing data base of LN single graves, which I address in a later part of the paper, also supports this. Important in this respect is a differentiated perspective on what is termed "collective grave". To begin with, I will address some general and recent observations on the typology of battle axes, which are important for recognising their significance in the LN.

Late Neolithic stone battle axes

In the middle of the Younger Neolithic (YN, c. 4400–3500 BC), the battle axe emerges as a distinct type of object in central Europe (Figure 2). This shaft-hole axe is not primarily a tool which can in addition function as a weapon, such as flint axes. Instead, it is specifically designed for being a weapon or weapon-symbol (Zápotocký 1992, 195; cf. Horn 2014, 222).[2] Being a specialised weapon differentiates the battle axe from mundane shaft-hole axes. Morphologically, mundane axes and battle axes differ by their shape (simple *vs* complex), use (sharp *vs* blunt cutting edges) and use life (often *vs* almost never re-worked when broken) (Hoof 1970, 80). As it is a specialised weapon and accompanies deceased persons in burials in many regions and periods all over Europe, many interpret these individuals as having a special social function (e.g. leaders and/or warriors) (Vandkilde 2006). However, due to the geographically wide distribution

2 The designation "weapon" does not necessarily mean that the item was used as such. It can be a signal element of being ready for defence and avoiding conflicts (Jung 2020, 622).

we cannot draw general conclusions. Yet in contrast to mundane tools, the typologies often are very similar over huge areas (Struve 1955; Zápotocký 1992). This indicates that although we are dealing with completely different societies and differences in the respective meaning of the battle axes, these axes do at the very least form one common denominator (Schultrich 2022, 347–49).

Introduction to the typology

Basically, two kinds of battle axes exist. On the one hand there are hammer axes, which possess two different ends (the cutting edge and a hammer-like butt). Such axes existed primarily during the YN (F- and K-axes; letters refer to the typology by M. Zápotocký 1992[3]) and again during the FN (CWC axes e.g. A-axe; Struve 1955). On the other hand, round-butted axes (R-axes) and double axes (*bipennes*, D- and L-axes) appear between these two periods in the LN.[4] Double axes can be completely symmetrical with two similar cutting edges; round-butted axes in contrast have a roundish butt end which is, however, clearly not hammer-shaped. D/L- and R-axes are typologically related to each other and various hybrids exist (Schultrich 2022, 212, 263–65; Zápotocký 1992, 98–102).

LN typologies

In the LN of western and central Europe, several distinct, although related lithic battle axe traditions existed (Schultrich 2022, 199–340).[5] Both R- and D-axes often occur in burials, so they are securely dated to the LN (Figure 9). In central Germany, R-axes clearly dominate. Here, very distinct local types occur, such as the RV-axes, also called *Hannoverscher Typ* (Figure 5) (Zápotocký 1992, 108–09), and the often decorated RII-axes (Figure 3.5), also known as *Salzmünder Äxte* (Müller 2001, 399; Schunke 2013b, 252; Zápotocký 1992, 107). Also in Bohemia, R-axes predominate (Furholt 2009). In Moravia, Slovenia and northern Italy, "iron-shaped" round-butted axes appear, which are not covered in this paper (Bernardini *et al.* 2018, 284; D'Amico *et al.* 2015; Schultrich 2022, 265).

In northern central Europe, D-axes occur (Figure 3.1.2). It is unclear whether the D-axes develop from R-axes (Schultrich 2022, 277–78). On the basis of early D(I)-axes, DIII-axes evolve predominantly in Denmark and *Nackenkammäxte* ("neck-comb" axes/N-axes) in north-eastern Germany (Figure 3.4) (Woidich 2014, 75; Zápotocký 1992, 143). N-axes often have oval shaft holes. Typologically related is a type labelled "Bohemian type", which does not feature a neck-comb (Figure 3.6). It predominantly appears in central Germany and the Czech Republic (Schultrich 2022, 264–65).

For a long time, the L-axes (lancet-shaped double axes) (Figure 3.7.8) of southern central Europe were not well-dated, as there is a general lack of LN burials in southern Germany and in the western Alps (Furholt 2009, 133). I. Burger (1988, 130) still questioned their attribution to the LN Cham culture. Since the late 1990s, however, there are enough settlement finds to date them to the LN (Matuschik 1999; Winiger 1999). Most dendrodates from the western Alps place them into the early third millennium denBC (Affolter and Suter 2017, 340; Schultrich 2022, 273–74). Moreover, burial contexts in western and central Germany and the eastern Alps date this type to the late fourth millennium BC (Beran 1990). Thus, the L-axes of the western Alps appear to be younger.

L-axes clearly are related to round-butted axes (Beran 1990; Maier 1964) and presumably they typologically evolved from them (Schultrich 2022, 274–78). Everywhere, except for the western Alps, L-axes of the so-called Halfing-Linz type occur (Figure 3.3). Such axes are very long (often more than 30 cm), with a marked profile, made of shining stones and polished very thoroughly. Often, they occur as single deposits in rivers (Maier 1964, 20–22; Schultrich 2022, 269–73). In the western Alps in contrast, where the L-axes seem to be younger, specimens with oval shaft holes are frequent (Figure 3.8) (Schultrich 2022, 275, 283–84).

In western and central France, *bipennes* appear. As Zápotocký (1992) did not address them, I pay them special attention here. Although the term *bipenne* is the French translation of double axe, it covers both round-butted and double axes (Schultrich 2022, 208–16). Some axes are rather simple, with roundish butt ends and round cross-sections (Figure 3.10). Other axes, in contrast, are very elaborate, with a marked profile, an angular cross-section and almost symmetrical shape — both vertically and horizontally. There is also a special variant which is symmetrical on the vertical axis only (Figure 3.9). Boat-shaped axes are called *bipenne naviforme* (Schultrich 2022, 208–16; see also Giot 1959).

Due to morphological similarities to the so-called I-axes of the Late FN Single Grave culture (Hübner 2005, 120–27; Schultrich 2018, 109–13), P. Giot (1959) proposed a similar date for the *bipennes* (late third millennium BC). The only

3 His studies are an important source for central European battle axes. Many of his suggestions are still valid, while others are disproven or set into perspective. He did neither address the LN specimens of southern central Europe (i.e. southern central Germany, southern Germany (Bavaria, Baden-Württemberg), Austria, Switzerland), nor the western European battle axes.

4 The simple concept of round-butted axes emerges prior to the LN (Hafner and Suter 2003, 15) and persists into the Metal Ages (Lekberg 2004). Rarely, double axes already appear in the late fifth millennium BC, as shown by an axe from a Swiss lake (Gnepf-Horisberger *et al.* 2000). They are, however, rather related to the Lengyel-type axes of more easterly regions (Zalai-Gaál 1991, 391).

5 Not addressed in this paper are the double axes of north-west Iberia, which are related to the French specimens (Schultrich 2022, 409–12).

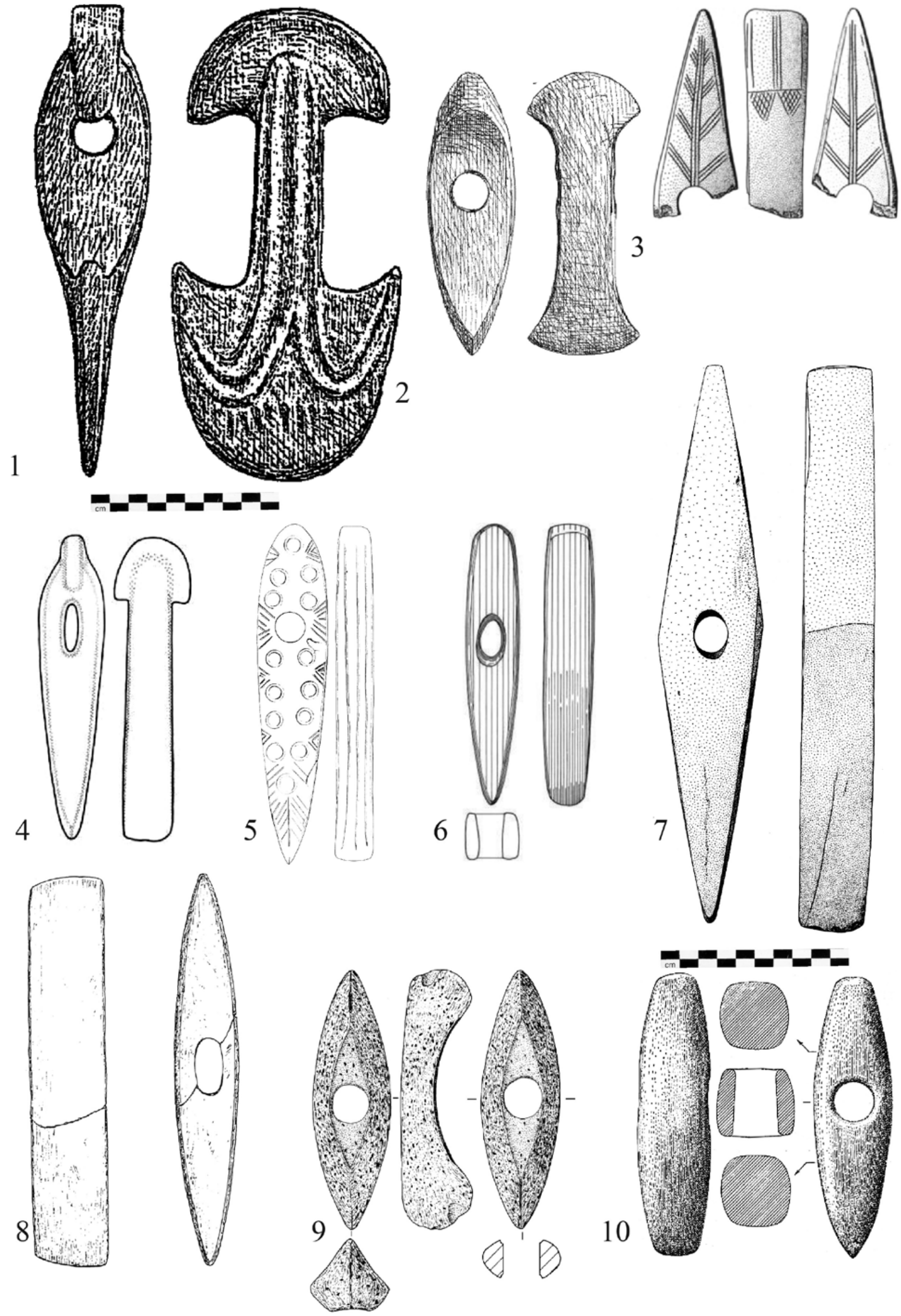

Figure 3. Selected LN stone battle axe types mentioned in the text. 1 DIII-axe from Oddengårds Mølles Mark, Denmark (Ebbesen 1975, 181 fig. 147.6); 2 DII-axe from Skaderedegårds Mark, Denmark (Ebbesen 1975, 178 fig. 144.5); 3 Halfing-Linz type axe from Bischofsheim, southern Germany (Maier 1964, list 3 no. 1, fig. 89.1; Schultrich 2022, kat. 568, tab. 43.a); 4 NI-axe from Oldenburg, northern Germany (Zápotocký 1992, 521 tab. 121.5); 5 RII-axe from Rassnitz, central Germany (Zápotocký 1992, 481 tab. 81.11; Schultrich 2022, tab. 46.b); 6 "Bohemian type" axe from Reinhardshagen-Vaake (Schultrich 2022, kat. 754, tab. 48.b); 7 L-axe from Neßlbach, south Germany (Maier 1964, 20 fig. 1.4); 8 L-axe from Lüscherz, Switzerland (Schultrich 2022, kat. 717, tab. 41.e; Winiger 1999, 100 fig. 55.1); 9 *bipenne naviforme* axe from Beuzevillette, northern France (Schultrich 2022, kat. 228, tab. 25.b); 10 simple *bipenne* axe from Chaumont-Sur-Loire, central France (Schultrich 2022, kat. 151, tab. 15.f). All same scale.

known ^{14}C-dates seemingly confirmed this (Gachina *et al.* 1975). However, in the original publication, the dates are not calibrated.

Only in Brittany do *bipennes* regularly come from burial contexts. As Giot (1959) noted, most contexts are passage graves. As they were erected in the late fifth and early fourth millennium BC and re-used for a long period (Scarre 2015, 79–81), these contexts do not help to date the axes. However, we know one gallery grave that yielded one *bipenne* (Herbaut 2001, fig. 66B). Gallery graves were erected in the second half of the fourth millennium BC — a *terminus post quem* for the dating of the axes. In western France, the fragment of a bipenne naviforme was found together with pottery of the so-called Peu-Richardien phase (3400–2900 BC) (Ard 2013). Calibrating the available ^{14}C-dates reveals a thirty-first century BC date (Schultrich 2022, 202).[6] The dating of the central European double axes is taken as further reference for the *bipennes*. Due to the lack of dated contexts, no internal typochronology exists (Schultrich 2022, 206–23).

Lastly, hammer axes do exist during the LN in some regions. Different forms occur in Baden, Ezero, and Coţofeni contexts, and in the Caucasus region — all dating to the late fourth millennium BC (Hansen 2010, 304; Zápotocký 1992, 194). Some knob-butted hammer axes (K-axes) appear in Copper Age contexts in northern and central Italy (Bernardini *et al.* 2018, 284; Skeates 1992, 401). In contrast to Zápotocký's (1992) suggestions, K-axes did exist during the LN of central Europe. A specific variant labelled *knobhamerbijl* (basically knob-butted hammer axe) occurs in the Netherlands and north-western Germany (Figure 2, Figure 5.2). Zápotocký (1992, 71–72) dated some of those axes to the YN and others to the Bronze Age. However, J.A. Bakker (1979) already suggested a quite different date for these axes. J.N. Lanting (2018) confirmed that the axes are a LN regional type. I shall return to these axes later.

Battle axes from other materials

During the FN, battle axes are depicted on stelae, albeit rarely (Figure 6.5). Miniature axes made of stone or clay occur (Seregély 2008, 281–82). In some regions, antler battle axes appear (Hafner and Suter 2005, 15). Copper hammer axes which resemble early CWC stone hammer axes are well-known and labelled *Eschollbrücker Äxte* (Kibbert 1980; Maran 2008). This multi-modular presence testifies to the high symbolic value of FN battle axes. However, the phenomenon of battle axes made in all these materials is not an invention of the FN.

LN copper double axes

Already during the Late YN, we know morphologically similar axes made of stone and copper. In the Alpine region and northern central Europe, many lithic hammer axes appear (Schultrich 2022, 249–51; Zápotocký 1992, 66–69) alongside a few copper hammer axes (e.g. Malmö, Sweden; Śmierdnica, Poland; Puch, Austria: Klassen 2000, 147; Zápotocký 1992, 196–97). The hammer axes confirm the network which becomes evident by examining the early copper distribution in general (Gebauer *et al.* 2020; Klassen 2000).

As there are both YN and FN copper axes, we should look for potential LN specimens. In some regions, so-called Zabitz-type copper double axes appear. Citing K. Kibbert's (1980) more than 40-year-old study, scholars mostly date them to the Late FN and Early Bronze Age. Judging from the material composition, the Zabitz-type axes are neither clearly LN, nor clearly not LN (Schultrich 2022, 322–23; see also Brozio *et al.* 2023). However, morphological considerations and spatial and contextual observations make a LN date plausible.

The general appearance of the copper double axes is very similar to lithic L-axes (Figure 4.4–5). Both are double-edged artefacts and in side view both are straight (Bunnefeld 2019, 191; Schultrich 2022, 323–26). This especially applies to the Zabitz sub-type Cochem, which has very small and oval shaft holes. We also know oval shaft holes from LN N- and L-axes, and the latter share their main distribution area in south-western Germany and Switzerland with the Cochem sub-type (Schultrich 2022, 285). One copper axe was found near a LN Horgen site, with no material dating to other phases known in the surroundings (Angeli 1953). This speaks in favour of a Horgen context and thus LN date. The ornamentation of the Flonheim sub-type was taken as indication for a younger date (Kibbert 1980). However, similar zig-zag and triangle motifs occur on LN pottery (Ebbesen 2011, 52–57; Lorenz 2018, 145–65) and LN stone slabs in graves (Schunke 2013a, 154).[7]

All these observations show that at least some of the Zabitz-type axes date to the LN. Whether they all are LN, or whether the smaller Westeregeln sub-type in central Germany is younger, is discussed elsewhere (Schultrich 2022, 319–29).

Copper and stone battle axes in north-western and central Germany

In north-western Germany, four peculiar copper hammer axes exist, which are here named Lüstringen-type axes after the last place of discovery (Figure 2, Figure 5.3). They show similarities to copper shaft-hole axes of the so-called

6 R-Date 1 (Lab. Nr. Gif-2608): 4410±120 bp, 3496–2702 calBC (95.4 %), 3378–2857 calBC (91.2 %), 3328–2911 calBC (68.3 %); R-Date 2 (Lab. Nr. Gif-2610): 4360±120 bp, 3368–2637 calBC (95.4 %), 3368–2837 calBC (86.2 %), 3326–2882 calBC (68.3 %) (Gachina *et al.* 1975; Schultrich 2022, 203).

7 They are even found on a LN antler dagger (Brozio 2016, 332).

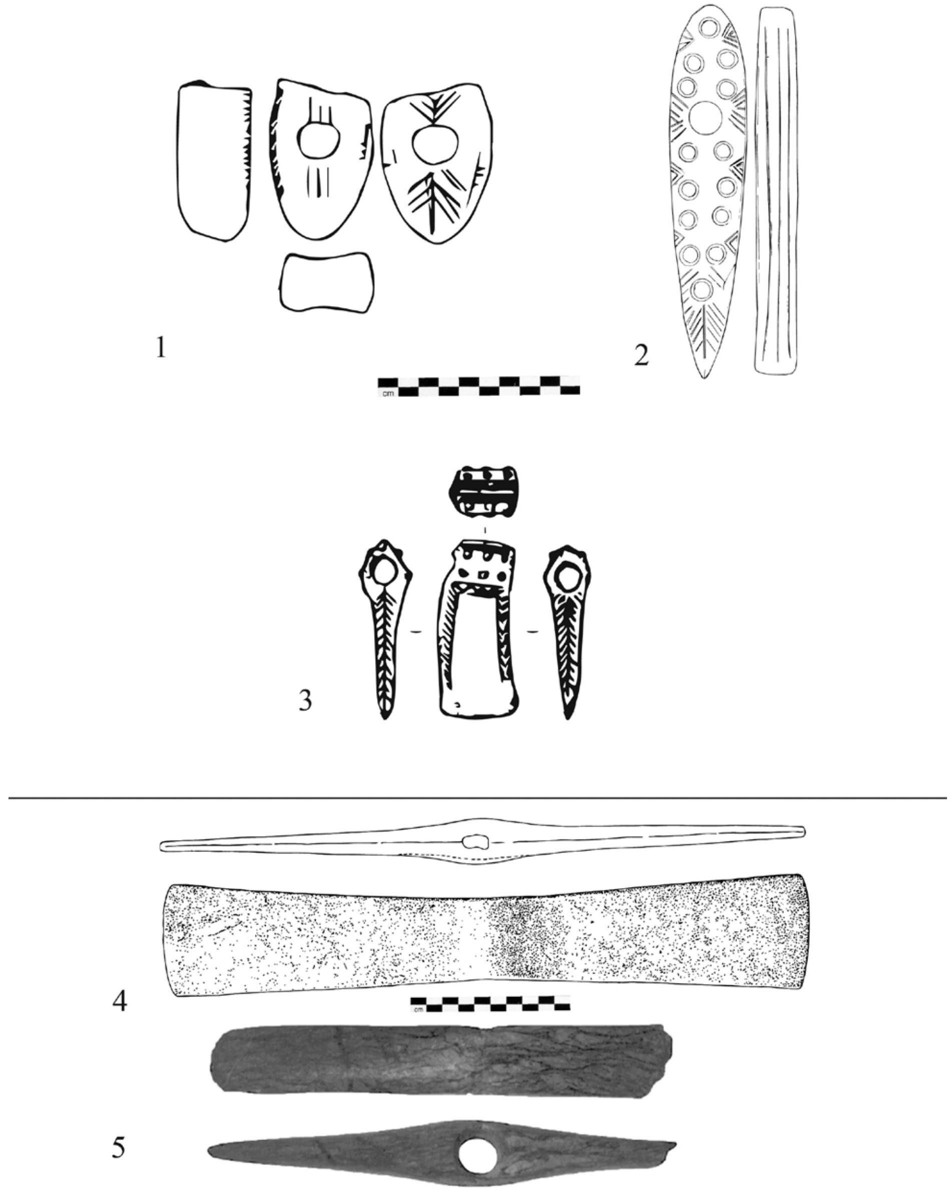

Figure 4. Comparison of lithic and copper battle axes. Top: axes without marked neck; bottom: double axes. 1 RII-axe from Praha Sárka, Czech Republic (Zápotocký 1992, 479 tab. 79.3); 2 RII-axe from Rassnitz, central Germany (Zápotocký 1992, 481 tab. 81.11; Schultrich 2022, tab. 46.b); 3 two *Schafthalsäxte* from burial mound 31/5 in Klady, Caucasus (Hansen 2009, 147 fig. 12.6.7). 4 axe of sub-type Cochem, unknown origin (Schultrich 2022, 324 fig. 4.28; see also Kibbert 1980); 5 L-axe from Hitzkirch-Seematte (Schultrich 2022, 324 fig. 4.28; see also Nielsen 2016, 14 fig. 24).

Bányabükk/Baniabic/Vâlcele type (*Schafthalsäxte*) of south-eastern Europe (Szeverényi 2013). G. Jacob-Friesen (1970) saw the potential significance of these axes, but due to their then low number he refused to define a type. K. Grote (2004, 325) already dated the axe from Müsleringen to the late fourth millennium BC and traced the material to south-eastern Europe. Recently, the Lüstringen copper hoard was discovered, consisting of a knob-butted axe, a large, thick ring and some *lunulae*. It was dated by the metal composition (high arsenic copper) to the late fourth millennium BC (Lehmann *et al.* 2018). A nearby cremation burial, which very likely is linked to the hoard, is ^{14}C-dated to this phase,[8] thus supporting this date for the hoard (Neumann and Ostrowski 2022).

The shaft holes of all four Lüstringen-type axes are near the butt ends. This is similar to copper *Schafthalsäxte* (see below) and some lithic R-axes (Zápotocký 1992, 93). However, their butt ends are different, as they do have a more or less pronounced knob-shaped butt. Especially the copper axe from Lüstringen is very similar to lithic *knobhamerbijl* axes from the Netherlands and north-western Germany. The axe from Eldagsen, on the other hand, is closely related to *Schafthalsäxte*, and the two others (Müsleringen and Reiffenhausen) are typologically in between these axes (Schultrich 2022, 306–10; see also Neumann and Ostrowski 2022).

8 Beta-502565, 4430±30 bp (3328–2924 calBC); Poz-134314, 4240±35 bp (2916–2696 calBC).

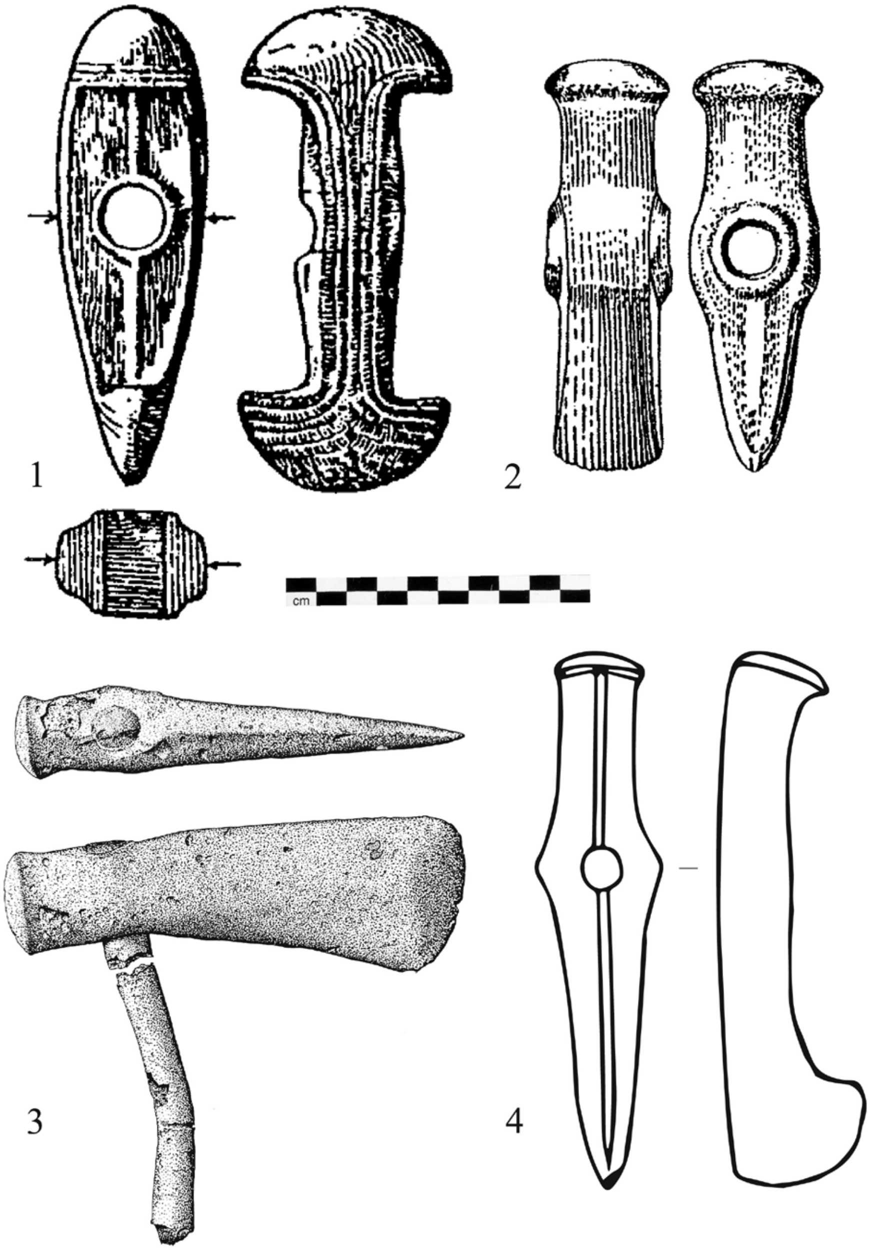

Figure 5. Comparison of lithic and copper battle axes from north-western Germany with plastic rims on the top side. 1 RV stone axe from Bargenstedt, northern Germany (Schultrich 2022, tab. 46.f; Zápotocký 1992, 496 tab. 96.11); 2 *knobhamerbijl* stone axe, Netherlands (Lanting 2018, 114–15); 3 Lüstingen-type copper axe from Reiffenhausen, northern Germany (Grote 2004); 4 FN stone A-axe from Lindet, Denmark (Hübner 2005, 83 fig. 47.d).

Generally, *Schafthalsäxte* appear from the late fourth to the early second millennium BC in south-eastern Europe and the Caucasus region (Hansen 2009, 145–48; Kaiser 2019, 238–40). Some pieces occur in eastern central Europe, and two even in eastern Germany (Schultrich 2022, 306), thus not far from the Lüstringen-type axes addressed here (Figure 2).

Schafthalsäxte and central European R-axes possess some morphological parallels (Figure 4.1–3). Both have roundish butt ends and shaft holes near these ends. The *Schafthalsäxte* are sometimes decorated with herringbone patterns and rivets (Hansen 2010, 303). In central Germany, especially in the Halle region, so-called *Salzmünder* (RII-) axes possess herringbone patterns and round applications (Schunke 2013b, 252; Zápotocký 1992, 115),[9] which could be related to rivets. Moreover, the contexts in which these axes are found are similar. In some areas, especially the Caucasus region, *Schafthalsäxte* are often grave goods (Hansen 2009). In central Europe, the number of battle axes in graves increases significantly with LN round-butted axes (Figure 7).

There are more possible connections. Knob-butted axes which are similar to the German ones occur in some burial mounds of the Caucasus region (Hansen 2010, 299). Moreover, in both regions there is one example

9 Also a few L-axes, especially of the Halfing-Linz variant, bear herringbone ornamentation (Pittioni 1954, 241).

Figure 6. Axe representations and non-lithic pieces. 1 depiction of a LN hammer axe in the chambered tomb of Göhlitzsch, central Germany (Patzold *et al*. 2010, 16); 2 depiction of an antler axe in a rock-cut tomb at Marais-de-Saint-Gond, central France (Charpy 2014, 316); 3 antler battle axe from the gallery grave of Hayettes à Congy, central France (Martineau *et al*. 2014, 431); 4 stela with axe depiction from Arco (Bagolini *et al*. 1989); 5 stela with axe depiction from Gelnhausen (Kerig 2010, 64 fig. 4).

of an engraving of a recurve bow (Hansen 2010, 299; Schunke 2013a).

Two of the four Lüstringen-type axes have a cast shaft. This is noteworthy, as lithic battle axes with sleeves[10] exist in this and adjacent regions (Figure 2). Strikingly, these are late LN types: the DII-axes of northern Germany, the RV-axes of central and north-western Germany and the *knobhamerbijl* axes of the Netherlands (Figure 5.3). Therefore, the sleeves might symbolically resemble the cast copper shafts (Schultrich 2022, 255).

Some of the stone axes (RV and *knobhamerbijl* types) even feature a plastic rim (Figure 5.1). Both axe types occur near the distribution of copper axes, which evidently were cast in two-piece moulds (Grote 2004, 325; see also Kaiser 2019, 238–40). With this technique, a weak line occurs on the axe where the two parts met. Adding a similar rim on lithic axes could have been intended as a casting-seam imitation. This is further supported by the fact that the decorations are similar. This brings a new perspective for the assessment of FN hammer axes.

Consequences for the FN hammer axe

Plastic rims imitating casting seams occur on Early FN hammer axes (Figure 5.4) (Hübner 2005, 138–39; Maran 2008, 173–74). These so-called A-axes are often compared to FN *Eschollbrücken* axes, which appear primarily in western and central Germany (cf. Kibbert 1980; Maran 2008). The idea that the plastic rims are symbolic casting seams is widely accepted for the FN axes (e.g. Hübner 2005, 143; Struve 1955, 110). However, now we see that this pattern already appears in the (Late) LN. We could ask whether the casting seams on FN A-axes

10 Two thirds of all RV-axes have a sleeve (Zápotocký 1992, 101), as do a few DII-axes (Zápotocký 1992 124) and *knobhamerbijl* examples (Lanting 2018).

resemble *Eschollbrücken* axes or if they rather are a continuation of the casting seams on the Late LN stone axes. That FN casting seams occur very often in northern central Europe speaks in favour of the latter possibility (Schultrich 2018, 82).

One of the CWC narratives is that battle axes as constituting symbols came from the east and were brought into central Europe as part of a wider "Corded Ware package" (Furholt 2014). However, on the basis of the considerable diversity of Earliest FN battle axes in northern central Europe, Furholt (2014) suggested they were invented here. But he did not explain where the idea came from. Although scholars realised the typological similarities of YN and FN hammer axes, the chronological gap between them is too big to consider them as one tradition (Klimscha 2016, 92–94). However, now that we know about *knobhamerbijl* LN hammer axes they can fill the gap alongside the RV-axes with plastic rims, which occur in direct vicinity to both the *knobhamerbijl* and the Lüstringen-type axes. As the LN axes and Early FN hammer axes share one special attribute, the casting seam, the FN hammer axes likely developed in northern central Europe from LN axes and did not emerge through external influence from the east.

Antler axes and pictograms

Due to bad preservation conditions in some regions of central Europe, it is not possible to obtain a representative picture of the distribution of LN antler and bone tools (Schultrich 2022, 290–91). However, in some areas they are preserved, such as in the lakeshore settlements of the western Alps. Interestingly, when antler battle axes appear there in the middle of the fourth millennium BC, the number of stone battle axes decreases drastically (Hafner and Suter 2005, 15). Antler axes seem to replace, and thus fulfil a similar function to, the stone battle axes.

Some special antler battle axes consist of antler shafts with shaft holes and an inserted flint axe as cutting edge (Winiger 1999, 74–75) (Figure 6.2–3). They are found in western Switzerland and the Paris Basin (Figure 2). In the latter region they appear as stray finds or in burials — rarely in gallery graves, frequently in rock-cut tombs in the Marne region (Cottiaux *et al.* 2014, 507–10; Sohn 2002, 505). In these contexts, engraved antler axes appear as well (Charpy 2014, 413–16) (Figure 6.2). This highlights the symbolic value of antler axes. As stone battle axes are rare in this area, the antler axes seemingly have a similar function to the lithic pieces in other regions (Schultrich 2022, 478–80).

In northern Italy, there are many depictions of weapons. In Trentino, on the famous stela from Arco, one artefact can be interpreted as a double axe (Figure 6.4). In contrast, depictions of weapons are infrequent in the LN of central Europe (Drummer 2022, 125–27). Beside the antler axes just mentioned, a few images of weapons are known from central German burial contexts (Schunke 2013a). Often, they are strongly stylised (e.g. Seehausen, see Kerig 2010). However, in the chamber tomb of Göhlitzsch, a depiction of a special kind of battle axe appears: it has a shaft hole near the butt and is straight, with a thicker cutting edge (Figure 6.1). This pictogram is very similar to the LN knob-butted axes mentioned above or to *Schafthalsäxte*. Thus, the strongly stylised axes can perhaps also be dated to the LN (Hansen 2010, 303–04; Schultrich 2022, 558–59). The axe from Gelnhausen (Figure 6.5) is in a FN style. As Drummer (2022, 125–27) points out, the turn from the LN to the FN in central Europe correlates with a shift in the context in which engravings appear: from burials to (anthropomorphic) stelae. The axe engravings follow this general trend.

In addition, miniature axes appear, both in central (Zápotocký 1992, 160) as well as western Europe (Schultrich 2022, 228), including clay axes and symbolic axes made of amber (Zápotocký 1992, 160; see also Brozio 2016, 154). All this testifies to the high symbolic value of the battle axe concept during the LN.

United in diversity

For a long time, due to the state of research, scholars have erroneously dated copper double axes and *knobhamerbijl* examples (Kibbert 1980; Zápotocký 1992) and did not regard L-axes as being LN (Burger 1988), while also ignoring *bipennes* completely (Zápotocký 1992). Finally, the Lüstringen-type axes were not identified as a type of their own. Accordingly, neither was the morphological relation of LN stone and copper battle axes recognised, nor was the extent of the battle axe horizon connecting western and central Europe appreciated.

Antler axes and axes made on other materials, miniature axes, or engravings on stones belong to the LN battle axe horizon. In all regions, simple axes as well as very elaborate and distinctive axes exist. This all testifies to the symbolic value of the battle axe during the LN.

With the analysis of LN battle axes, we see a dynamic network, in which the shapes were negotiated supra-regionally. A prerequisite for this is constant communication between the actors, as well as a basic agreement on (one of) the meaning(s) of the battle axe. Apart from the shared attributes, in each region own characteristics occur, so that this horizon really follows the motto *united in diversity*.

When we accept that battle axes had a special social function, maybe attached to a certain social role or cosmological idea, we can reconstruct a specific network of shared values and ideas already during the LN, and not first with the onset of the FN.

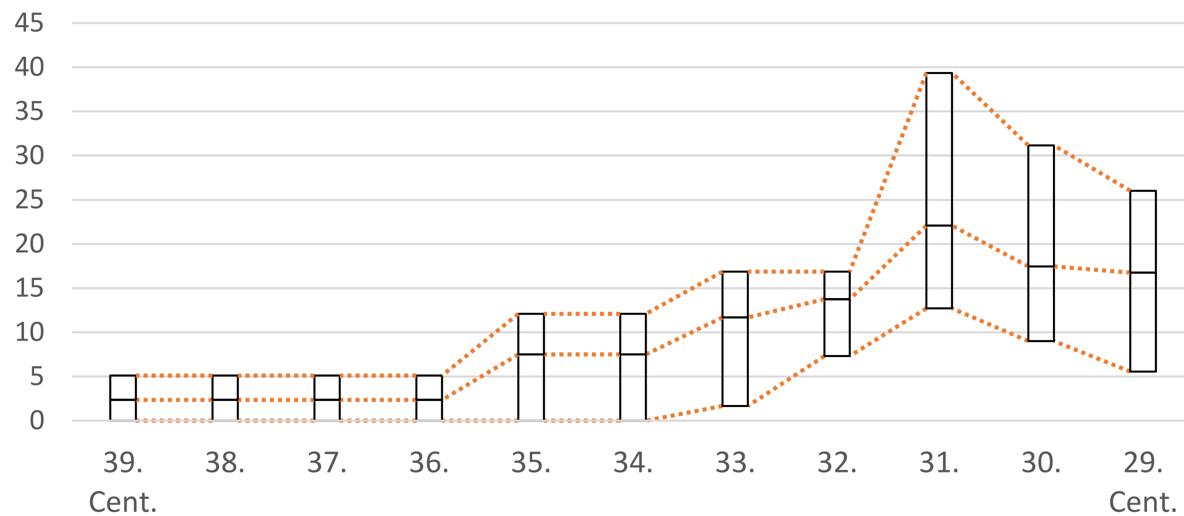

Figure 7. The percentage of battle axes from burial contexts in northern central Europe plotted using the aoristic method (after Mischka 2007). The central dotted line marks the average of all regions, the lower and upper lines represent the extremes of individual regions (Schultrich 2022).

Differences in context

In some regions, stone, copper and antler battle axes are recovered from bogs, lakes or rivers, testifying to the activity of intentionally depositing battle axes as single finds (Howell 1986, 72; Iversen 2015, 46; Schultrich 2022, 353). LN copper axes were deposited mostly as single finds or, rarely, in multi-object hoards (Kibbert 1980; Neumann and Ostrowski 2022). It is important to note that no grave finds of copper axes are known in central and western Europe.

During the YN, lithic battle axes in all regions were predominantly deposited as single finds. Grave finds appear in only a few regions. These are often broken pieces, indicating deliberate destruction (Schultrich 2022, 356–59; Zápotocký 1992, 157–58).

During the LN, this pattern changes in northern central Europe, but persists in the south. Most L-axes are single finds and burial finds appear rarely (Schultrich 2022, 473). The same pattern occurs in France, except for Brittany. Here, battle axes were regularly deposited in burials (Figure 8). However, these axes are broken pieces, rough-outs or miniature axes (Schultrich 2022, 477–78). This strongly indicates a certain symbolic function that differs from the deposition strategy in northern central Europe. Here, complete, regular-sized R- and D-axes regularly come from burials (with a peak in the thirty-first century BC with on average >20 % of graves containing an axe, in Denmark even almost 40 %) (Figure 7) (Schultrich 2022, 459). Accordingly, with the emergence of new battle axe concepts (round-butted and double axes), a new pattern is established.

	All FN burials	Burials with battle axes	
		N	%
Southern Sweden	244	129	52.9
Jutland	~2566	1129	44.0
Netherlands	145	34	23.4
Altenburg (T)	18	3	16.7
Danube region	96	11	11.5
Hesse	118	7	5.9
Dittigheim	62	1	1.6

Table 1. Absolute number of Final Neolithic burials and burials with battle axes. Grey: northern central Europe. No shading: central and southern Germany. T= Thuringia. Data from Schultrich 2022.

The difference between the north and the south is still visible during the FN. In the south, burials with battle axes are rare. While in the northern regions, 20–50 % of all known FN burials are furnished with a battle axe, in the south the figure is below 10 % (Schultrich 2022, 500) (Table 1). This pattern of restricted access to specific symbols in burials during the FN is likely rooted in the LN. Thus, a tradition is revealed which we do not recognise if we limit ourselves to generalised narratives of marked change at the transition between LN and FN.

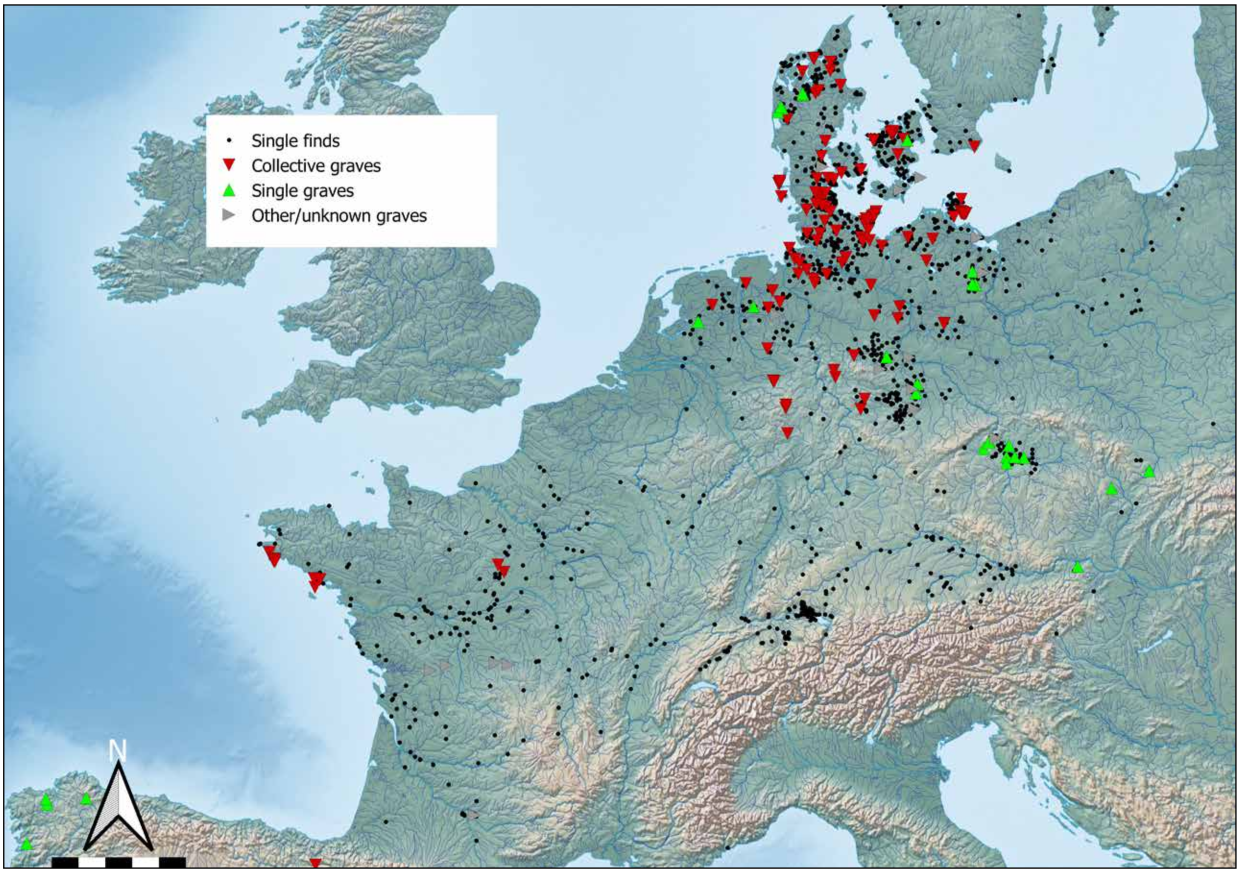

Figure 8. Distribution of LN burials with battle axes (Schultrich 2022).

The burial evidence

In addition to the battle axe phenomenon, a critical assessment of the burial rites helps to recognise that certain developments which are important during the FN already began during the LN.

Single graves

A single grave furnished with a battle axe and a cord-decorated beaker is said to be typical for the FN. In some areas, Early FN battle axes appear in burial contexts before cord-decorated beakers do (Hübner 2005, 655). In other areas, single burials completely without diagnostic CWC items predate those with typical burial assemblages. This is the so-called Kalbsrieth horizon that is defined by single crouched inhumations under burial mounds, without grave goods (or only with chronologically undiagnostic goods such as flint blades) (Kluttig 1994). Recently, there have been attempts to return this horizon to scholarly attention by collecting new data (Heyd 2021), but it remains problematic.

The Kalbsrieth horizon is based on the premise that the CWC is the beginning of something new. Accordingly, most attempts to prove the existence of this horizon deal with one side of the transformation only — the time after the onset of "the CWC". But there are certain developments during the late fourth and earliest third millennium BC which clearly show that many "CWC attributes" do appear much earlier.

During the LN, single graves appear regularly. In these, we often find a material culture that is similar to that in the collective graves of the respective regions. For example, Danish LN cattle burials in north-western Jutland very frequently contain flint axes, sometimes pottery and rarely battle axes — but if so then always in combination with flint axes (Fabricus and Becker 1996, 178–79; Jensen 2001, 400). The same pattern is typical for the late use of the Jutish passage graves (Ebbesen 2011, 316). A similar pattern even continues in early CWC burials. Although battle axes are much more frequent, the specific combination of flint and battle axes re-occurs and pottery is still rare (Hübner 2005, 625).

Sometimes in northern central Europe, single flat graves are located near passage graves, and they appear to be younger than the main use of the monument. This is particularly frequently documented in the Netherlands (Raemaekers and Van der Velde 2022, 190), for instance in connection with the passage grave at Mander (Lanting and Brindley 2004, 78). Recently, P. Borup and his team have also excavated such a site at Bygholm Nørremark, Denmark. With one exception, all single flat graves, located between a megalithic and a non-megalithic barrow, were unfurnished (Per Borup, pers. comm.; Seeberg 2020). The graves date to the final LN (Seeberg 2020). A similar observation was made by J.P. Brozio (2016, 159), who found one single grave without grave goods dating to the thirty-first century BC, in the mound of a passage grave. Thus, in some areas the transition from collective to single graves is gradual rather than abrupt.

In central Germany, different forms of single graves occur throughout the entire LN sequence (Müller 2001, 358–66). For example, within the enclosure of Salzmünde several crouched individual inhumations were found in conjunction with sherd deposits (Schunke 2014, 438). Clay extraction pits also yielded crouched inhumations with few grave goods. The burials date to the transition from the fourth to the third millennium BC (Schunke 2014, 432–33). The excavators suggest that these may be low-ranking individuals (Schunke 2014, 439).

In the burial ground of Dalfsen (Netherlands), 84 of the 135 LN single flat graves are associated with pottery and 51 of them with just one pot (mostly Brindley's types 4–5, but also 6–7 and thus dating c. 3000–2750 BC) (Brindley 2022, 69, 118). Only a few burials contain more than two pots or even flint or ground-stone axes, and only one grave is furnished with a battle axe. A similar ratio between the different items is observed in the collective graves of the region, thus promoting the idea that each pot in collective burials was assigned to one individual (Raemaekers and Van der Velde 2022, 190). This explanation has been proposed for collective burials in other regions as well (Brozio 2016).[11] In Dalfsen, the graves are similar to CWC burials: crouched body position, standardised grave goods, wooden cists and indirect evidence for burial mounds (Van der Velde and Raemaekers 2022, 20).

There are quite a few cemeteries with single burials in the Netherlands and north-western Germany, although most are much smaller than Dalfsen.[12] Another recently excavated example is Heek, where 24 burials (c. 3300–3100 BC) were unearthed. Again, only one is furnished with a battle axe (Pak and Pfeffer 2020, 3; see also Lanting 2018).

According to R. Kossian's (2005) catalogue, single graves appear most frequently between 3600–3200 BC — the same time span in which collective graves were erected (Müller 2019, 46). However, the recent discoveries show that single burials appear more often than expected in a later part of the LN. And many of these graves fully or partly correspond to the definition of the Kalbsrieth horizon. This means that we can actually trace many of the attributes which define this horizon back to the LN. Accordingly, this horizon is not exclusively a CWC phenomenon.

The hidden significance of collective graves

Collective graves still make up the largest part of all known LN burials. As people erected and used them collectively for a long period, the common interpretation is that these societies were collectively oriented. This assumes that all these societies would have the same social structures and beliefs.

A society that only uses collective graves might indeed do this because of specific ideological reasons. However, this could also simply be "the correct way of doing this", i.e. a society's habitus. A combination of both is also possible. "Collective burials once were more common than they are today […]. People are always treated individually when they die. […] The difference between individual and collective deposition in prehistory does not reflect differences between communalist and individualistic people" (Weiss-Krejci 2011, 164; see also Müller 2003).

In interpreting societies building collective monuments, we have to take the huge regional differences in the treatment of the bodies and grave goods into consideration. Thus, the ideas and beliefs of the societies using these burial sites were potentially very different.

The LN collective burial traditions

In the late fifth and early fourth millennium BC, Neolithic societies in Europe used dolmens (northern central Europe) and passage graves (Brittany) (Mischka and Furholt 2019; Scarre 2015). However, in the middle of the fourth millennium BC, a remarkable phenomenon occurs. Now, people started erecting new forms of large collective graves with antechambers and entrances and used them for many centuries. At the entrances, ceremonies were held and artefacts deposited (Brindley 2003, 49; Gebauer 2014; Jensen 2001, 383). These graves had room for dozens or hundreds of individuals (Cottiaux *et al.* 2014, 515; see also Pape 2019).

Specifically, these are passage graves and *Großdolmen* in northern central Europe (Jensen 2001, 268; Mischka 2022; Mischka and Furholt 2019, 934), and different kinds

11 In the passage grave of Wangels LA 69, Brozio (2016, 171–72) reconstructed 40 buried people on the basis of the number of pottery vessels.

12 Netherlands: Uddel-Uddelermeer, Zeyen, Vledder (five burials each), Mander (nine cremation burials), Angelslo and Zuidwolde (ten burials each), maybe Hardenberg-Baalderes. Germany: Heek (24 burials), Averbeck (26 burials), Flensburg (29 burials), Ostorf (50 burials) (Van der Velde and Raemaekers 2022, 23–24; see also Kossian 2005).

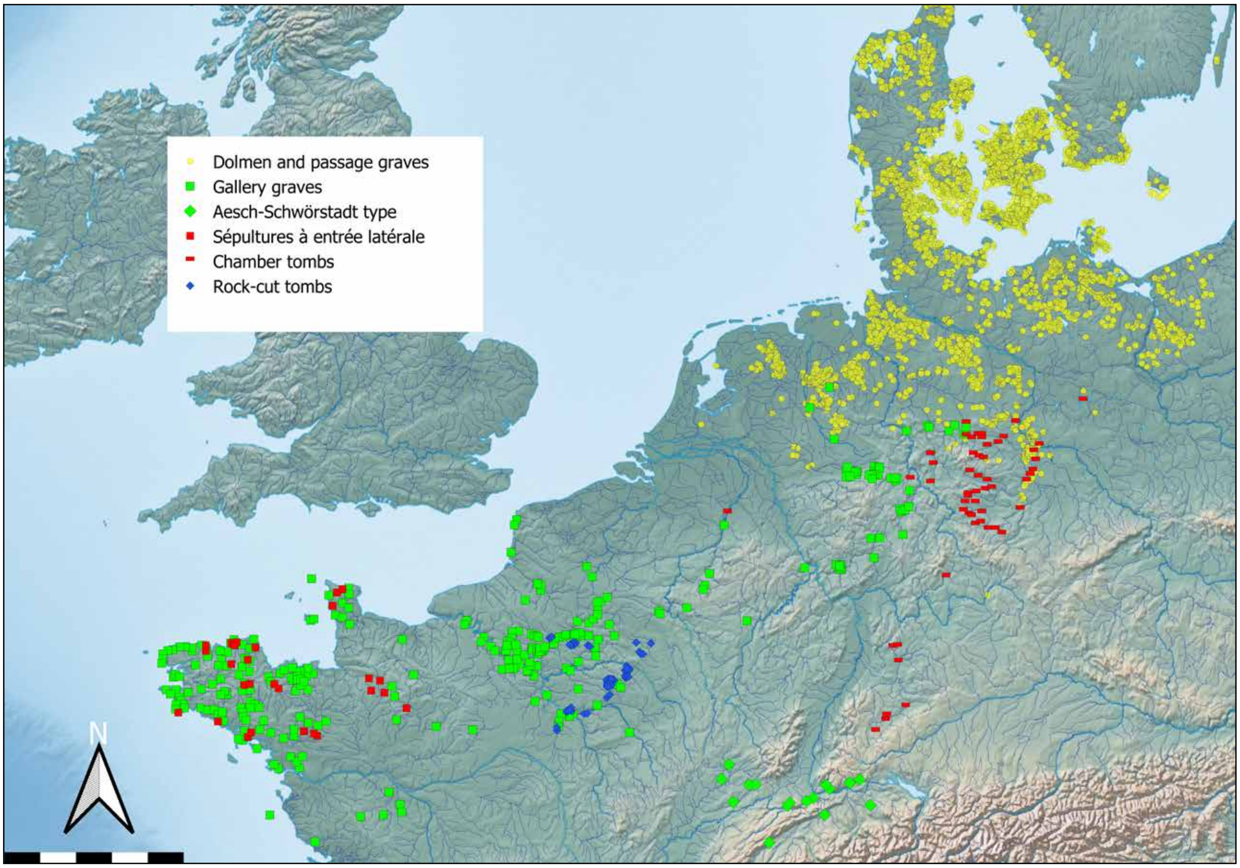

Figure 9. Distribution of LN collective burials. Britain and Ireland not mapped (Schultrich 2022).

of gallery graves in Brittany,[13] western Germany, the Paris Basin and the western Alps[14] (Pape 2019; Siebke *et al.* 2020). Rock-cut tombs appear in the eastern Paris Basin (Blin 2015; Cottiaux *et al.* 2014). In Brittany, similar to passage graves, *sépultures à entrée latérale* were erected (Blanchard 2012, 355; Laporte 2009, 736–37). In central Germany different kinds of chamber tombs (*Mauerkammergräber*) appear (Müller 2001, 115) (Figure 9). In southern, western and central France, *dolmens simples* occur and in western France more complex *dolmens angevins* (not mapped) (Burnez 1976, 83). Also, caves (*grottes sépulcrales*) were used for burials there (Blanchard 2012, 360; Burnez 1976, 83). Caves were also used in northern France and Belgium (not mapped) (Cauwe *et al.* 2001, 81; Toussaint *et al.* 2007, 107).

Besides the common threads, there are differences, especially when we look at the grave goods and the treatment of the deceased. In the gallery graves, often hundreds of individuals are buried, whereas grave goods are rare (Figure 10). Most of the grave goods come from the entrance or antechamber and were thus deposited apart from the individuals (Cottiaux *et al.* 2014, 515; Sohn 2002, 505). Often the artefacts were deliberately broken and they are "common tools" — there is no difference between grave and settlement pottery (Cottiaux *et al.* 2014, 459). The bodies were secondarily manipulated. For instance, the bones were sorted and parts of an individual's body were not kept together. The dead were "collectivised" (Pape 2019). The same is true in the western Alps (Siebke *et al.* 2020).

In the passage graves of northern central Europe, it is uncertain how the bodies were treated due to the bad bone preservation. There are examples of both re-arrangements

13 In recent research, the Breton gallery graves are portrayed as a different tradition to the Paris Basin ones (Pape 2019, 164). However, architectural differences are minor. The Breton burials are not dug into the earth as the others are. From an architectural perspective, the gallery graves of the Paris Basin and western Germany differ much more from each other (Pape 2019, 164). The date of the Breton burials is not very clear, as they are almost never undisturbed or have been excavated early (Patton 1993, 134–43). However, LN pottery styles (Groh-Collé and Kerogou) clearly show that they were erected in the late fourth millennium BC (Blanchet 2012, 315; Patton 1993, 134–43).

14 We can add the collective burials of the western Alps to the tradition of gallery graves. Their layout and use, the treatment of the bodies and the grave goods are similar to gallery graves (see Sohn 2002, 502). A long discussion about the date of the graves was solved recently: they (also) date to the LN (Siebke *et al.* 2020).

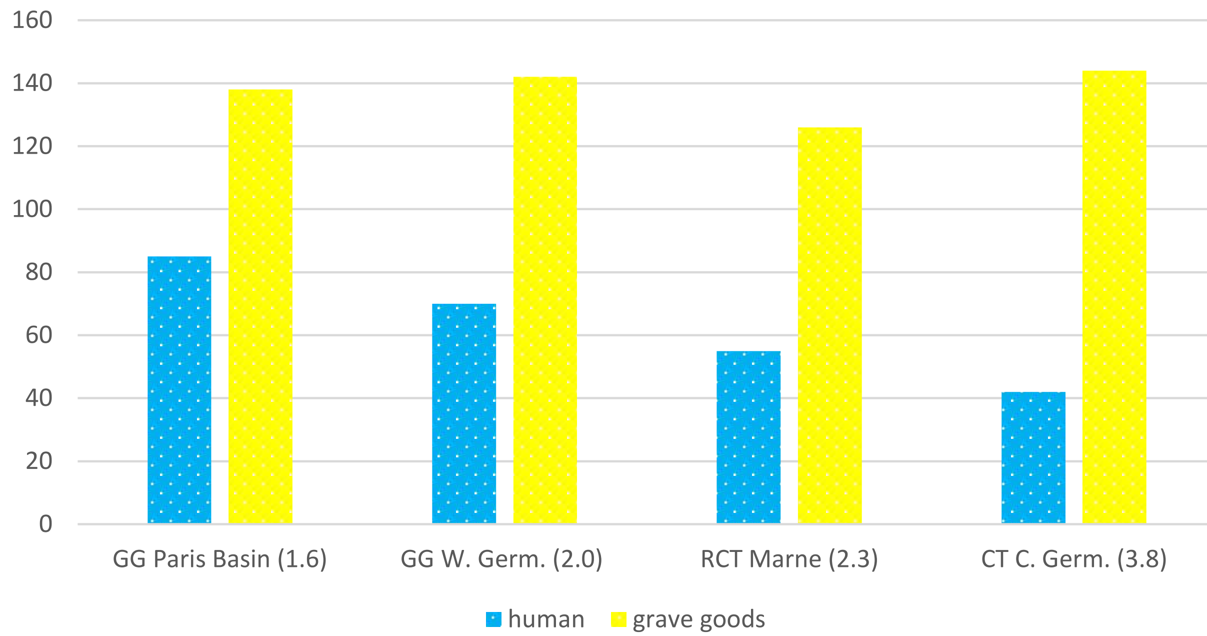

Figure 10. Average number of individuals and grave goods in the gallery graves (GG) of the Paris Basin and western Germany, the rock-cut tombs (RCT) of the Marne region and the chamber tombs (CT) of central Germany. The relation of individuals and grave goods is given in brackets. The data come from the 53 sites selected by Cottiaux *et al*. (2014).

as well as of individuals who were kept in primary positions (Jensen 2001, 379; Mischka and Furholt 2019, 926), but we cannot draw general conclusions. However, there are huge differences to gallery graves when we consider the grave goods. The highly ornamented and thin-walled burial pottery is strikingly different from settlement pottery (Brozio 2016, 144–45). Apart from pottery destruction in front of some monuments (Brindley 2003, 49; Gebauer 2014; Jensen 2001, 383), pottery and other artefacts appear in the chambers and are thus directly linked to the deceased (Brozio 2016, 169–72; Ebbesen 2011, 315–16). Battle axes are mostly deposited complete in these burial contexts (Schultrich 2022, 356–57; Zápotocký 1992, 157–58). In the gallery graves of western Germany, in contrast, only three heavily fragmented battle axes were found alongside a few "working axes" (see Rinne 2003, 104); no complete battle axe is known (Schultrich 2022, 470).

In the rock-cut tombs of the Marne region (Figure 10), the individuals were not manipulated secondarily (Blin 2015, 591). Also, there are more grave goods than in the gallery graves (Cottiaux *et al.* 2014, 505; Sohn 2002, 505). The grave goods are often directly related to the bodies. Here, battle axes made of antler appear in large numbers (Sohn 2002, 505; see also Blin 2015). Accordingly, the treatment of the bodies and the burial good tradition are both similar to northern central European passage graves and to the chamber tombs of central Germany (Cottiaux *et al.* 2014, 505).

Accordingly, we see completely different deposition strategies of humans and grave goods in the respective regions. There is nothing like a universal collective grave with an associated universal rite. Thus, these societies probably had strikingly differing beliefs. Again, the similarities and differences in the collective grave horizon correspond to the motto *in varietate concordia*. It is important to note that, similar to single graves, collective graves can yield deposits associated with a specific individual. Thus, certain social roles which are connected to battle axes could be articulated in the LN collective burials just as much as in the FN single burials.

The coarse ware horizon

Coarse ware

In many of the aforementioned regions a distinct — or rather, a very indistinct — kind of pottery appears: a coarse, unprofiled, barrel- or bucket-shaped vessel with flat base and no decoration, except for small holes beneath the rim. Many studies highlight its local origin in the diverse regions. However, its supra-regional significance is almost unknown (but see Iversen 2020).

E. Vogt (1938) already noted its significance. In the Paris Basin, coarse ware pottery belongs to a complex which was formerly labelled S.O.M. (or Seine-Oise-Marne) (Cottiaux *et al.* 2014, 515; Pape 2019, 8). In Switzerland, such pottery is called Horgen. The Paris Basin pottery yields older dates than the archaeological complex known as Horgen (Cottiaux *et al.* 2014, 456). On the other hand, in the Alps, the process of ceramic coarsening (*Vergröberung* in German) already starts prior to Horgen, in Pfyn and Cortaillod contexts (Burri-Wyser and Jammet-Reynal 2016, 73; Hafner and Suter 2003, 9).

Even though J. Winiger (1998, 161) warns against labelling all coarse pottery as Horgen, there are some striking parallels to the pottery traditions of other regions. In south-western Germany pottery of the so-called Goldberg-III facies appears, in south-eastern Germany Cham and in western Germany the Late Michelsberg/Early Wartberg. In all of these archaeological complexes, the pottery is similar to Horgen (Raetzel-Fabian 2000, 101). Both the western and northern Funnel Beaker (FBC) pottery develop in a similar way. The complex shapes and decorations of the Late YN/Early LN gradually decrease and, in the end, coarse pottery emerges (MN V/Brindley 7) (Brindley 1986, 100; Brozio *et al.* 2019, 129; see also Iversen 2015).

We also find coarse pottery in Belgium (Cauwe *et al.* 2001, 82; Toussaint *et al.* 2007, 108) and in western France (e.g. styles Seuil du Poitou and Taizé, see Ard 2013). In Brittany, it occurs side-by-side with fine pottery styles (Blanchard 2012, 314–15).

Many of these regions share more pottery types. Important are undecorated collared flasks (*Kragenflaschen*) which appear frequently in central and northern-central Europe, especially in the LN western FBC (Brindley 1986, 95–100; 2022, 108), but also in Brittany and the Paris Basin (Huysecom 1986, 201–07). In the latter region, hybrids of collared flasks and coarse ware appear — so-called *vases á col* (Cottiaux *et al.* 2014, 459–63). Their occurrence in the Netherlands and Brittany is noteworthy, as the Breton *sépultures à entrée latérale* are reminiscent of passage graves (Blanchard 2012, 355; Laporte 2009, 736–37).

Discussion: expanding networks and the equalisation of pottery styles

For northern central Europe, one interpretation of the LN loss in pottery diversity is that pottery's former importance as socially cohesive force decreases (Brozio *et al.* 2019, 141–42). At the same time, other collective efforts decrease: causewayed enclosures are abandoned, the short phenomenon of large-scale settlement agglomerations disappears and passage graves are no longer used frequently (Mischka and Furholt 2019, 936; Müller 2019, 39–40).[15] Interestingly, at the same time as the "collective" efforts and regional signs disappear, battle axes — a warrior-related sign of individual power — increase in absolute numbers and become frequent especially in burials (Figure 7). Additionally, in many areas we see a shift in land use which could be related to extensive grazing economies (Feeser *et al.* 2019, 1602). This kind of economy potentially intensifies supra-regional communication (Furholt 2021; Preda *et al.* 2015, 85). In sum, there seems to be a correlation between expanding communication networks and a loss of regional identity (see Brozio *et al.* 2019; Müller 2019). In this phase, pottery styles become more similar over vast territories.

It is not appropriate to ask which was the original coarse ware pottery tradition and which are its imitators. Similar to one suggestion for the supra-regional appearance of Bell Beakers,[16] maybe the different local prototypes were reshaped according to supra-regionally negotiated ideas (see Jeunesse 2015), "[t]he process by which divergent origins might converge upon a common goal" (Barrett 2018, 18).

This does not mean that a supra-regional identification similar to that of Bell Beakers also applies to LN coarse ware pottery. Rather, the low importance of pottery for Late LN societies makes it vulnerable to changes. These changes happened in all regions, whose inhabitants were communicating with each other. Accordingly, a network connecting western and central Europe was present in the late fourth and early third millennium BC.

Conclusion: the LN as precursor of FN behaviours

In this contribution, my aim was not to ignore all significant features of the CWC. Without any doubt, the "CWC package" — battle axes, cord-decorated beakers and "male graves" — is very similar over a vast area (Bourgeois and Kroon 2017; Furholt 2019). Regional case studies demonstrate that during the LN, material culture symbols were more locally distributed and the networks were spatially smaller (Drummer 2022, 174–75).

However, we must stop thinking in absolutes. Just because certain aspects are more evident during the FN does not mean they are new. Coarse ware pottery, battle axes (especially double axes) and large collective burials are shared signs in western and central France. This "package", however, is regionally rather diverse — *in varietate concordia*. Also, individual representation of certain idealised roles was possible during the LN. Collective graves do not necessarily hinder the representation of individual roles. The number of burials with battle axes increases during the LN. In addition, single graves appear — even graves that can be labelled as the Kalbsrieth horizon.

The main symbol of the LN and the FN is the battle axe. In both periods, this symbol was included in burials, made

15 However, this does not account for the Danish islands and Scania. Extensive settlements do appear in this phase, palisade enclosures were erected and megaliths re-used (Iversen 2015, 69).

16 Which also are regionally different (see contributions in Czebreszuk 2004).

in stone, copper and antler, and engraved on stones. There is even evidence that the early CWC A-axe could have been based on the LN hammer axes of northern central Europe.

The specific combination of single graves, crouched position, hammer axes and cord-decorated beakers — the CWC innovations — are not the outcome of the rapid spread of a new idea or even people. Large-scale networks are rather a prerequisite for the spread of CWC symbols (Barrett 2018; Bernbeck and Burmeister 2017; Rogers 1995; Schultrich 2022, 608–13). The LN networks, through which the importance of battle axes and cosmological ideas were shared, paved the way for the spread of those symbols we term CWC. Thus, the early CWC does not mark the beginning of something new. Rather, it is the more established version of specific ideas which had already circulated for centuries.

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Continuation and change in settlement of the Polish Lowland in the period 3300–2700 BC

Marzena Szmyt

Abstract

In the Polish Lowland, 3300–2700 BC is a period when the symptoms of two opposing processes are discernible. One was oriented towards uniformity (in terms of settlement organisation based on medium-sized and small sites as well as a social organisation based on small groups), while the other led to increased cultural differentiation (in terms of manifestation of identity through material culture, rituals and ceremonial activities). The existence of small and dispersed communities was possible thanks to a kind of balance: on the one hand, a day-to-day and almost perfect adaptation to the local natural environment that could cause isolation of individual groups, and on the other hand, a deep social need to break this isolation through communal rituals, mostly performed at funerary sites. In turn, cultural transformations involved the rise of new cultural groups often contemporary in a single region. In such a diverse cultural landscape of the Lowland, material culture was very actively used to manifest identity and distinguish oneself from other groups.

Keywords: Late Neolithic, central Europe, social organisation, economic strategies, cultural diversification

This article aims to present prehistoric settlement in the Polish Lowland between 3300 and 2700 BC. The area covers the eastern part of the central European lowland, between the Odra and Vistula rivers (Figure 1), and consists of several regions: Kujawy in the east, Wielkopolska (Greater Poland) in the centre and Lubusz Land in the west (on the middle Odra). There, between the thirty-third and twenty-seventh century BC, the symptoms of two potentially contradictory processes are noted: on the one hand, a trend towards uniformity, and on the other hand, towards diversification.

The increase in uniformity is seen mainly in gradual changes in the social organisation of the Lowland inhabitants from stable and relatively large agricultural communities to small and dispersed groups of higher mobility. Various cultural units were part of this process in the fourth and third millennia BC (Czebreszuk and Szmyt 2008b; Czebreszuk *et al.* 2019; Szmyt 2022; Szmyt and Czebreszuk 2013).

In D. Hofmann, D. Mischka and S. Scharl (eds) 2025. *The eve of destruction? Local groups and large-scale networks during the late fourth and early third millennium BC in central Europe*, 243–260. Leiden: Sidestone Press.

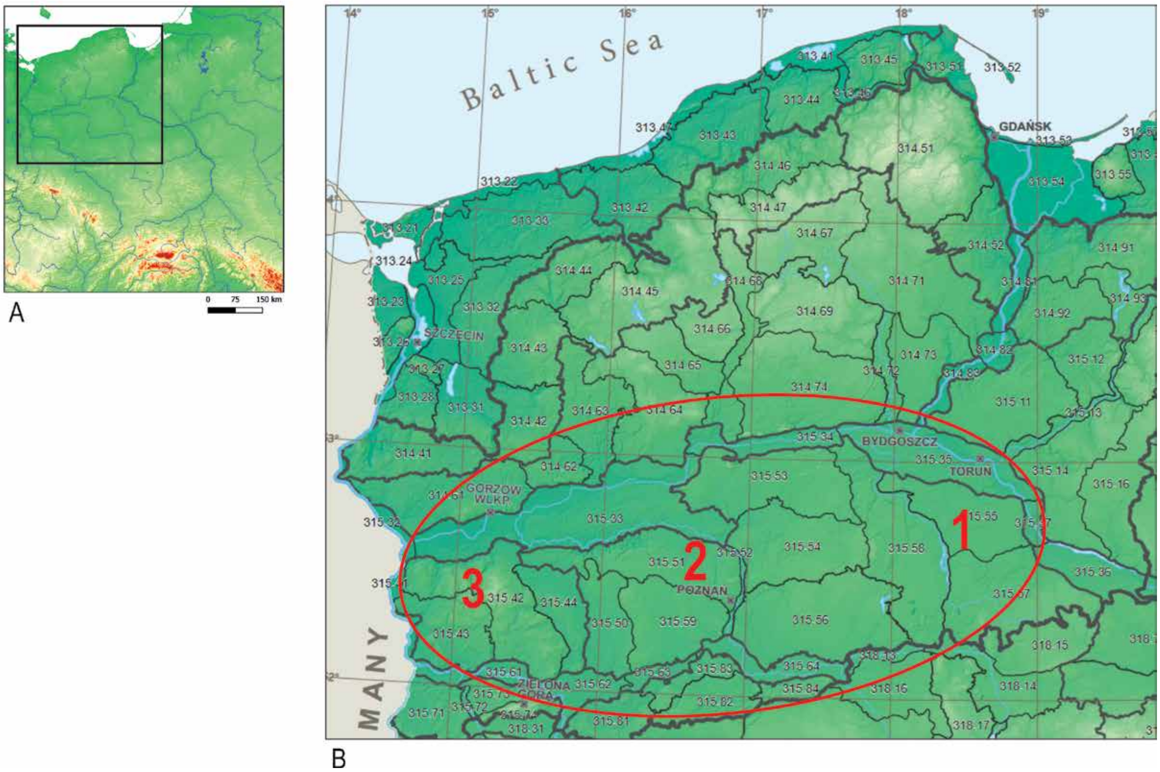
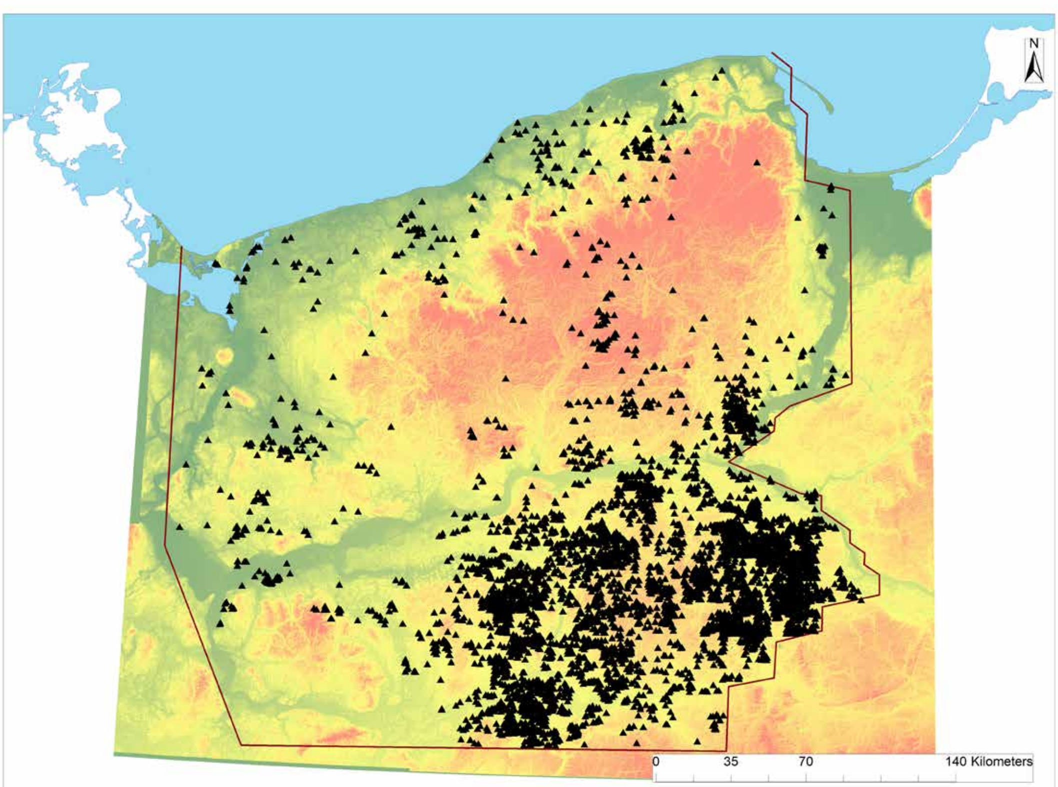


Figure 1. Study area and the most important regions. 1 Kujawy; 2 Greater Poland (Wielkopolska); 3 Lubusz Land. Based on the map of physico-geographical mesoregions of Poland edited by J. Solon and J. Borzyszkowski (Solon *et al.* 2018).



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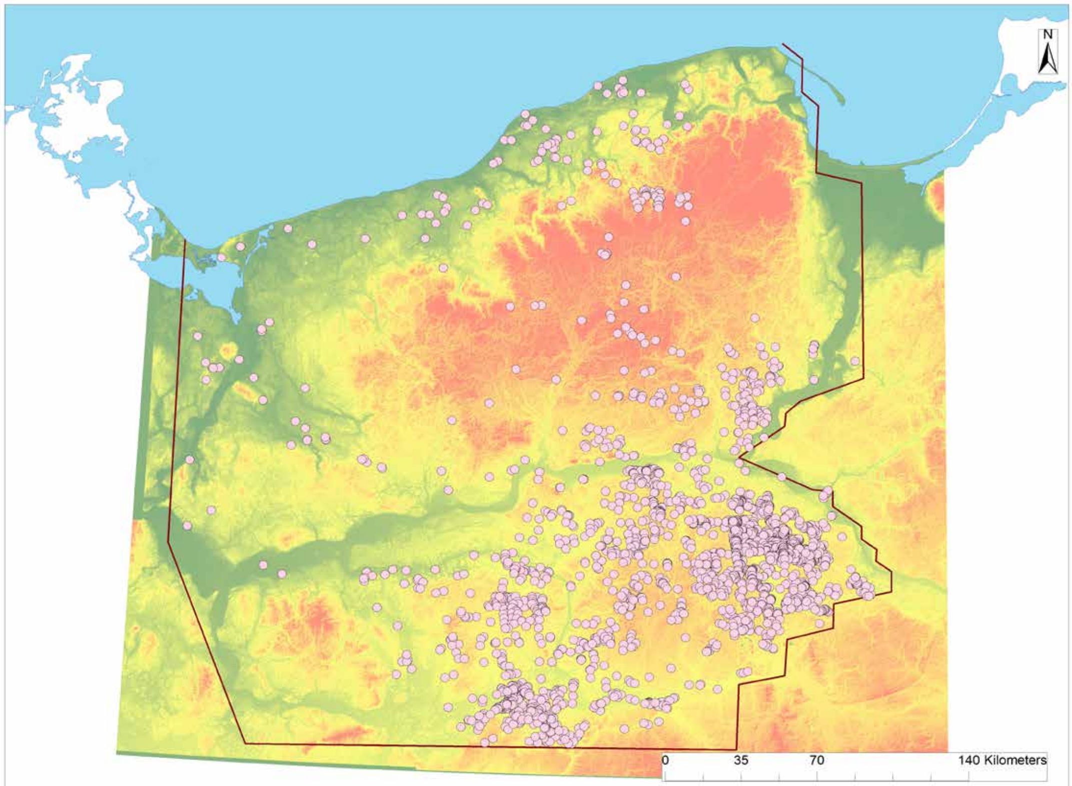

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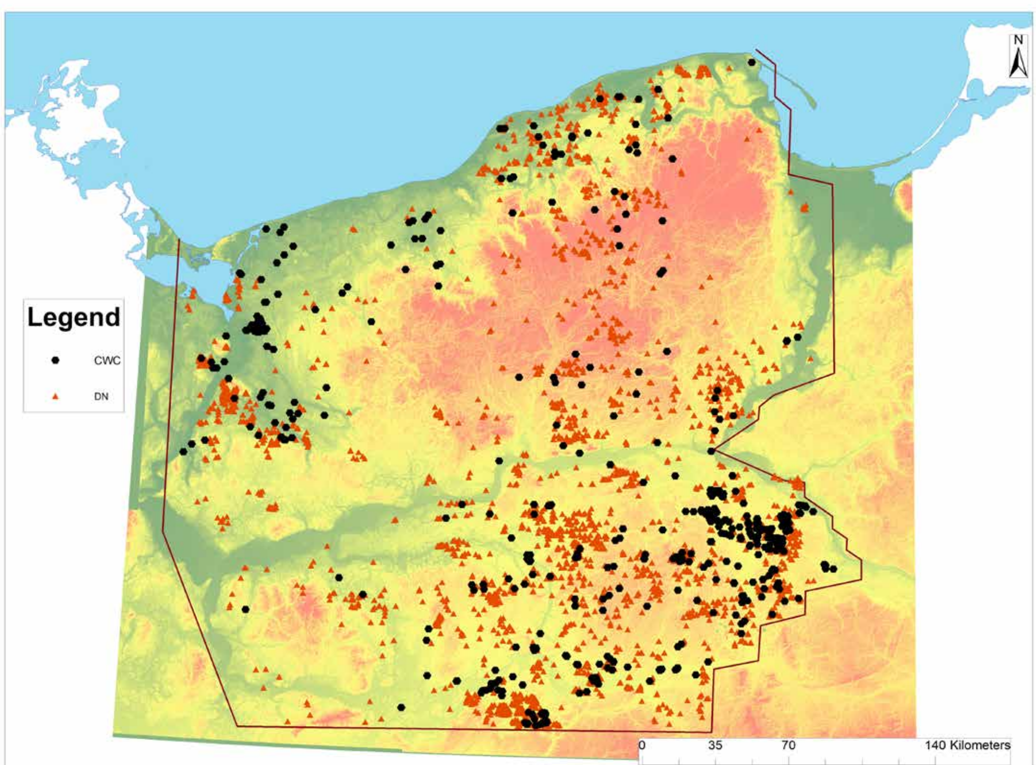

Figure 2. North-western Poland. Distribution of sites related to: A. Funnel Beaker culture; B. Globular Amphora culture; C. Corded Ware culture (black) and Decline Neolithic (orange). Data from Czebreszuk *et al*. 2019, 818 pl. 1, 819 pl. 2, 820 pl. 3.

In turn, the increase in diversification is most visible in material culture, thanks to which it is used in archaeological taxonomy, producing a multitude of units such as cultures, groups, phases, sub-phases and phase-groups (Szmyt 2013). This process had both internal and external causes that intertwined with each other. These include extensive circulation of cultural information at the regional and supra-regional levels, enhanced by the multidirectional influx of new patterns and ideas, sometimes combined with migrations of human groups (Czebreszuk 2001; Kośko *et al.* 2017; Szmyt 2017; 2022). As a result, a network of relationships arose both within Lowland communities as well as between them and their neighbours, entailing cohabitation, cooperation and competition (Czebreszuk and Szmyt 2011; Szmyt and Czebreszuk 2010). This article attempts to conceptualise the above-mentioned processes from the perspective of long-term socio-cultural transformations in the Neolithic and Bronze Age.

Processes towards increased uniformity

The first process that led to a kind of uniformity or similarity in the Lowland communities was a consequence of the broader process of social transformation marked by changes in settlement and economic organisation. The current conception, various aspects of which have already been presented (Czebreszuk *et al.* 2019; Szmyt 2022; Szmyt and Czebreszuk 2013), holds long-term social and economic transformations to have been a series of successive changes that were not fast but followed one another gradually during the fourth and third millennia BC.

The changes affected primarily society and the economy in a correlated manner. As far as society is concerned, the size of the basic unit of social organisation and residential groups was reduced. Economic transformations, in turn, can be characterised as comprising three major trends: an increase in mobility, resulting in frequent changes of residence; a greater dispersion of settlement; and improved economic flexibility, following from the availability of different subsistence strategies (Szmyt and Czebreszuk 2013).

The starting point was the stable and centralised settlement system of the younger Danubian groups formed and developed in the fifth millennium BC in the Lowland. In central settlements (e.g. Brześć Kujawski, Krusza Zamkowa, Osłonki, Racot; e.g. Czerniak 2002; 2012; Czerniak *et al.* 2016; Grygiel 2008), the number of contemporaneous large trapezoid houses is estimated at eight to ten and the corresponding number of inhabitants can be expected to have been some 100 people. Recent studies show that such large and multi-house settlements came to an end in 4000/3900 BC (Czerniak and Pyzel 2019).

The process of gradual changes in the settlement system started with the Funnel Beaker culture onwards at the turn of the fifth and fourth millennia BC (for discussion and opposite concepts, see Nowak 2017; Rzepecki 2003). It accelerated from the middle of the fourth millennium BC in both the late groups of this large cultural structure as well as in the newly formed structure of the Globular Amphora culture and, at the beginning of the third millennium BC, in the Corded Ware culture. The changes involved, on the one hand, the systematic reduction of the size of domestic sites (= *reduction trend*), while, on the other hand, there was an increase in the number of residential sites evidenced archaeologically (= *increase trend*). Moreover, areas used regularly by human groups were gradually getting larger (= *enlargement trend*).

These opposite trends (reduction and increase + enlargement) continued in parallel over time, and they even combined and connected. It can be argued that they reflected the deep transformations of social and economic relationships that led to the re-organisation of human groups and their adaptation to the Lowland natural environment.

The following stages of this process can be identified at various spatial scales. At a large scale, it is possible to analyse the arrangement of Funnel Beaker, Globular Amphora and Corded Ware culture settlements (together with indeterminate so-called "Decline Neolithic" sites), relying on the big data gathered in a long-term programme of archaeological surveys of the entire territory of Poland, the Archaeological Record of Poland (in Polish: Archeologiczne Zdjęcie Polski; Ławniczak in prep.). It can be concluded that the communities of the Funnel Beaker and Globular Amphora cultures preferred a moderately agglomerated settlement model (Figure 2 A–B), while in the Corded Ware culture, sites became increasingly dispersed across the entire study area (Figure 2 C). The turning point for the reverse shift that resulted in more agglomerated and complex settlement came around 2400 BC, together with impulses from the Bell Beaker milieu, and developed in the Early Bronze Age (Czebreszuk and Szmyt 2015; 2019).

At a small scale, it is possible to present the major features of each of the three trends mentioned above: reduction, increase and enlargement. How can they be defined and how have they manifested themselves in the archaeological record?

After a careful analysis of a very rich database from the Lowland, it is possible to identify several traits regarding the reduction of settlement sites compared to the previous period: the area of settlements contracts, the size of houses is reduced, the maximum number of contemporaneous houses is much smaller, the settlement infrastructure becomes simpler, and the number of artefacts left within a settlement drops. Extremely low sizes are identified in the Corded Ware culture. Its domestic sites are described as lacking any permanent structures, having very few, if any, accompanying features (such as pits or hearths) and only few artefacts (Czebreszuk and Szmyt 2011).

That is why they are hard to even recognise in usual archaeological practice.

As a result, from the end of the fourth until the middle of the third millennium BC, the dominant form of settlement became somewhat ephemeral: small (one-dwelling) and medium-sized (several-dwelling) settlements. Additionally, the number of so-called camps — i.e. places with no permanent structures, with very few, if any, accompanying features such as pits or hearths, and only few artefacts — increased (Czebreszuk and Szmyt 2011; Kośko 1979). It is supposed that all these sites were used for a relatively short time.

Almost nothing is known of Corded Ware dwelling structures, whereas various dwelling forms were identified at Funnel Beaker and Globular Amphora sites (Czebreszuk and Szmyt 2011; Szmyt 2017). In the latter two cultural units, these were either above-ground post-built houses or shallow pit houses. The houses of the Globular Amphora culture were of various shapes (rectangular, trapezoid, polygonal and irregular), while their size covers between 15 and 60 m^2. The design of Funnel Beaker houses was similar, but they had more regular forms and their size range was greater (buildings of about 90 m^2 were encountered). The accompanying infrastructure included hearths, storage pits, waste disposal pits, wells and pits left by sand or clay extraction. In some Globular Amphora domestic sites, rituals, involving the deposition of animal carcasses, were also performed.

Settlements related to the Funnel Beaker and Globular Amphora cultures. Selected cases and general characteristics

Examples of newly analysed or re-analysed medium-sized and small settlements of Funnel Beaker communities come from Mrowino, site 3 (with four excavated houses) and Opatowice, site 42 (with one house). Relevant cases of Globular Amphora settlements include Opatowice, site 36 (one house with two phases of use) and Janowice, site 2 (three successive settlement phases).

Mrowino, site 3, Wielkopolska region

The first case is Mrowino, site 3 — a settlement related to the Funnel Beaker culture, the so-called Luboń style/stage, taxonomic phase V (Szmyt 2018). Based on detailed stratigraphic studies, two phases of Funnel Beaker occupation have been recorded there: an older one, MRO-A1, and a younger one, MRO-A2. Thanks to a series of AMS radiocarbon dates from secure contexts (Table 1) and associated modelling, the settlement is placed between 3374 and 2901 calBC (1σ; Goslar *et al.* 2018[1]). The older phase (MRO-A1), dated between *c.* 3300 and 3150 calBC, was the most intensive time of human occupation and a majority of features and artefacts are related to that phase (Figure 3 A). Re-occupation of the site just after 3150 calBC, again by an FBC population (phase MRO-A2), left only four settlement features and a limited number of artefacts.

Four above-ground buildings were reconstructed and designated as Houses A, B, C and D in the excavated area (1,230 m^2). All were related to phase MRO-A1. There could have been more houses, but no traces of them have been uncovered. All buildings were destroyed by fire, probably intentionally (Diachenko *et al.* 2018; 2021).[2] Surviving related features consisted of at least 100 pits.

A very large collection of artefacts testifies to a diversified economic activity, the vast majority of which relied on the processing of local resources: food (plants — about 240 palaeobotanic identifications, and animals — about 100 bones) but also clay, flint, stone, wood, fibres, bone tools and antler. Mostly domestic plant species were used and processed (Rennwanz 2018; Sikorski 2018): cereals (including barley (*Hordeum vulgare*), emmer wheat (*Triticum dicoccum*), einkorn wheat (*Triticum monococcum*)) and leguminous plants (field pea (*Pisum sativum*)). Other plants that were used include crop weeds (brome grass (*Bromus* sp.) including rye brome grass (*Bromus secalinus*), poison darnel (*Lolium temelentum*), corn cockle (*Agrostemma githago*), goosefoot (*Chenopodium* sp.) and field poppy (*Papaver rhoeas*)), as well as trees and shrubs (Scots pine (*Pinus sylvestris*), willow (*Salix* sp.), European hornbeam (*Carpinus betulus*), European alder (cf. *Alnus glutinosa*)). The animals that were used included domestic and wild mammals, with the former clearly dominating (Makowiecki *et al.* 2018). Among the domestic mammals, cattle dominated, followed in terms of number by small ruminants, with the third most common species being the pig. Wild mammals were represented by the bones of deer.

The processing of local raw materials is also confirmed in flint production (Kabaciński and Winiarska-Kabacińska 2018). The flint assemblage (820 artefacts) is very homogeneous, being dominated by items made of erratic Cretaceous flint (so-called Baltic flint). About 98 % of the artefacts whose raw material could be identified (763 items) were made of this flint.[3] Only 12 artefacts were made of flint coming from the south (upper Vistula catchment). Artefacts were made using two techniques of flint working: classic core exploitation and the bipolar technique. The former clearly dominates, as 82.7 % of the assemblage were made in this way. The basic method of flint working was the exploitation of single-platform

1 See Goslar *et al.* 2018 for the discussion on various models of interpretation.

2 Arguments for the proposed interpretation can be found in Diachenko *et al.* 2018; 2021.

3 55 artefacts were burnt and two others were not identified.

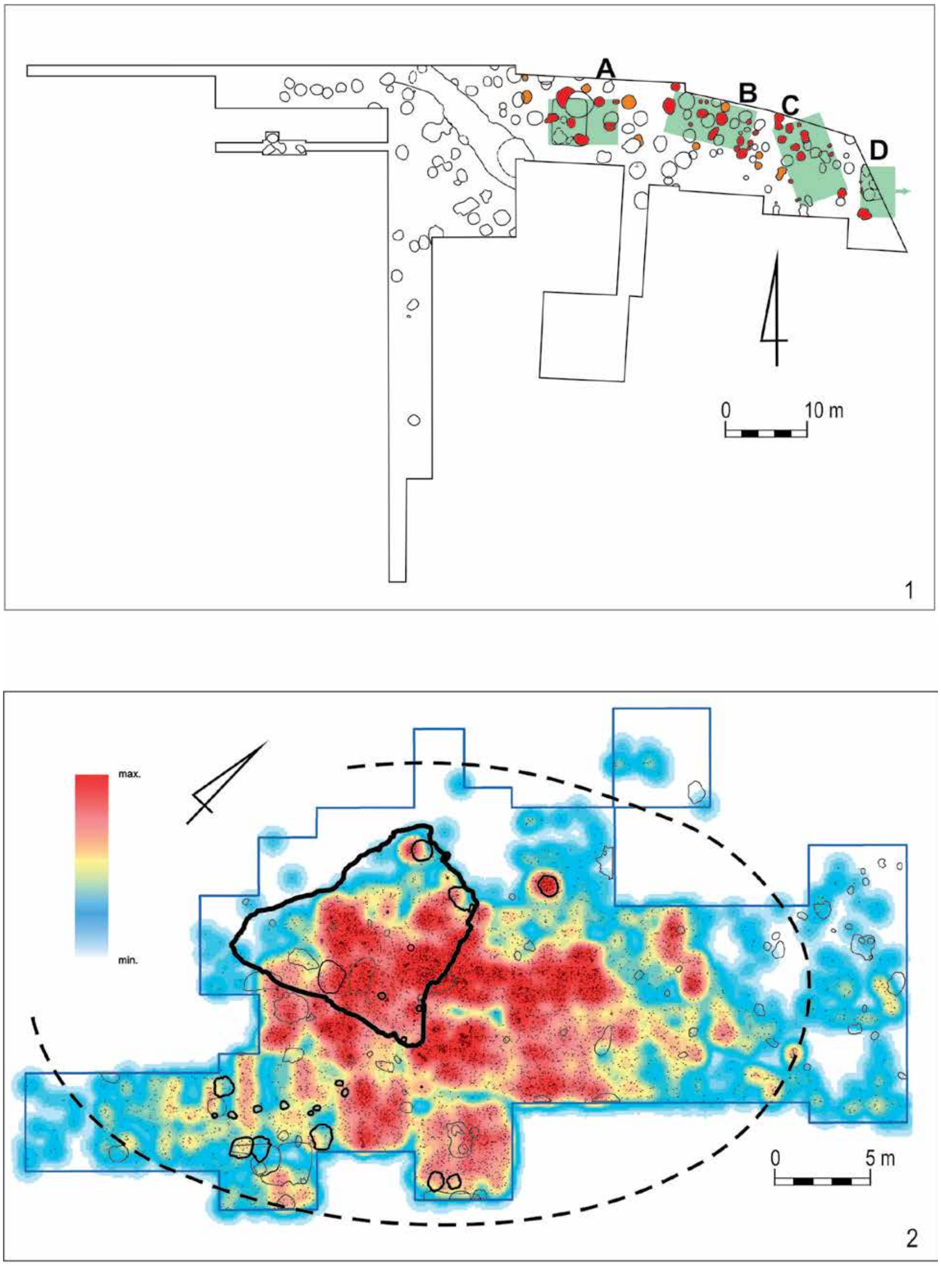

Figure 3. Examples of medium-sized and small settlements related to the late phases of the Funnel Beaker culture and dated to the last quarter of the fourth millennium BC.
1 Mrowino, site 3, Greater Poland region (A–D: houses reconstructed);
2 Opatowice, site 42, Kujawy region (location of the house (Op42-B2) and other features on the background of kernel density analysis of pottery). Based on Kośko and Szmyt 2007, 61 fig. 4.1; Diachenko *et al*. 2018, 133 fig. 4.9.

flake cores. The chief purpose of core exploitation was to procure flakes. Blades were relatively rarely produced (5.1 %). The bipolar technique was employed in the manufacture of 17.3 % of artefacts. It seems that it was used in two ways: to a limited extent, it served the purpose of recycling worn flake cores or even larger flakes. Use-wear analyses showed that the flint tools had been used in three clearly defined types of activity: processing wood, plants (including cutting cereals) and hides.

Opatowice, site 42, Kujawy region

The second example is Opatowice, site 42 — a settlement related to the Funnel Beaker culture, taxonomic phase IVB/VB (Kośko and Szmyt 2007). Several occupation phases have been recognised at this site. A majority of features and artefacts are related to phase Op42-B, a single homestead related to the Late Funnel Beaker culture and dated to 3350–3100 calBC (Kośko and Szmyt 2015b). Its dominant element was a single house (Figure 3 B). During the time it was used, and continuing the same spatial formula, this building was remodelled, which justifies distinguishing two construction phases: an older one (Op42-B1), and a younger one (Op42-B2). As seen in the pottery distribution, in both construction phases the settlement covered at least 900–1000 m^2. The ground plan of the house in phase Op42-B1 was polygonal and its longer

No.	Site	Feature	Sample material	Lab. No.	BP	Context	References
1	Mowino site 3, Wielkopolska region	Pit 9	Cattle bone	Poz-101806	4405±35	FBC, phase MRO-A1	Goslar *et al*. 2018
2	Mowino site 3, Wielkopolska region	Pit 10	Animal bones	GrN-14017	4480±35	FBC, phase MRO-A1	Goslar *et al*. 2018; Tetzlaff 1989
3	Mowino site 3, Wielkopolska region	Pit 10	Pig bone	Poz-104189	4475±30	FBC, phase MRO-A1	Goslar *et al*. 2018
4	Mowino site 3, Wielkopolska region	Pit 55	Charcoal (*Pinus*)	Poz-107407	4495±35	FBC, phase MRO-A1	Goslar *et al*. 2018
5	Mowino site 3, Wielkopolska region	Pit 63	Cervidae, antler	Poz-107092	4590±35	FBC, phase MRO-A1	Goslar *et al*. 2018
6	Mowino site 3, Wielkopolska region	Pit 73	Charcoal (*Pinus*)	Poz-107405	4530±35	FBC, phase MRO-A1	Goslar *et al*. 2018
7	Mowino site 3, Wielkopolska region	Pit 91	Mammal bone	Poz-104190	4490±35	FBC, phase MRO-A1	Goslar *et al*. 2018
8	Mowino site 3, Wielkopolska region	Pit 94	Mammal bone	Poz-101920	4505±35	FBC, phase MRO-A1	Goslar *et al*. 2018
9	Mowino site 3, Wielkopolska region	Pit 98	Horse? bone	Poz-101921	4480±35	FBC, phase MRO-A1	Goslar *et al*. 2018
10	Mowino site 3, Wielkopolska region	Pit 99	Cattle bone	Poz-101922	4440±40	FBC, phase MRO-A1	Goslar *et al*. 2018
11	Mowino site 3, Wielkopolska region	Pit 101	Cattle bone	Poz-101923	4460±35	FBC, phase MRO-A1	Goslar *et al*. 2018
12	Mowino site 3, Wielkopolska region	Pit 123	Cattle? bone	Poz-101924	4300±35	FBC, phase MRO-A1	Goslar *et al*. 2018
13	Mowino site 3, Wielkopolska region	Pit 135	Cattle bone	Poz-101925	4395±35	FBC, phase MRO-A1	Goslar *et al*. 2018
14	Mowino site 3, Wielkopolska region	Hut 1	Cattle bone	Poz-104188	4420±30	FBC, phase MRO-A1	Goslar *et al*. 2018
15	Mowino site 3, Wielkopolska region	Post 8	Charcoal (*Pinus*)	Poz-107406	4635±35	FBC, phase MRO-A1	Goslar *et al*. 2018
16	Opatowice site 3, Kujawy region	Feature 1	Animal bone	Poz-37524	4145±35	GAC, phase Op3-C2	Kośko and Szmyt 2014
17	Opatowice site 3, Kujawy region	Feature 19	Pig bone	Poz-37523	4480±35	FBC, phase Op3-B1	Kośko and Szmyt 2014
18	Opatowice site 3, Kujawy region	Feature 19	Sheep/goat bone	Poz-37617	4440±40	FBC, phase Op3-B1	Kośko and Szmyt 2014
19	Opatowice site 3, Kujawy region	Feature 19	Cattle bone	Poz-37525	4440±35	FBC, phase Op3-B1	Kośko and Szmyt 2014
20	Opatowice site 3, Kujawy region	Feature 19	Animal bone	Gd-2642	4330±90	FBC, phase Op3-B1	Kośko and Szmyt 2014
21	Opatowice site 3, Kujawy region	Feature 35	Bone artefact	Poz-61634	4370±50	GAC, phase Op3-C1	Kośko and Szmyt 2014
22	Opatowice site 3, Kujawy region	Feature 35	Charcoal	KN-3765	4290±120	GAC, phase Op3-C1	Kośko and Szmyt 2014
23	Opatowice site 3, Kujawy region	Feature 44	Cattle? bone	Poz-15054	4280±40	FBC, phase Op3-B2	Kośko and Szmyt 2014
24	Opatowice site 3, Kujawy region	Feature 64	Cattle bone	Gd-4117	4230±110	GAC, phase Op3-C1	Kośko and Szmyt 2014
25	Opatowice site 42, Kujawy region	Feature 21	Clay mass	Kiev-13237	4380±80	FBC, phase Op42-B	Kośko and Szmyt 2007
26	Opatowice site 42, Kujawy region	Pit 52	Charcoal	Gd-2764	4460±80	FBC, phase Op42-B	Kośko and Szmyt 2007
27	Opatowice site 42, Kujawy region	Trench VIII	Wood tar	Poz-11040	4540±35	FBC, phase Op42-B	Kośko and Szmyt 2007

Table 1. List of radiocarbon dates used in the text. FBC = Funnel Beaker culture, GAC = Globular Amphora culture (continued on the following page).

No.	Site	Feature	Sample material	Lab. No.	BP	Context	References
28	Opatowice site 42, Kujawy region	Trench VIII	Wood tar	Poz-15056	4475±35	FBC, phase Op42-B	Kośko and Szmyt 2007
29	Janowice site 2, Kujawy region	Feature E70	Animal bone	Poz-83599	4375±35	GAC, phase JAN-D1	Goslar and Szmyt 2016
30	Janowice site 2, Kujawy region	Feature K79	Black grouse bone	Poz-48819	4055±30	GAC, phase JAN-D3	Goslar and Szmyt 2016
31	Janowice site 2, Kujawy region	Feature M686	Cattle bone	Poz-48820	4280±40	GAC, phase JAN-D2	Goslar and Szmyt 2016
32	Janowice site 2, Kujawy region	Feature M822	Cattle? bone	Poz-48821	4340±30	GAC, phase JAN-D2	Goslar and Szmyt 2016
33	Janowice site 2, Kujawy region	Feature O171	Cattle bone	Poz-48822	4315±30	GAC, phase JAN-D2	Goslar and Szmyt 2016
34	Opatowice site 36, Kujawy region	Feature 67	Cattle bone	Gd-6438	4010±100	GAC, phase Op36-B2	Kośko and Szmyt 2015
35	Opatowice site 36, Kujawy region	Feature 101A	Cattle bone	Kiev-5137	3920±60	GAC, phase Op36-B2	Kośko and Szmyt 2015
36	Opatowice site 36, Kujawy region	Feature 101A	Cattle bone	Gd-8037	3850±50	GAC, phase Op36-B2	Kośko and Szmyt 2015
37	Opatowice site 36, Kujawy region	Feature 123	Cattle bone	Gd-6522	4350±120	GAC, phase Op36-B1	Kośko and Szmyt 2015
38	Opatowice site 36, Kujawy region	Feature 123	Cattle bone	Poz-57540	4210±35	GAC, phase Op36-B1	Kośko and Szmyt 2015
39	Opatowice site 36, Kujawy region	Feature 123	Cattle bone	Kiev-5136	4180±70	GAC, phase Op36-B1	Kośko and Szmyt 2015

axis ran from the south-east to the north-west. Several cellars were connected to the house.

The younger house (Op42-B2) was located in part in the location of the older building. Its ground plan was trapezoidal and covered about 90 m^2. Two pits — probably cellars/storerooms — formed its integral elements. Inside the house, there was a great number of finds, mostly pottery. The vast majority of them were concentrated in the eastern half of the building. It was here that textile, flint and stone processing took place. In the same part of the house, there was also a concentration of vessels covered with birch tar coating. The space surrounding the house was structured into three zones. Right next to the house a kind of courtyard was located. This was an area where household activities concentrated and, consequently, a large number of movable finds accumulated. Inorganic waste, resulting from the accidental destruction of pottery or tools, or originating from different industries (e.g. stone or flint working), was usually left in place. The second zone (a farmyard) was an area where rather dispersed activities were carried out. It was there that most of the storage pits were located. In the third zone (the boundary), sand extraction took place (Kośko and Szmyt 2015b).

The settlement inhabitants consumed the meat of domesticated animals, mainly cattle with a smaller share of sheep/goats (Makowiecka 2007). The use of plants is evidenced by a large series of plant impressions, charcoal and traces of plant material processing (Koszałka 2007; Langer *et al.* 2007; Stępnik 2007). The major crop was cereals, mainly wheat in its four varieties: einkorn (*Triticum monococcum*), emmer (*Triticum dicoccum*), spelt (*Triticum* cf. *spelta*) and bread wheat (*Triticum* cf. *aestivum*). The most popular wood raw material was pine (*Pinus* sp.), used for construction and most likely burnt for heat as well. Its remains account for over 95 % of charcoal on site. Hardwood was only sporadically used for specialised manufacturing (in the case of oak) or — in the case of birch wood and bark — for producing wood tar. In pottery from settlement Op42-B, a "wood-tar glaze" was applied to the outer surface of vessels (Kośko *et al.* 2021). Exceptionally many instances of this practice (380 sherds) were recorded on this site within the eastern part of the younger house and the adjacent farmyard. Vessels were covered with a layer of birch tar about 1 mm thick. For the manufacturing of tools, local erratic flint was mostly used, while southern raw materials such as chocolate, Volhynian and Jurassic flint were far less frequent (Domańska 2007). Telltale flakes of Jurassic flint show that axes made of this material were re-utilised on site. Fibre processing is confirmed by spindle whorls, of which 30 were found in the house and its surroundings.

In sum, the site documents the daily life of a small group of inhabitants. They were farmers who cultivated plants, bred domestic animals and processed all materials they needed. Daily consumption, too, concentrated in the house and its immediate surroundings.

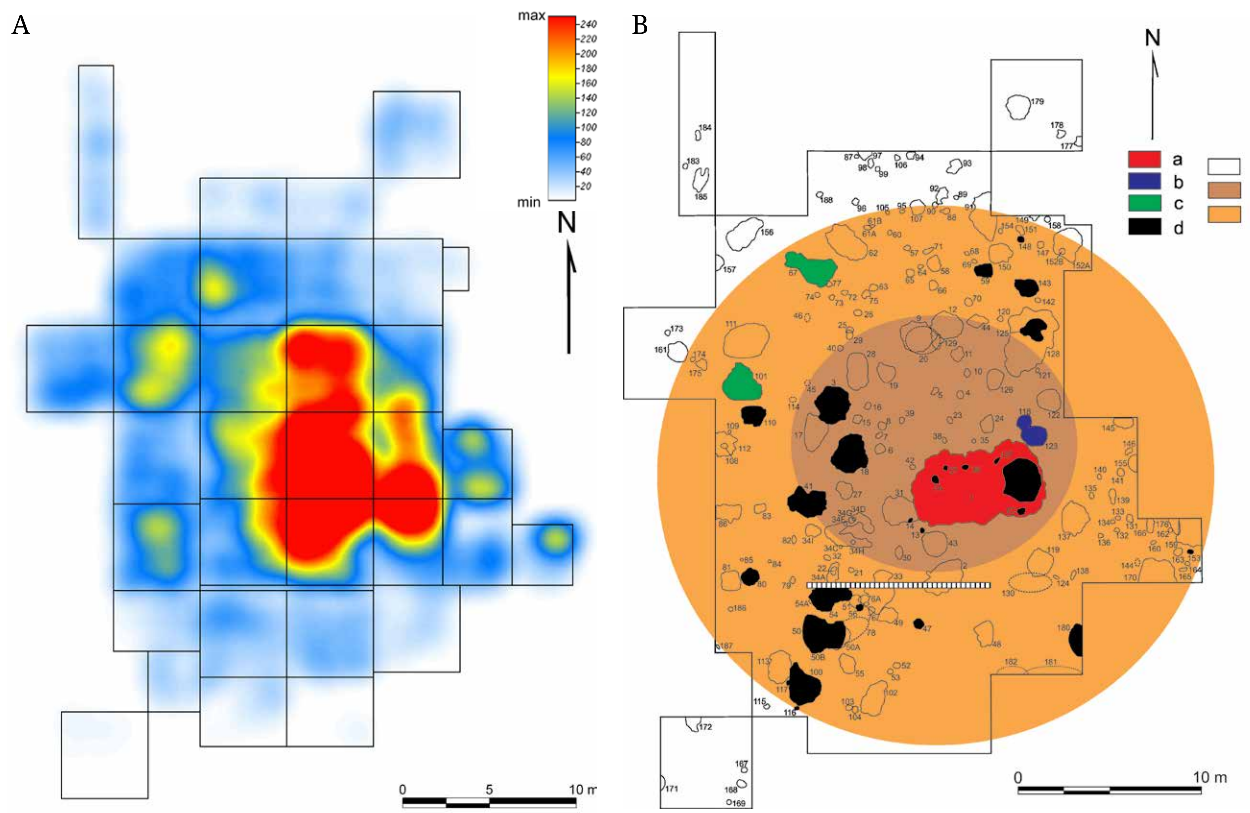

Figure 4. Opatowice, site 36, Kujawy region: a small Globular Amphora culture settlement dated to the first half of the third millennium BC. A Results of kernel density analysis of pottery distribution. B Spatial organisation. a) house; b) cattle deposit of phase Op36-B1; c) cattle deposits of phase Op36-B2; d) features of phase Op36-B1 or Op36-B2; e) other features, not connected to Op36-B; f) concentration of Globular Amphora pottery; g) range of settlement phases Op36-B1 and Op36-B2. After Kośko and Szmyt 2015, 487 fig. 20.2.

Opatowice, site 36, Kujawy region

The third example is Opatowice, site 36, a settlement related to the Globular Amphora culture, taxonomic phase IIIa (Kośko and Szmyt 2015a). This single-homestead settlement had two construction phases called Op36-B1 and Op36-B2. The settlement was established in the twenty-eighth century BC, and a house erected on a rectangular plan (c. 35 m^2) was its dominant architectural feature (Figure 4). The building was aligned on an east–west axis and slightly sunken into the ground; its floor was made of clay. The processing of organic raw materials was focused inside the house, while around it were traces of other activities (including pits, cellars, fireplaces and sand extraction pits). A ritual feature containing the carcass of a cow was located near the house.

In total, the central part of the settlement extended over an area of approximately 250 m^2. In the described form, settlement Op36-B1 could have lasted at least 40 years (2730–2690 calBC). It is possible that in terms of both spatial organisation and the material culture characteristics it continued in the form of settlement Op36-B2. At the latest by the twenty-sixth century calBC, the then residents partially changed the inhabited space and sacralised its north-eastern edge by placing two animal deposits, containing parts of bovine carcasses, in this area. This was probably not a one-time event, but rather a repeated action that happened twice in 2570–2510 calBC. At the same time, the house did not alter much.

The everyday life of the residents of settlement Op36-B was reconstructed in some aspects. Their subsistence was based on animals and plants. Cattle were used, which is reflected not only in skeletal remains but also as traces of processed milk preserved in the form of lipids in the walls of clay vessels (Makowiecki *et al.* 2015; Szmyt 2015). Cereals and legumes were also utilised (including emmer wheat, *Triticum dicoccum*), which is confirmed by impressions identified on pottery (Koszałka and Szmyt 2015).

Mineral raw materials were mainly used for manufacturing tools, predominantly flint. Locally available erratic flint was of particular importance (Domańska 2015). It was supplemented to a small extent by banded flint imported from the south, which was mostly used to make axes. Tools (polishing plates,

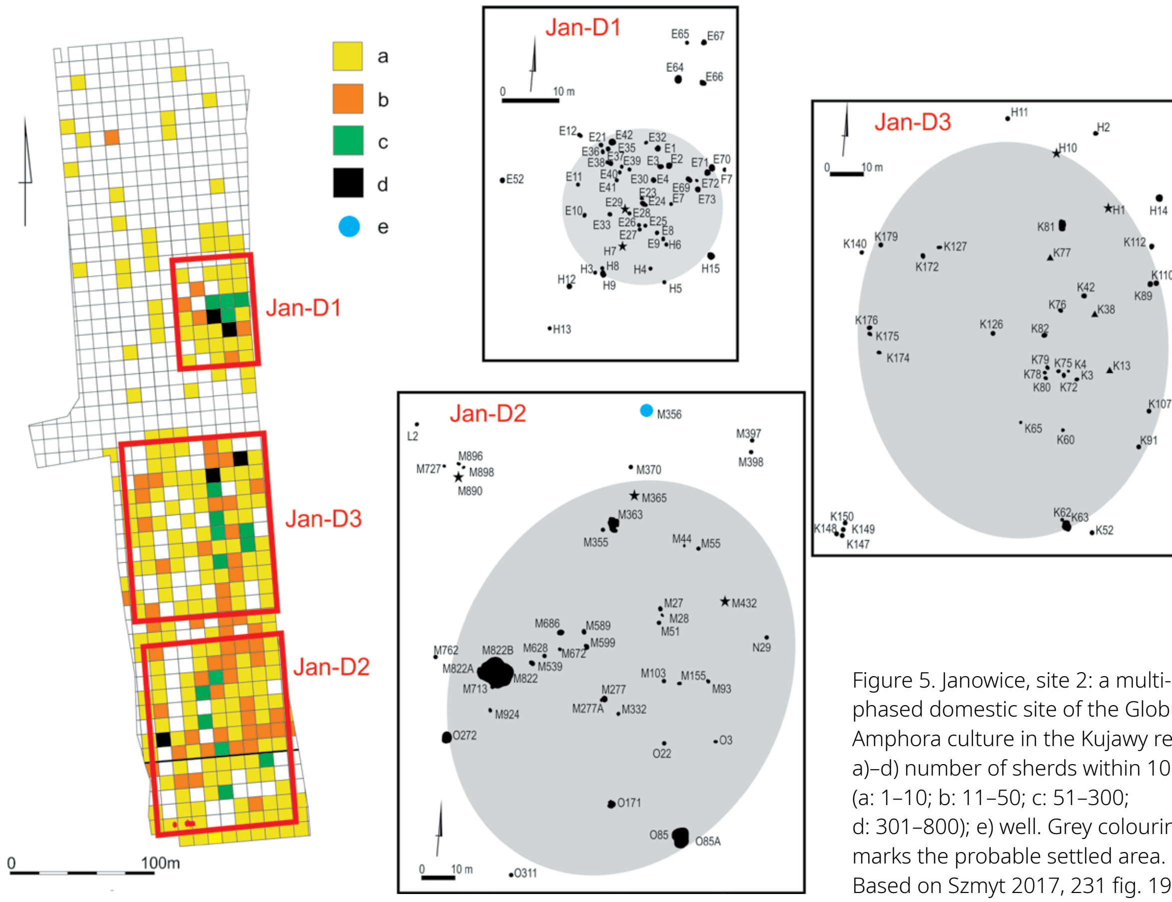

Figure 5. Janowice, site 2: a multi-phased domestic site of the Globular Amphora culture in the Kujawy region. a)–d) number of sherds within 100 m² (a: 1–10; b: 11–50; c: 51–300; d: 301–800); e) well. Grey colouring marks the probable settled area. Based on Szmyt 2017, 231 fig. 19.

grinders, axes) were also made of local erratic rocks (Szmyt and Zieliński 2015). Clay for pottery manufacture was mixed by the addition of two basic tempers: crushed igneous rocks and sand, occasionally also organic material (Rauba-Bukowska 2015). Vessels were fired mostly at low temperature (c. 700°C). Coniferous wood (mainly pine), the most easily available in the area, was used as the primary building material and fuel; deciduous wood was used only occasionally (Stępnik and Szmyt 2015). Imprints on pottery attest that fibrous materials in the form of braided cords, probably made of phloem, were used. Additionally, traces of the use of plain weave were identified (Kośko *et al.* 2015).

Janowice, site 2, Kujawy region

The last case is Janowice, site 2, where three settlement phases of the Globular Amphora culture have been identified and dated to the period from 3010–2923 calBC until at least 2674–2490 calBC, taxonomic phases IIb–IIIa (Goslar and Szmyt 2016; Szmyt 2016). From more than 100 features and a cultural layer, 7900 GAC pottery sherds were recovered, weighing in total 96.37 kg, as well as 2433 daub fragments, seven flint artefacts, 13 stone objects, two bone tools and 84 animal bones (Chachlikowski 2016; Makowiecki 2016; Sobkowiak-Tabaka 2016; Szmyt 2016). Further studies yielded a mineralogical-petrographic description of eight pottery samples and identified mollusc shells deposited in three GAC features, as well as charcoal and plant impressions on pottery (Koszałka 2016; Kurzawska 2016; Rauba-Bukowska 2016; Stępnik and Szmyt 2016).

The distribution pattern of finds and features showed several clusters. Major clusters were identified as belonging to three settlement phases dated to successive periods (Figure 5; Table 1):

- JAN-D1: 3010–2923 calBC
- JAN-D2: 2919–2901 calBC
- JAN-D3: 2851–2814 calBC or 2625–2568 calBC (68.2 % probability).

The clusters contained pits, cellars, hearths and postholes as well as features of more specific functions such as a dwelling structure (M822) and an oven (feature H1). Outside the clusters, the only well associated with the Globular Amphora settlement was located (M356). No stratigraphic sequence was recorded between the features under discussion.

The pottery, being the most numerous find type, was assessed relying on technological and stylistic traits. The most important conclusions concerned differences in the technological, morphological and ornamentation traits of vessels. Thus, it can be justifiably claimed that the finds from the Janowice settlement are the results of several sojourns by GAC populations in the area, while the clusters distinguished above are a record of chronologically separate settlements (Szmyt 2020).

The cluster associated with phase JAN-D1 corresponds best to the typical GAC settlement module. It represents the first traces of the presence of GAC settlers on the site, who in the late thirty-first and thirtieth centuries BC established a settlement there. Most household features (above all pits, including cellars) concentrated in a restricted area of 30–40 m in diameter. Within it, however, a possible dwelling structure is hard to identify.

Some time later, towards the end of the thirtieth century BC, the southern part of the site was settled. This time the settlement (JAN-D2) occupied the summit of a small hill and its southern slope, descending towards a watercourse. In addition, the settlement inhabitants had a well at their disposal. What remained of their sojourn was a cluster of finds and features whose western portion saw the only dwelling feature (M822) identified on the site, which was partially sunk into the ground. The main row of pits and cellars extended east and north-east of the structure and the outermost features (a well, two hearths and a clay pit) stayed within a radius of 70–80 m from it.

In turn, the youngest remains, dating in all likelihood to the twenty-ninth century BC or late twenty-seventh to early twenty-sixth centuries BC (JAN-D3), were found in the central portion of the site and occupied the eastern slope of the principal elevation. The cluster distinguished there was rather dispersed. It could be divided into two smaller ones, tied to pottery concentrations: northern and central. These might be the remains of zones where special economic activities were carried out, for instance involving the use of fire in the northern portion. This is corroborated by an oven, which contained strongly burnt daub and a large set of pottery.

It follows from the above description that during the three sojourns of GAC settler groups on the site the area selected for settlement was intensively developed by building settlement infrastructure, including household features (e.g. cellars, pits, hearths, an oven or a well) and dwelling structures (not archaeologically visible for the most part), forming temporary or semi-permanent settlements (Kośko and Szmyt 2006).

The economic foundations of the GAC populations at Janowice can be reconstructed in part. Analyses confirmed the exploitation of grasses and cereals, including emmer wheat (*Triticum dicoccum*). In turn, the examination of animal remains provided evidence for the use of domesticated animals, mainly cattle and pigs. The role of wild animals was limited, but two interesting finds have to be mentioned in this context: black grouse bones were found in a feature from phase JAN-D3 and mollusc shells were discovered in features from phase JAN-D2. For both the oldest and the youngest settlements, there is evidence of the use of erratic Baltic flint, which was processed ad hoc, with the bipolar technique being the most popular. The inhabitants of all settlements used stone grinding tools, but the presence of stone axes is confirmed for both younger settlements (JAN-D2 and JAN-D3), while grinding stones are known only from the youngest phase — JAN-D3.

General characteristics

Summing up, the interpretation of material evidence suggests that the basic social units related to the Funnel Beaker and Globular Amphora cultures were limited and comprised medium-sized or small groups. Based on the number of contemporaneous houses, it can be assumed that they usually did not exceed 50 people.

Most production, distribution and consumption took place in these relatively small groups. This is confirmed by various productive activities (e.g. in pottery making and using, flint knapping and stone processing). It is quite clear that one of the most important traits of the societies in question was an extensive adaptation to local raw material resources, which caused changes in the technologies used. This can be seen in the analyses of flint and stone artefacts, which were made of even poor-quality local raw materials. Thus, the principal agents of day-to-day production, distribution and consumption were small groups of people living together.

In this respect new information has come from stable isotope (^{13}C and ^{15}N) analyses. For instance, data from human remains deposited in multi-burial tombs of the Globular Amphora culture revealed a rather uniform diet with a poorly marked tendency to increase animal protein consumption "during the lifetimes of both males and females" (Eriksson and Howcroft 2013, 117; Pospieszny 2017, 297). All examined individuals consumed terrestrial food consisting of animal (including meat and dairy products) as well as plant products. The consumption of dairy foods was independently borne out by the identification of milk lipids in some vessels from Kujawy (Roffet-Salque *et al.* 2017). In turn, analyses of human remains related to the Corded Ware culture revealed individuals who had lived on a diet of mainly animal proteins, i.e. meat or milk (Pospieszny *et al.* 2015).

However, in contrast to the rather small and dispersed human groups that dominated everyday life there were also activities which involved larger communities, composed of several or a dozen or so basic groups. They were reflected in communal rituals mainly focused on ancestors' graves and included communal

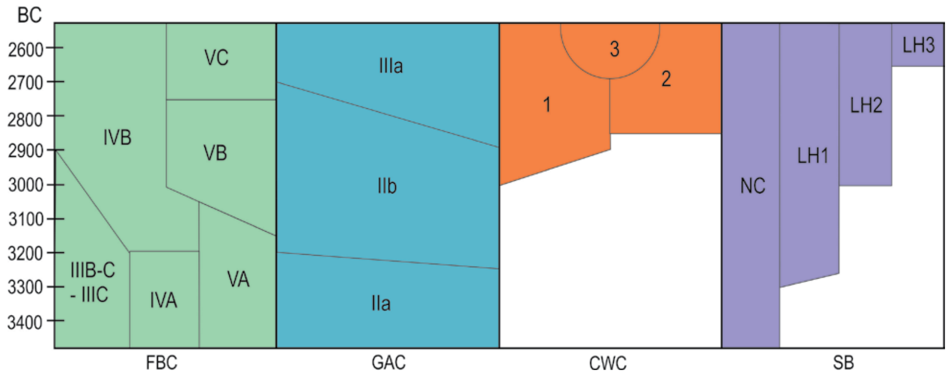

Figure 6. Temporal relationships and phases of cultural traditions on the Polish Lowland in the period 3400–2600 BC. CWC: Corded Ware culture; FBC: Funnel Beaker culture; GAC: Globular Amphora culture; LH: Linin horizon; NC: Neman culture; SB: Subneolithic. Data adapted from Czebreszuk *et al*. 2000; Józwiak 2003; Kośko and Szmyt 2015; Szmyt 2013.

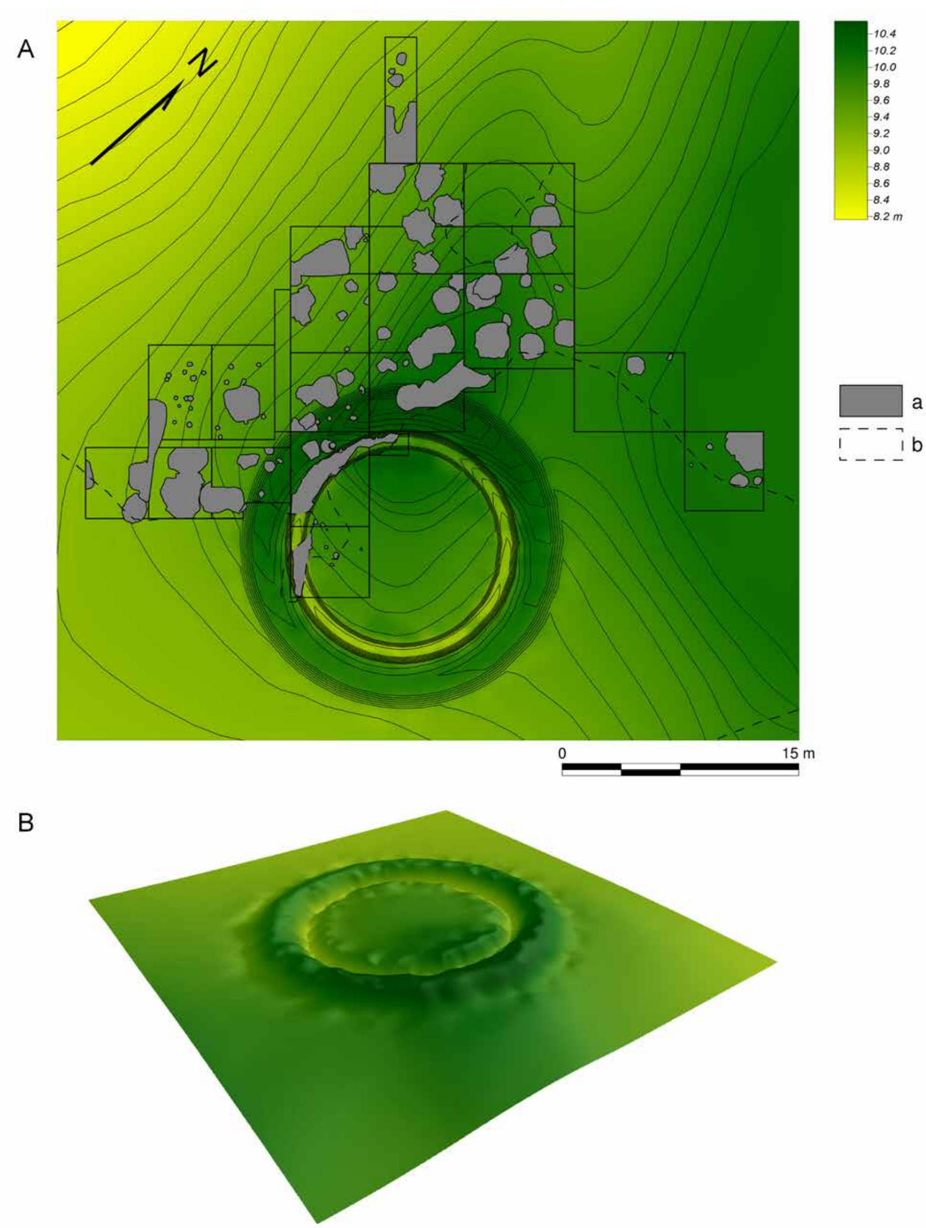

Figure 7. Opatowice, site 3, Kujawy region. A fortified settlement dated to the turn of the fourth millennium BC. Based on Kośko and Szmyt 2014, 43 fig. 2.6.

feasts as well as additional ceremonial practices, such as depositions of animal carcasses. Relevant examples are related to the Funnel Beaker, Globular Amphora and Corded Ware societies. They have many different features, but also some common elements. The most important of these is group celebration of funeral rites and commemoration of selected deceased by making their graves monumental and highly visible in the landscape (Szmyt and Czebreszuk 2012).

The oldest examples of this are linked to the Funnel Beaker societies. In contrast to the rather modest houses people lived in, the tombs in which they buried the remains of some chosen dead were monumental (Midgley 2005; Rzepecki 2011). They were erected away from settlements, but often in deforested areas (e.g. in places where settlements once stood or in the fields), and had huge elongated earthen mounds, making them easily noticeable (Papiernik *et al.* 2020). Most of these long barrows have survived in forested areas, sometimes in clusters, and their remains have been located using new techniques such as airborne laser scanning (e.g. Gorczyca *et al.* 2019; Matuszewska and Schiller 2016; Żurkiewicz *et al.* 2020).

Globular Amphora communities interred their dead in graves of diverse kinds, but the most typical were tombs in the form of a stone cist (Szmyt 2017). A few were covered with a barrow while others were located under the ground surface. One of the best investigated is a monumental tomb in Kierzkowo, where long sequences of ritual activities have been identified (Nowaczyk *et al.* 2017). There are many other tombs with several phases of use, yielding traces of repeated rituals and feasts. In some of them, and also in some settlements, depositions of domestic animals, mainly cattle, were intentionally placed as articulated carcasses and with no evidence of consumption (Pollex 1999; Szmyt 2006). This special status of domesticated animals (especially cattle) made them an important part of the social life of human communities.

The most characteristic graves of the Corded Ware communities are those over which round barrows were built, surrounded by a ditch usually around 5 m in diameter. In the ditch stood a wooden palisade. Placed under a barrow, a grave, sometimes with an additional stone structure, usually held a single corpse — most often of an adult male (Pospieszny 2009; Pospieszny *et al.* 2015).

In sum, it can be argued that for the long existence of small and dispersed communities it was vital to strike a kind of balance between two opposites: on the one hand, a day-to-day and almost perfect adaptation to the local natural environment that could cause isolation of individual groups, and on the other hand, a deep social need to break this isolation through communal rituals, mostly performed at funerary sites and not within settlements. Such periodically repeated rituals legitimised the social organisation of communities.

Processes of differentiation

Cultural transformations involved the rise of new cultural groups (often living in parallel in a single region). As a result, in the period of 3300–2700 BC, several traditions can be identified: the Funnel Beaker culture (its final stages: end of phase III and phases IV and V), the Globular Amphora culture (phases IIb and IIIa), the Corded Ware culture (phases 1 and 2) as well as the differentiated groups of Subneolithic hunters and foragers (Figure 6).

At the same time, the Polish Lowland witnessed various influxes of ideas, innovations and even groups of people. The most profound was the impact of the Baden culture (Przybył 2017; Szmyt 2008) and cultural groups originating from the east European steppe area (Kośko and Szmyt 2009).

Importantly, in the highly diversified cultural landscape of the Lowland, material culture was very actively used to manifest identity and distinguish oneself from other groups. As mentioned earlier, several forms of interaction can be observed in this highly varied Lowland cultural milieu. Two of them can be mentioned: cooperation and competition.

A form of cooperation perhaps can be suggested for some interactions between the communities of the Funnel Beaker and Globular Amphora cultures, as well as those of the Funnel Beaker and Corded Ware cultures. The first case is well illustrated by Opatowice 3 in Kujawy (Kośko and Szmyt 2014), where badly damaged remains of a ditch (1.0–1.5 m wide and 0.7 m deep) and a bank have been uncovered in an area settled by Late Funnel Beaker communities of the Radziejów group (Figure 7). Postholes were identified in the ditch fill, testifying to the existence of a palisade. The remains of the bank were documented along the external, western side of the ditch (Kośko and Szmyt 2018). In the ditch fill, rich material of the Funnel Beaker culture (phase Vb) and the Globular Amphora culture (phase IIb) was found. A detailed planigraphic and stratigraphic analysis of the ditch fill revealed the co-occurrence of the Funnel Beaker and Globular Amphora artefacts at all levels. Together with chronometric data, this thus provides grounds for a hypothesis concerning the cohabitation of both communities using the enclosure. AMS radiocarbon measurements allow one to set this period to 3014–2990 calBC (Kośko and Szmyt 2014) (Table 1).

The second type of cooperation, this time between the communities of the Funnel Beaker and Corded Ware cultures, may be seen in similarities in the manufacture of ceramic vessels. In short, both microscopic examinations as well as macroscopic ones confirm the use of similar recipes for the ceramic paste, to which only grog (i.e. crushed pottery) was added. All the earliest Corded Ware beakers and amphorae contain such temper (Czebreszuk 2001). It differs completely from the recipes typical of Globular

Amphora pottery, which usually contain an admixture of crushed stone (Szmyt 2013).

By contrast, the nature of the interactions between Globular Amphora and Corded Ware communities was completely different. A few years ago, we introduced the term "symbolic conflict" to characterise the specific relationship between the communities of the Globular Amphora and Corded Ware cultures (Czebreszuk and Szmyt 2011; Szmyt and Czebreszuk 2010). Its basic assumptions take into account the results of multifaceted studies, including in particular the following considerations: the long-lasting coexistence of these communities (2800–2500/2400 BC), their presence in the same area (both at the macro- and microscale), and their manifestation of differences in the various fields of material culture.

The long duration of the interaction in the form of symbolic conflict imposed specific behaviours on both communities, as both strengthened their internal cohesion and continually referenced the traditional models of community life. Thus, after 3000–2900 BC the Globular Amphora communities maintained their internal organisation and traditions, revealed by the long-lasting nature of communal rites tied to the "graves of the ancestors" and also involving animal sacrifice. Among Corded Ware communities, an equally active cultivation of traditions can be observed up to 2400 BC, when the appearance of Bell Beaker-using groups set in motion a slow change in social and economic systems (Czebreszuk and Szmyt 2008a).

Conclusion

In the Polish Lowland, 3300–2700 BC is a period when the symptoms of two opposing processes are discernible. One was oriented towards uniformity (in terms of settlement organisation based on medium-sized and small sites as well as a social organisation based on small, probably kin groups), while the other led to increased cultural differentiation (in terms of manifestation of identity through material culture, rituals and ceremonial activities). Both processes came to an end about 2400 BC when the first impulses from Bell Beaker groups reached Lowland communities. Then, a new trend led to a centralised or agglomerated settlement organisation, new ideas regarding social life and a greater similarity in how material culture was manipulated.

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Societal rise, dissolution and diversity

From Funnel Beaker (TRB) societies to Single Grave groups on the north European plain (c. 3300–2700 BC)

Jan Piet Brozio

Abstract
On the north European plain, as in many other regions of central and northern Europe, significant transformations can be observed around the transition from the fourth to the third millennium BC. This study focuses on social processes in Funnel Beaker societies (TRB) on the eve of the Single Grave culture (SGC) phenomenon. It is shown that the last generations of TRB societies, before the arrival of SGC groups, are already characterised by a loss of social orientation within the TRB groups. This includes a differentiation of social processes, for example changes from agglomeration to disorganisation or from more collective to more individual behaviour. Thus, the TRB phenomenon does not end abruptly with the rise of the SGC, but was already undergoing internal changes that manifested themselves in increasing social differentiation.

Keywords: north European plain, Funnel Beaker societies (TRB), Single Grave groups (SGC), social processes

Introduction
In modern societies, profound transformations are associated with terms such as demographic change, pluralisation of lifestyles, individualisation, integration, as well as exclusion and conflicts. Evidence for equally profound transformations in prehistoric societies can be observed on the north European plain, as in many other regions of central and northern Europe, around the transition from the fourth to the third millennium BC (Dörfler and Müller 2008; Iversen 2020; Matuschik and Schlichtherle 2016; Szmyt 2008). Thus, the appearance of Single Grave culture (SGC) groups as a northern phenomenon of Corded Ware culture (CWC) societies is visible, amongst others, in characteristic changes in parts of the material culture and burial forms. In particular, new aDNA analyses have brought the phenomenon of the SGC back into focus (Allentoft *et al.* 2024; Furholt 2019; 2021; Heyd 2017; Kristiansen *et al.* 2017).

However, the groups of the SGC phenomenon (Brozio and Hage 2013; Hübner 2005; Jacobs 1991; Schultrich 2019; Strahl 1990) faced complex social structures when they

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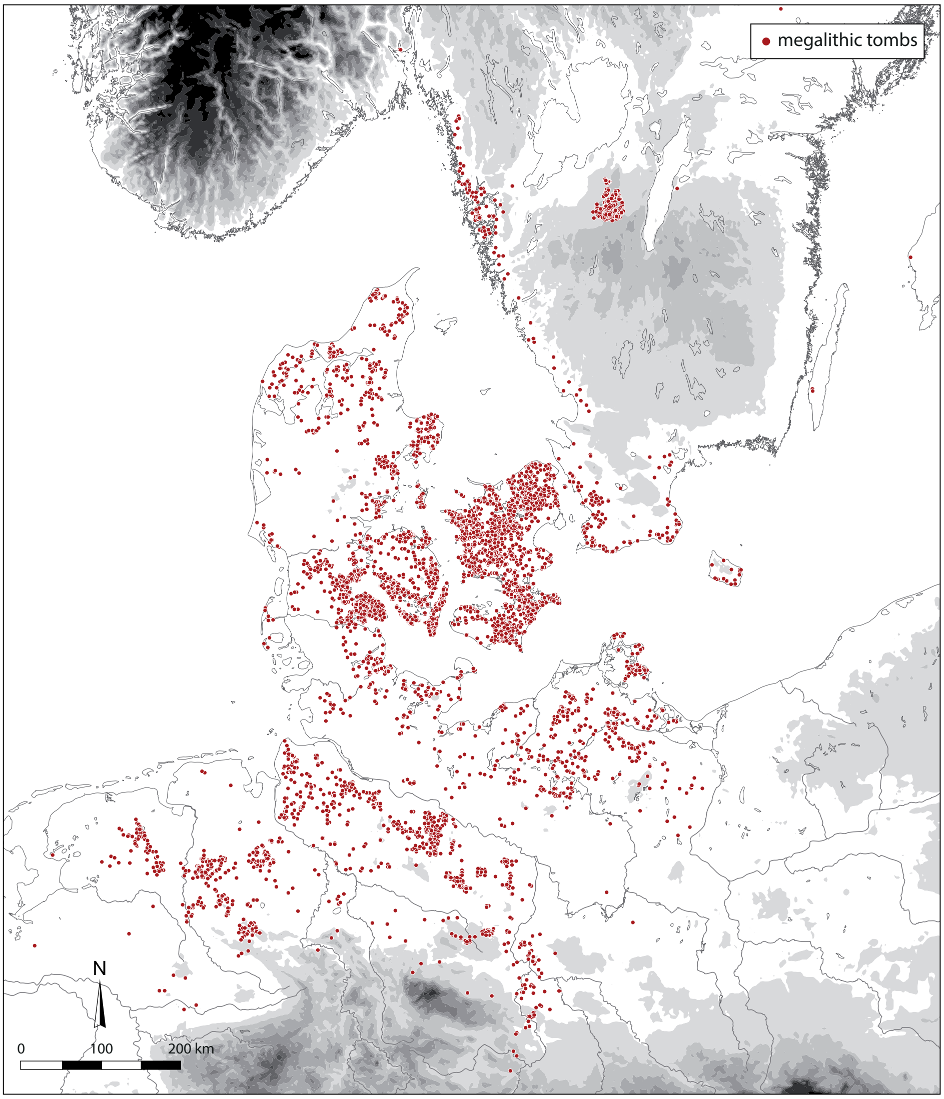

Figure 1. Megalithic tombs in northern central Europe and southern Scandinavia (Fritsch *et al.* 2010, 2 fig. 1).

reached the north European plain (Brozio 2019). They entered cultural landscapes which had been created and shaped centuries earlier by Funnel Beaker groups (TRB) due to two main factors: agricultural use, and thus the creation of open land for fields and domestic sites through the clearing of forests, as well as the distinctive monumental burial architecture of non-megalithic and megalithic long barrows (Behrens and Darvill 2021; Brozio *et al.* 2019a; Müller *et al.* 2014; Sørensen 2014). These developments culminated in a boom of megalithic tombs from 3450 BC onwards (Brozio *et al.* 2019a) (Figure 1).

Furthermore, changes in domestic sites, material culture (Müller and Peterson 2015), demography (Feeser *et al.* 2019), human impact on the landscape (Feeser *et al.* 2012), the development of new style categories, such as Store Valby ceramics (Brozio *et al.* 2019b), and contact with new influences, such as the Globular Amphora (GAC) phenomenon (Müller 2023), also point to groups characterised by social dynamics at the end of the fourth millennium BC (Brozio 2020; Furholt 2021).

The discussion of the underlying social processes in TRB groups on the eve of the SGC phenomenon are the focus of this study and the following questions are of particular interest: what kind of social structures can be observed before the appearance of the SGC phenomenon on the north European plain? Did social changes already occur before the appearance of the SGC phenomenon? What social processes can we identify at the transition from the fourth to the third millennium? In order to address these questions, I first discuss the approach used in this study.

Basic considerations of the study

The social processes analysed in this study are defined as continuous, long-term, i.e. multi-generational changes in the way people lived together. This definition allows the use of conceptual pairs, such as societal rise and dissolution, or collectivity and individuality, which also indicate the direction of social processes from one situation to another. It is important to note that social processes are reversible, different processes can take place simultaneously and these processes can be interwoven (Elias 2018, 361–62). In order to define these pairs of terms, the spheres of social organisation, economy, demography and climate are included as fundamental aspects of human–environment interactions (Bowden and Hinz 2021; Müller 2014a, 32–33):

- The form of coexistence is a fundamental component of social organisation. Therefore, social space is created at different levels (Nakoinz 2013, 215–16). This includes the creation, visualisation and appropriation of cultural landscapes through their use (Earle 2000a), the construction of monuments or domestic sites and their relationship to each other, as well as the internal design of domestic sites and buildings (Bailey *et al.* 2005; Madella 2013; Souvatzi 2008), which are included and discussed in this study at various levels. In order to organise their relationships to each other, the individual actors of a society necessarily use forms of social ground rules, i.e. social forms of organisation, which are also manifested, for example, by concepts such as mentality. Closely connected to this is also the concept of ideology, i.e. the production of ideas, meanings and values in confrontation with social life (Lull *et al.* 2011).
- The sphere of the economy covers not only the production and reproduction of subsistence goods, but also status and prestige objects. This also includes the organisation of production, as well as the distribution and consumption of goods. At the same time, these aspects are int egrated into specific moral-ethical conceptions of societies (Beckert 2003, 773–79; Bernbeck 1994; Müller and Bernbeck 1996; Polanyi 2021; Windler 2017, 95–97).
- The demographic development of a society significantly influences its social, economic, symbolic and cultural spheres. Thus, group size as well as population density influence the economic and social opportunities of groups. This also encompasses forms of decision-making processes or the significance of kinship relationships as a social construct of living and residential communities (Bettencourt *et al*. 2010; Feinman 2011, 52; Roscoe 2012, 43–46; Shennan and Edinborough 2007, 1343–44; Shennan *et al.* 2017; Whitehouse *et al.* 2014).
- The influence of climatic changes on subsistence economies, as well as ecological changes, are essential aspects of human–environment interactions. Human impact on the landscape, as reflected in the pollen data, can also be used as a demographic indicator. This is based on the assumption that increasing population density leads to an increased clearing of forests due to an increasing demand for resources and space (Feeser *et al.* 2019, 1600–04; Heitz *et al.* 2021; Lechterbeck *et al.* 2014, 1303–04).

The aspects listed above are, in many cases, closely interwoven and necessarily simplistic. Thus, categories such as economic capabilities, social ties and ideology — to name but a few examples — are also to be understood as ideas for the maintenance of power relations, since they enable the development and maintenance of power structures as the basis of political forms of organisation (Arendt 1970; Earle 2000b; Lund *et al.* 2022). Nevertheless, the listed spheres allow for a categorisation and thus a heuristic approach to discuss social processes at different spatial, qualitative and quantitative scales. Quantitative scales methodically use rates of built monuments and rates of deposited archaeological objects as approximations to describe trends in architecture and material culture. Ratios of botanical macroremains are used to describe changes in subsistence agriculture. Rates of land development are reconstructed using principal component analyses (PCAs) of palynological data, identifying eigenvectors that describe such developments. This allows the comparison of data from different archives with similar temporal resolutions. To compare the different data from palaeoecological, palaeoeconomic and archaeological records, the different values can also be statistically normalised as z-scores (Brozio *et al.* 2019a, 1560).

The aim of this study is thus to work out the most important lines of transformation, whereby diversity is already evident in the different reception and design of cultural landscapes in different regions.

A mosaic of spheres and activities around 3300–2700 BC

In the following, four spheres of human–environment interaction are examined which form the qualitative and quantitative background of social processes in this study.

Social organisation

Different arrangements of social space and thus different concepts of space use can be traced at the transition from the fourth to the third millennium on the Cimbrian peninsula (Müller *et al.* 2020, 117–21). Thus, GAC groups are almost completely absent in the west (Woidich 2014, 89–92), whereas in the east, they are represented in megalithic graves, in hoards and in domestic sites from 3100 BC (Brozio *et al.* 2019c, 217). In the west, SGC burial mounds appear rapidly, whereas in the east there seems to be no evidence of early graves (Figure 2), but axes of the SGC are deposited as fragments and as individual

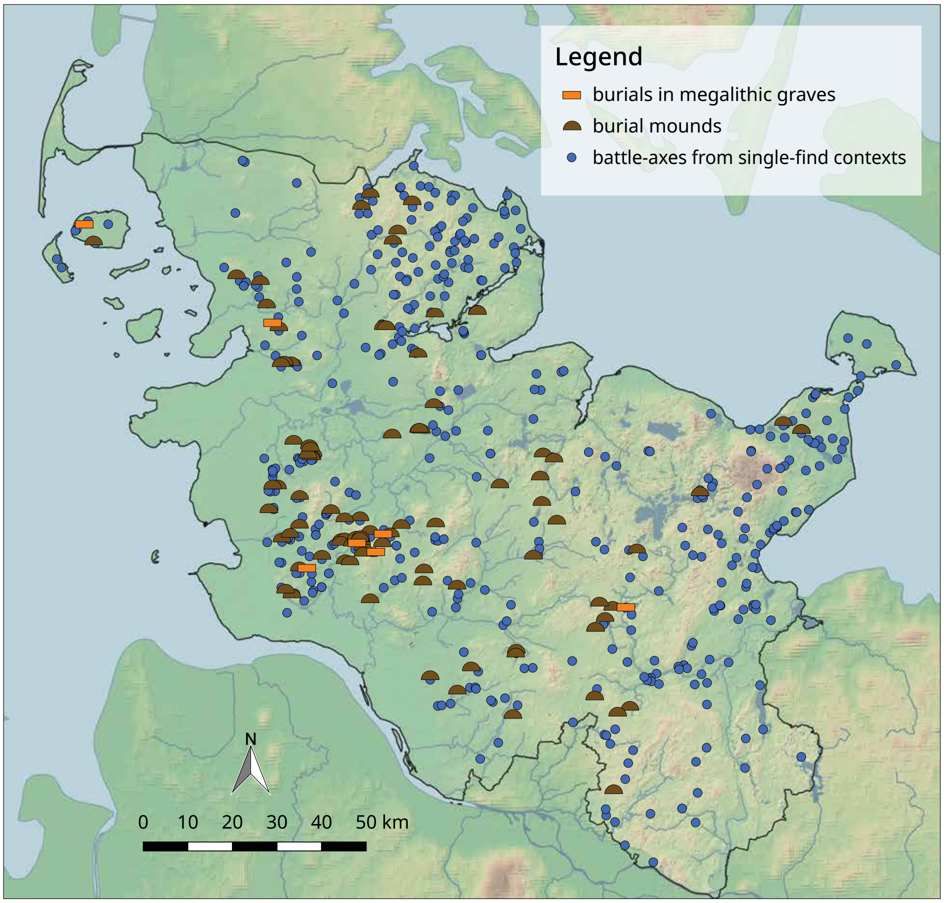

Figure 2. Battle axes from single graves and megalithic graves of the Early Single Grave groups and stray finds of battle axes (modified after Schultrich 2019, 215 fig. 61, 216 fig. 62).

objects (Schultrich 2019, 213–19). In the west, the Dieksknöll (Albersdorf LA 68) enclosure was used until 2400 BC (Dibbern 2016, 49), while the activities at the Rastorf enclosure in the east ended around 3200 BC (Steffens 2009, 184–86). In the west, Store Valby and SGC burials in megalithic tombs are known (Brozio *et al.* 2019b). In the east, on the other hand, the re-use of megalithic graves by SGC societies did not occur until 2600 BC (Hübner 2005). Although the boom phase in the construction of megalithic tombs ended around 3100 BC, the number of individual tombs continued to increase (Brozio 2020, 108–09; Müller 2019, 46) until they were replaced by the burial mound traditions of the SGC (Schultrich 2019, 25–35).

The internal structure of domestic sites also changes in terms of size. Thus, by 3000 BC, villages (Kossian 2007) with occasionally more than 100 inhabitants exist (Brozio 2016, 113–18). Houses have uniform shapes and identical sizes, but no public buildings can be distinguished by either size or architectural design. In general, we can assume an agglomeration of people, at least in some regions (Brozio *et al.* 2019c, 211–16). The picture then changes to smaller hamlets/single farms and domestic sites with possible light building structures, often in wetlands (Brozio *et al.* 2021), and belonging to small groups on the north European plain (Brozio *et al.* 2023). There are also indications of an increase in violent conflicts from the later phases of the TRB (Lidke 2005, 222). However, a peak in young male human remains is not present in the osteological collections, which could indicate that they were not involved in conflicts as much as in other Neolithic societies of central Europe (Müller 2019, 68–70; Petrasch 2000). Changes in material culture can be traced, among other things, in pottery decorations and vessel forms, which became increasingly diverse at the transition from the fourth to the third millennium (Brozio 2020, 109 fig. 10.9; Lorenz 2018; Müller and Peterson 2015). At the same time, the Store Valby phenomenon is seen to continue the trend towards thicker axe bodies that already emerged in the earlier stages of the TRB (Nielsen 1979), whereas the pottery represents a clear separation in terms of vessel forms and decorations (Davidsen 1978; Iversen 2020).

Economy

In the Neolithic, cattle breeding (Benecke 1994; Hinz 2018, 217–23) and the cultivation of crops in horticultural plots as well as fields (Kirleis 2019; Kirleis *et al.* 2011), become the dominant forms of subsistence farming on the north European plain. Thus, in the bone assemblages present

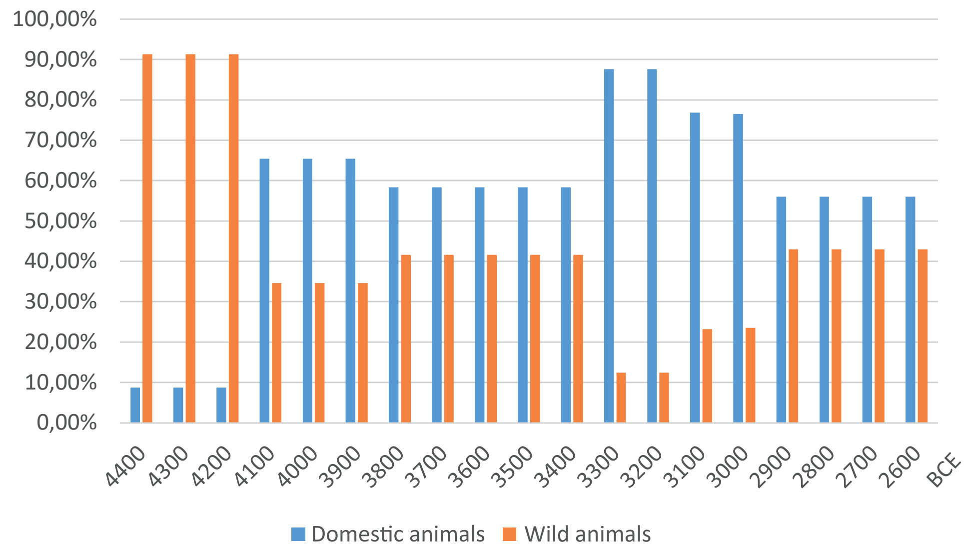

Figure 3. Diagram of the percentages of domesticated and wild animals from selected animal bone inventories from domestic sites in eastern Holstein (Neustadt LA 156: Glykou 2016, 207; Wangels LA 505, Early Neolithic layer: Heinrich 1999, 44; Siggeneben-Süd/Grube LA 12: Nobis 1983, 115; Oldenburg LA 191: Kaczmarek 2017, 70; Matthey 2005, 9; Oldenburg LA 77: Brozio *et al.* in prep.; Wangels LA 505, Middle to Young Neolithic layer: Schmölcke 2001, 46). The distribution over 100 years was achieved by aoristic distribution.

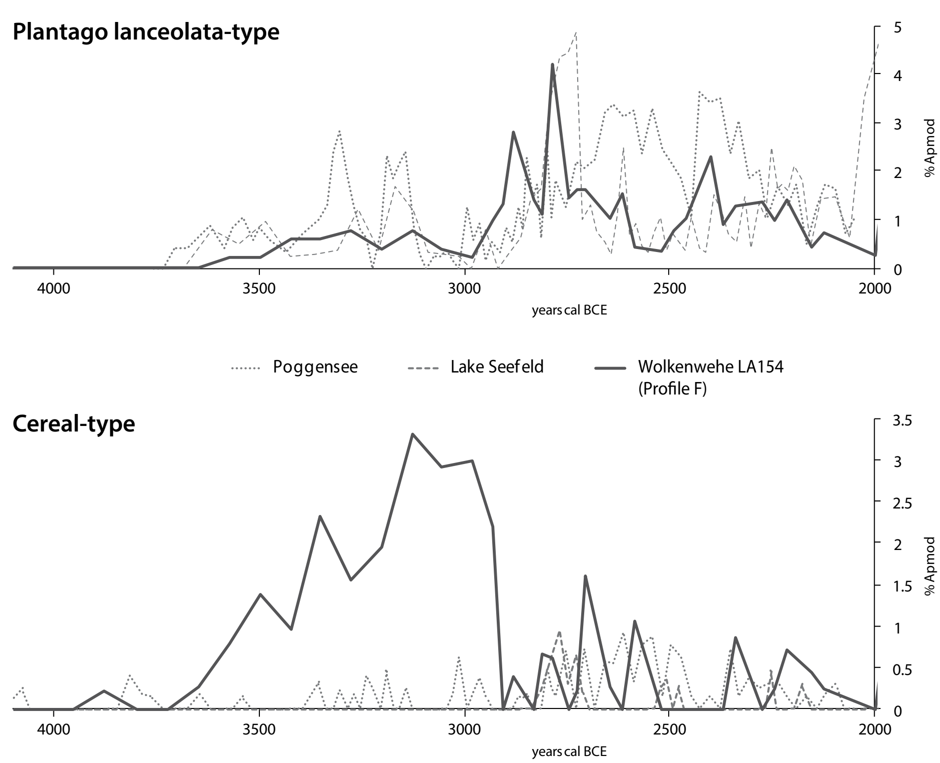

Figure 4. Comparison of the relative abundance of *Plantago lanceolata*-type and cereal-type pollen from Bad Oldesloe-Wolkenwehe LA 154 and the pollen profiles of Poggensee and lake Seefeld on the Cimbrian peninsula (Feeser and Dörfler 2019, 202 fig. 23).

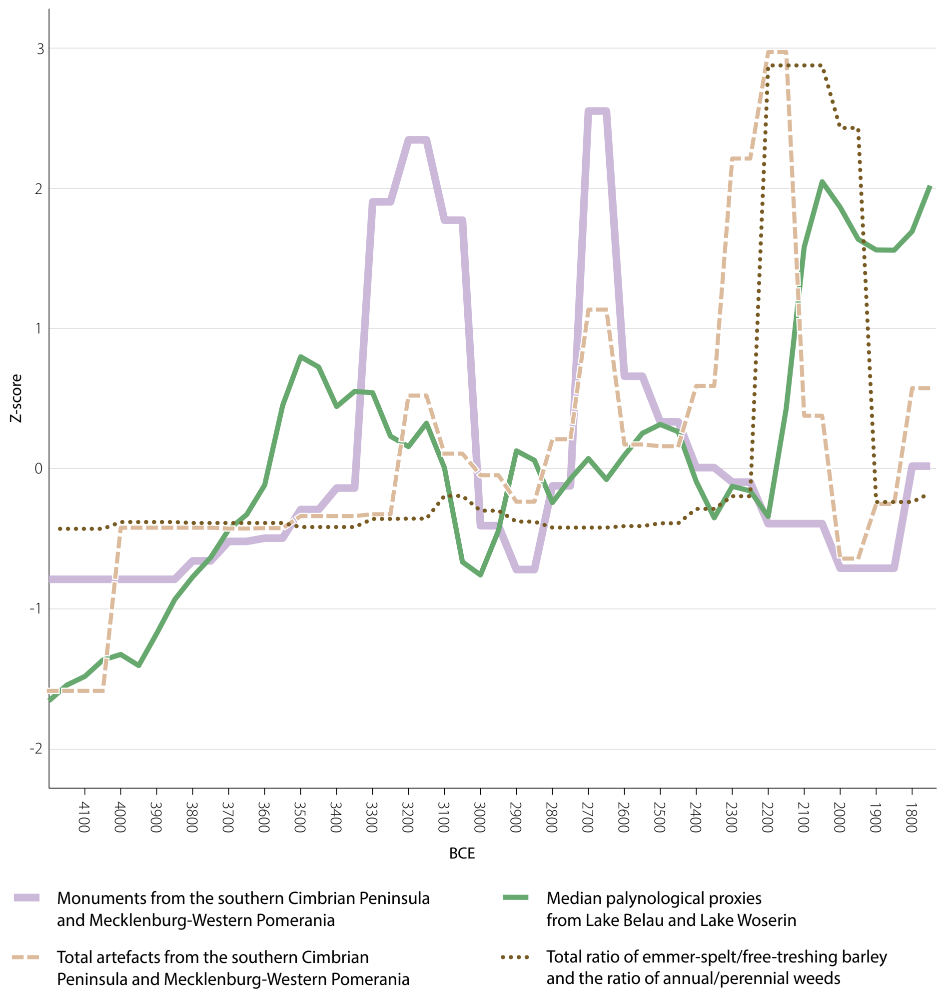

Figure 5. Compilation graph of the records for monumentality, artefacts, subsistence economy and palynological proxies for the southern Cimbrian peninsula and Mecklenburg-Western Pomerania, c. 4100–1750 BC (z-scores based on absolute numbers of projected artefacts per 50 years) (Brozio *et al.* 2019a).

at the domestic sites, there is a trend for domesticated animal bones to increase in relation to wild animal remains between c. 4000 and c. 3000 BC (Figure 3). Crucially, our information comes mainly from sites with permanently wet sediments, which provide excellent preservation conditions for organic material. In contrast to the terrestrial sites without bone preservation, sites with wet sediments have been investigated in much smaller numbers and are often located at former inland bodies of water or in coastal areas. Cattle are the most frequently used domestic animal species compared to pigs, sheep/goats and dogs. In contrast, the proportion of wild animals declined from about 40 to 10 % by the end of the fourth millennium BC, but hunting and fishing never lost their importance completely (Steffens 2005). Around 3000/2900 BC, however, a change can be observed. The proportion of wild animals rises again to about 40 %. Thus, at the transition from the fourth to the third millennium, a ratio is reached which corresponds to the first 500 years of the TRB, which had been characterised by experiments with agriculture and animal husbandry.

After phases of differentiation and uniformity in the cultivation of crops (Kirleis 2019; Kirleis *et al.* 2011), the subsistence economy changed in some regions. On the Wagrian peninsula on the Baltic shore of eastern Holstein, TRB societies relied largely on the expansion of arable land, while the SGC phase was less visible in the landscape archives (Knitter *et al.* 2019, 11). In contrast, at the site of Bad Oldesloe-Wolkenwehe LA 154 in the hinterland of the Cimbrian peninsula (Hartz *et al.* 2007; Mischka *et al.* 2007), for example, from 3000 BC onwards it is evident that the proportion of cereals in the pollen record falls abruptly, indicating a change or decline of local activities. *Plantago lanceolata* increases sharply, also indicating a regional opening of the landscape with increased cereal cultivation (Feeser and Dörfler 2019, 202) (Figure 4).

In addition, if the number of artefacts is considered as an indication of not only the economic but also the social potentials of societies, it becomes apparent that the potentials decrease in accordance with a decrease in artefacts from 3100 BC onwards and only begin to increase again around 2800 BC (Brozio *et al.* 2019a, 1562).

Beyond that, a breakdown of the TRB exchange system, which had previously remained stable over generations, can be observed. In this system, new cereals (Kirleis and Fischer 2014, 91–92) as well as copper objects were transported northwards from the Alpine region and south-western Europe over centuries, until 3300 BC (Klassen 2000). Red Heligoland flint was also exchanged (Müller 2014b) and jadeite axes as well as hammer axes (Klassen 2004) were imported from the south (Figure 5).

Demography

Relative population development through radiometric sum calibration (Rick 1987) and the quantification of human impact proxies of pollen analyses indicate a demographic bust phase from c. 3400–3100 BC, followed by an increase (Feeser *et al.* 2019, 7). For the southern Cimbrian peninsula (15,800 km²), we can assume a population of about 30,000 persons (p) at c. 3300 BC and 10,000 p at c. 3000 BC (Müller 2019, 68). There are various more specific demographic calculations for the TRB; these amount to 1.0–7.4 p/km² on the north Frisian islands (Müller 2011, 277), 0.7–1.6 p/km² in Mecklenburg-Western Pomerania (Schiesberg 2012, 127) or 2.7–3.1 p/km² for the area of southern Scandinavia and central Europe (Müller and Diachenko 2019, 6). Such a development can also be observed at the level of domestic sites, as in the case of Oldenburg-Dannau LA 77 (Brozio 2016, 113–18). At this site we can trace an increase in the number of inhabitants between 3300 and 3000 BC, which can be deduced from an increase in houses, reaching its peak around 3000 BC. This development is associated with erosion as well as increased proportions of cereal pollen (Feeser and Dörfler 2019, 198–200) (Figure 6).

Climate

Drill cores in laminated sediments of lakes Woserin and Belau (Feeser *et al.* 2012), as well as intermediate and deep-water temperature reconstructions from the Skagerrak (Butruille *et al.* 2017), reveal colder summer temperatures from c. 3350 BC onwards, which did not recover until c. 2950 BC. Despite uncertainty concerning the intensity of climatic impact on these societies, an influence of climatic fluctuations can be assumed. For example, a period of cooler air temperatures between 3000 and 2600 BC could be associated with an increase in naked barley and the decline of emmer in northern Europe (Schirrmacher *et al.* 2024).

Rise and dissolution of social configurations around 3300–2700 BC

Following the general developments described above, two social configurations of the TRB societies, for the periods 3400–3000 and 3000–2700 BC respectively, can be identified.

Sharing and common organisations (3300–3100/3000 BC)

The construction boom of passage tombs for collective burials around 3350 BC points to TRB societies with tendentially low institutionalised forms of political organisation, whose individuals operated as actors of a community rather than an institutionalised social class, even if a deliberate concealment of social inequality is possible (Shanks and Tilley 1982). However, genetic kinship lineages, along with social bonds, may have played a significant role in the use of chambers for burials, as demonstrated in case studies from Britain (Fowler *et al.* 2022) and Ireland (Cassidy *et al.* 2020). Anthropological studies indicate that there was no segregation in terms of biological sex or age (Gerling *et al.* 2019; Grimm 1984). The burial chambers contained mainly decorated pottery, often highly ornamented, and jewellery (Lorenz 2018). Weapons, understood here as battle axes and arrowheads, were of little importance (Müller 2011). In the passage grave of Wangels LA 69, for example, one battle axe was found for every 50 vessels (Brozio 2016).

At domestic sites with several buildings, house layouts are characterised by predominantly identical house shapes and sizes, an observation that does not suggest any common buildings such as meeting houses or similar (Schaefer-Di Maida *et al.* 2024). Simultaneously, there seems to be a trend of population increase with agglomeration in villages, reaching group sizes of up to 100 people. Groups of this size can organise themselves without centralisation of power or institutionalised authority (Gonzalez 2014, 147). Moreover, comparisons of house inventories show that no hierarchical differences between buildings and domestic sites are detectable (Brozio 2016; Hage 2016). The development of village-like domestic sites and the coexistence of people and animals could have favoured zoonoses and epidemics, although there is no evidence for this (Fuchs *et al.* 2019).

The internal organisation of TRB groups can therefore be described as “prestige societies” (Brozio *et al.* 2019a; Iversen 2015; Wunderlich 2019). Livestock breeding with a focus on cattle, whose meat played a special role in burials, may have been of particular importance (Weber *et al.* 2020). The lack of evidence for conflict points to a tendency towards peaceful cooperation and/or competition between individuals and groups (Gebauer 2014). This includes the construction of tombs and the decoration of vessels as a common but also competitive stylistic device used as a strategy to maintain social balance. The integration of other ideas and probably also people into the social groups, such as the those of the GAC, also indicates a tendency towards openness (Müller 2023; Müller *et al.* 2020; Szmyt 2017;

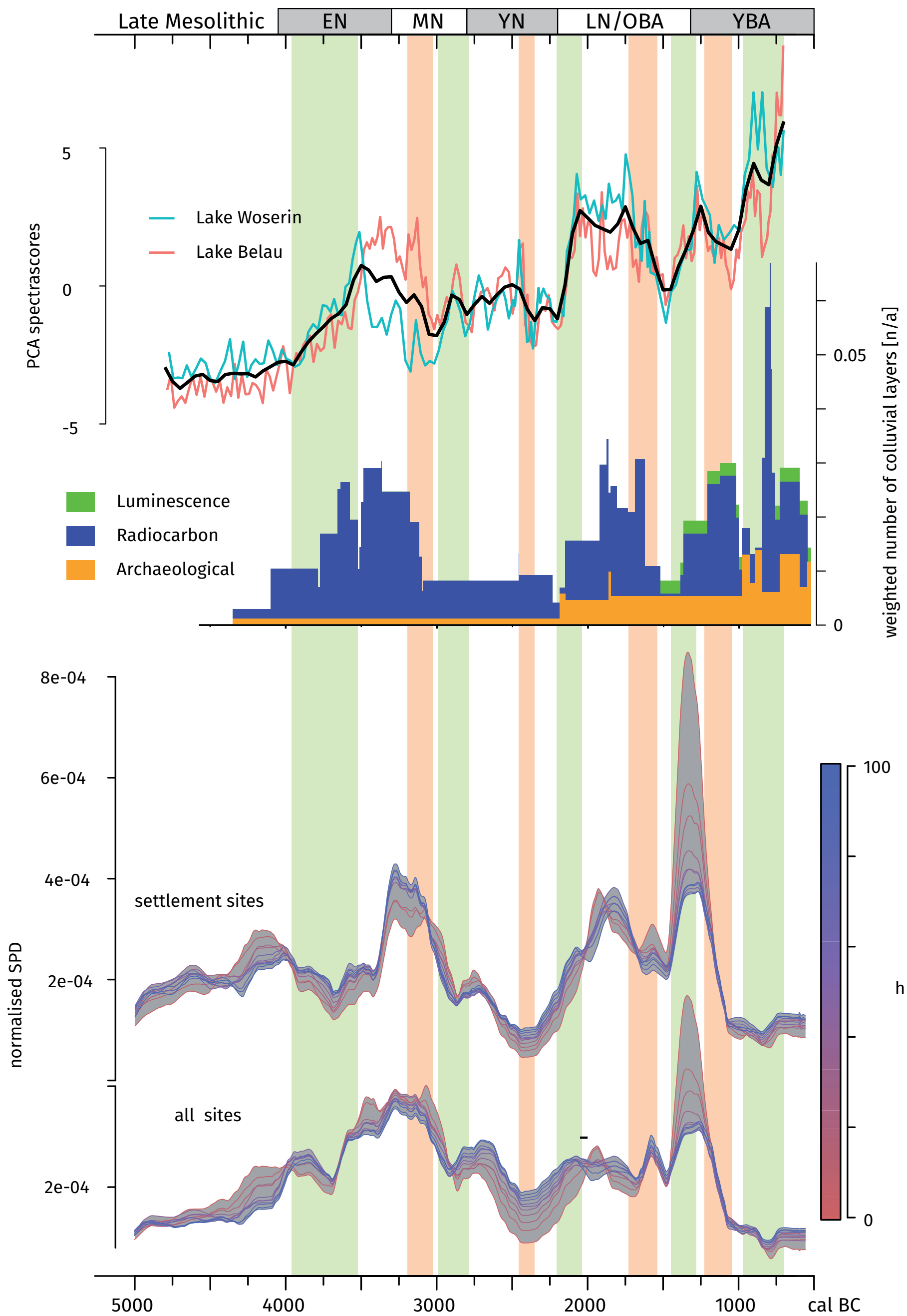

Figure 6. Palynological proxies and deposition of colluvial layers indicate a boom of land opening around 3600–3400 BC which continues at a relatively high level until 3200 BC. Radiometric sum calibration indicates a possible population increase around 3300 BC, as well as a decline around 3050 BC in north-western central Europe (Feeser *et al.* 2019, 7; Müller 2019, 67).

Woidich 2014) of social groups that have their own concept of collective behaviour. These are certainly not societies that were free of conflict, but in contrast to the SGC, specialised weapons and therefore roles cannot be defined (Horn 2021).

Social dissolution and new concepts (3100/3000–2700 BC)

An emphasis on the individual becomes evident from 3100/3000–2700 BC onwards, when burials are not only carried out in the chambers of megalithic tombs, but also increasingly in single graves (Brozio 2020, 108–09; Müller 2019, 46). In addition to single flat graves, these burials also comprise graves with stone installations or even singular monumental transformations of megalithic burial mounds for a single burial (Brozio 2016, 174–75). Likewise, the concept of living together within villages in longhouses comes to an end. Village-like structures now include smaller areas with huts, for example at Hunte 1 (Brozio and Heumüller 2022; Kossian 2007) or Bad Oldesloe-Wolkenwehe LA 154 (Brozio 2016; Hartz *et al.* 2007; Mischka *et al.* 2007). Likewise, fences, such as those at

Oldenburg-Dannau LA 77, built around 3100–2900 calBC (Brozio 2016, 99), and palisades, for example at Hunte 1, dated to between 2837–2744 denBC (Kossian 2007, 118–19), can be observed. They represent a demarcation of the interior and the exterior. In many cases, domestic sites were founded in areas that had not seen domestic activity in the period c. 3300–2900 BC (Brozio *et al.* 2019b, 136 tab. 6; Davidsen 1978, 159 fig. 77). The domestic sites become smaller, which suggests smaller groups such as extended families. In addition, a demographic decline is discernible across the region, indicating a disorganisation of social groups.

Furthermore, the pottery becomes more diverse in terms of vessel forms and decorations (Brozio 2020, 110; Müller *et al.* 2020; Saev 2015). This is an indication that the sign system expressed through material culture (Graves 1998) was changing and that smaller groups familiar with this sign system were emerging at the same time. Simultaneously, groups increasingly separate from each other symbolically and spatially in terms of how social differentiation is organised. This shows a gradual turning away from the old structures. At the same time, the lack of participation in a common set of signs based on ceramic types, as well as vessel forms and decorations, reveals increasing differentiation. An increase in battle axes between 3100 and 2900 BC can also be observed (Brozio 2020, 109–10), whereas flint axes, as multifunctional tools, occur in smaller numbers (Breske 2017). It is assumed here that battle axes, because of their shape, were seen as weapons and thus as symbols of power. While some meanings were shared across regions, others were regionally or contextually different. For instance, that axes of the SGC were used as potential tools for clearing roots shows that these objects served a variety of functions (Wentink 2020, 120–26).

With the transition from the fourth to the third millennium BC and the following centuries (Figure 7), social differentiation intensified in the SGC, characterised by battle axes, beakers and single graves (Brozio and Hage 2013; Hübner 2005; Schultrich 2019). Burial mounds and secondary burials show the emergence of a wide-ranging social system, probably related to kinship and based on smaller groups and their translocal relations (Hübner 2005, 85–87). In this context, SGC groups would also have been involved in the exchange of copper artefacts, albeit to a lesser extent. Quantitatively, these objects are detectable only in small numbers (Iversen 2015, 108–09; Klassen 2000, 198–209; Schultrich 2019, 156–58).

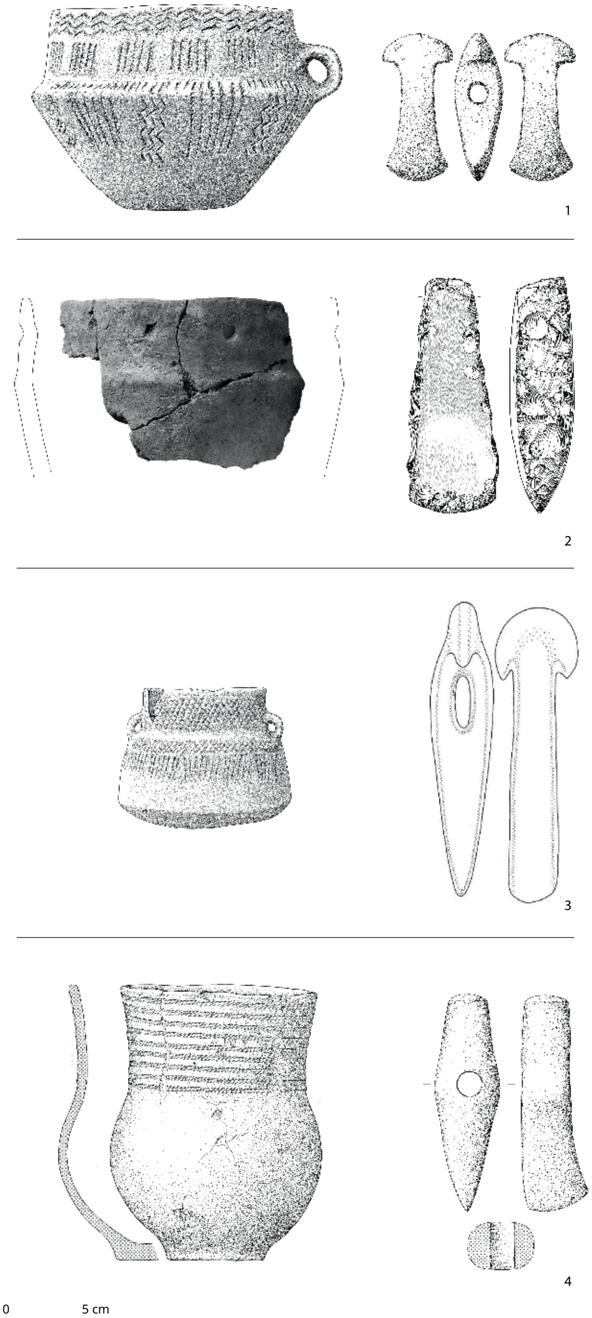

Figure 7. Vessels and axes of TRB (1), Store Valby (2), GAC (3) and SGC (4) groups (image: C. Reckweg, CAU Kiel; data: 1. Brozio 2016, 464 pl. 174, 511 pl. 221; 2. Brozio 2019a, 112 fig. 7, 113 fig. 8; 3. Brozio 2016, 481 pl. 191; Zápotocký 1992, pl. 120.11; 4. Zich 1999, fig. 13).

Conclusion

In this study, social processes have been understood as long-term comprehensive changes in the configurations formed by people, or in aspects of these. The last generations of TRB societies, before the arrival of SGC groups, were connected by social processes characterised by a shift from agglomeration to disorganisation in social spaces and from collective to individual behaviour in the context of social organisation. Related to this is also a social process in the late TRB societies shifting from groups in social balance to groups in social imbalance.

On the one hand, population increase can be suggested as a possible trigger (Brown 1981, 27). Although there is no evidence that a natural limit of potentially available land and associated resources had been reached (Knitter *et al.* 2019, 1582), larger societies may have triggered a greater degree of stress and conflict within groups (Dunbar 1993; Johnson 1982; Johnson and Earle 1987). In this context, it should be noted that there is no direct correlation between large groups and growing social inequality (Green 2021; Hodder 2014, 17; Sigrist 1967). On the other hand, mechanisms for conflict resolution were obviously not in place. For example, structures that served as assembly buildings or other spaces created for this purpose are not detectable at domestic sites. The causewayed enclosures seem to have been less and less able to fulfil the purpose of keeping groups together through ritual gatherings. However, this may have led to non-violent conflicts. The cold summer temperatures and the possibility of zoonoses and/or epidemics through the agglomeration of people could also have contributed to the dissolution of the TRB societies.

The social structure of society on the eve of the SGC is thus characterised by a loss of social orientation in the TRB groups that took place over generations. Linked to this was a shift of TRB societies to increasing social differentiation, which is represented by two factors: the increasing establishment of varied ritual behaviour and symbols through first contacts with the SGC, as well as, in the case of the Store Valby phenomenon, through an abandonment of practices and symbols passed down through generations (Brozio *et al.* 2019b; Iversen 2020). This dissolution of social bonds was at the same time the basis for openness associated with the adoption of a new ideology in the form of the GAC phenomenon. Therefore, an increasing symbolic separation from the ancestors and the rule systems of the previous generations can be seen, which can be explained by more individualised behaviour of groups and thus probably also of individuals, as suggested by the increasing number of graves.

However, the TRB phenomenon did not end abruptly with the appearance of the SGC, but was already subject to internal changes that manifested themselves in differentiation. The TRB phenomenon was not even sustained by the TRB concept of monumentality introduced in the Early Neolithic, which, amongst others, also functioned as genealogical links to long-gone ancestral groups (Müller 2018).

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Global transformation?

Globular Amphora sedentary pastoralists 3200–2700 BC

Johannes Müller

Abstract

How, why and for what purpose did Globular Amphora communities (GAC) develop? A new study on this subject is available (Müller 2023a), some aspects of which are discussed here. Firstly, two spatially different Globular Amphora networks are reconstructed as communication spaces (Elbe in the west, Vistula–Podolia in the east); secondly, a common formation between the Middle Elbe and the Lower Vistula from c. 3200 BC is described; and thirdly, on the basis of palaeogenetic analyses, a causal separation from local Funnel Beaker (TRB) societies is highlighted. The foundation for this are the different ecological and economic orientations and the development of a new socio-cultural identity with, among other aspects, the monopolisation of the practice of cattle burials (from c. 3000 BC). This GAC separation is interpreted as a levelling mechanism that becomes effective in a phase of increased social differences within Funnel Beaker societies and leads to a type of sedentary pastoralism.

Keywords: prehistoric archaeology, Neolithic, globular amphorae, separation, hybridisation, transformation, sedentary pastoralism

Introduction and research questions

Around 3000 BC, social transformations become discernible in central and eastern Europe, involving both local and regional groups as well as socio-cultural phenomena developing supra-regionally for the first time in European history. Within these processes, which bring about a new structure in numerous societies, the Globular Amphora societies represent the first socio-cultural practice of a "new type" that is archaeologically visible beyond the region. In the following, we will first briefly consider the spatio-temporal constitution of this phenomenon as it emerges from the archaeological sources, in order to then pursue specific questions:

1. How and why did the Globular Amphora phenomenon arise?
2. What were the consequences of the Globular Amphora phenomenon for existing regional Neolithic societies?
3. How did the Globular Amphora phenomenon transform the processes taking place between the thirty-second and twenty-eighth centuries BC?

In D. Hofmann, D. Mischka and S. Scharl (eds) 2025. *The eve of destruction? Local groups and large-scale networks during the late fourth and early third millennium BC in central Europe*, 277–290. Leiden: Sidestone Press.

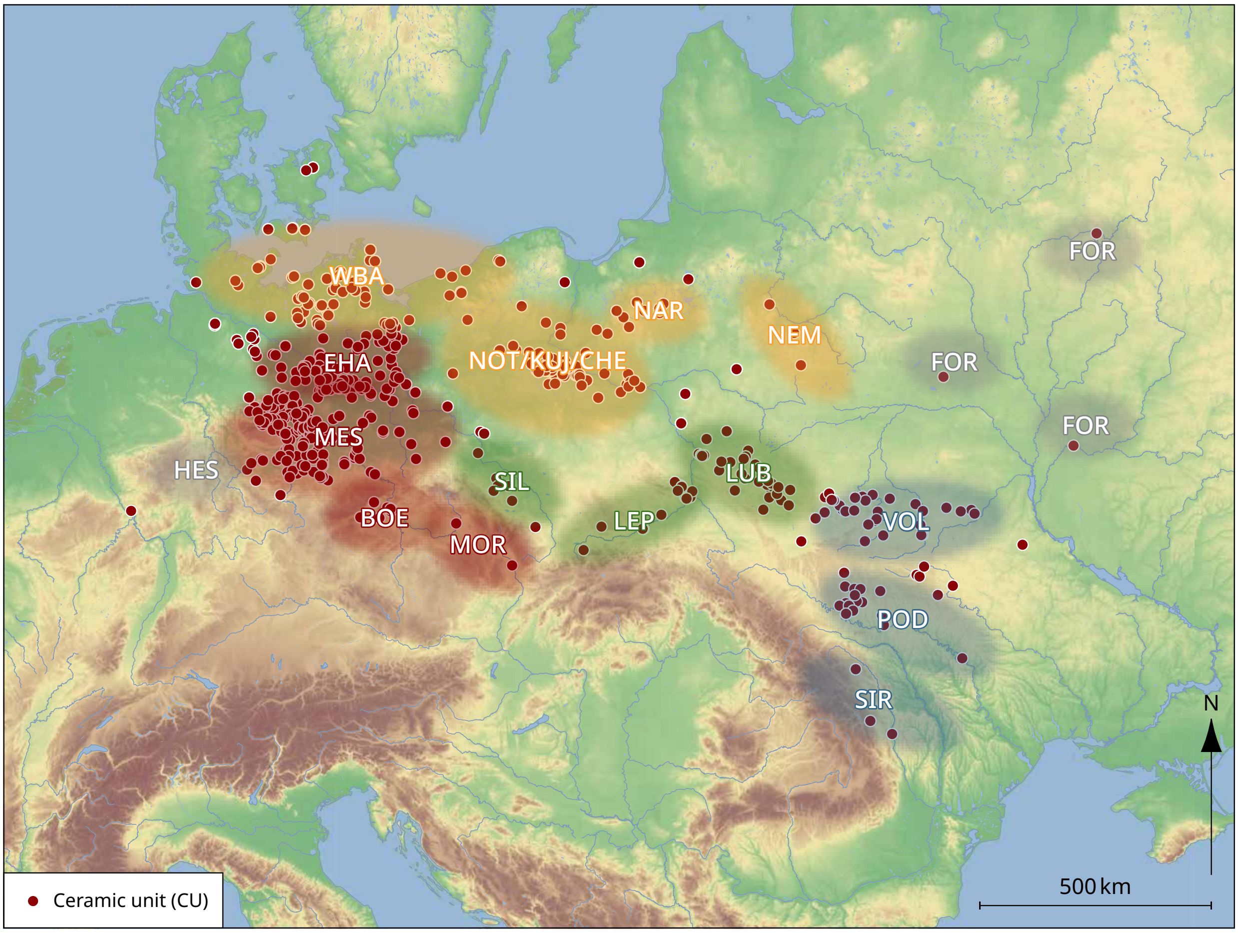

Figure 1. Globular Amphora communities occur in a wide variety of regions between the Baltic Sea and the north-west Pontic plateaus. In the west: the south-west Baltic (WBA), the Elbe-Saale-Havel region (EHA), the Middle-Elbe Saale region (MES), Hessen (HES), Bohemia (BOE), and Moravia (MOR); on the eastern European plain: Middle Noteć (NOT), Kujawy (KUJ), Chełmno Land (CHE), Podlasie on the Upper Narew (NAR), and sites on the upper reaches of the Neman (NEM); on the southern plateaus and the lower mountain ranges: Lower Silesia (SIL), Lesser Poland (LEP), and the Lublin Plateau (LUB); followed in the east by Volhynia (VOL), Podolia (POD), and the Moldavian plateau on the Siret (SIR). Some influences are visible even further east in the Dnieper area (FOR). The colours indicate geographical links, the dots sites from which fully reconstructed vessel shapes of the GAC are known (data: Müller 2023a, fig.1; drawing: Ralf Opitz and Johannes Müller).

Conceptually, we define "transformation" or "transformative practices" as episodes in which temporally accelerated processes of change arise from various events (Müller and Kirleis 2019). These lead to irreversible new structures and practices in the social (e.g. questions of the justification of power), cultural (e.g. the regulation of rites of passage such as funerals) or ecological spheres (e.g. the organisation of the subsistence economy in relation to the environment). Often, these are not only socio-cultural but socio-environmental interactions in which specific cultural landscapes are newly formed. Terminologically, we want to identify "societies" as groups that exhibit a comparable *habitus*. The latter becomes recognisable archaeologically through common practices that can be recorded, for example, through the use of specific ceramic objects with characteristic decorative motifs, or specific spatial structures of huts or houses (Bourdieu 1977; Kadrow and Müller 2019).

Basic patterns of Globular Amphora societies

"Globular amphorae" were defined at the end of the nineteenth century as a special vessel form and classified spatio-temporally for the first time (Götze 1900). Since then, numerous studies have documented the large-scale distribution of the "Globular Amphora" phenomenon (e.g. Beier 1988; 1991; Szmyt 1996; 1999; 2017; Wiślański 1966; Woidich 2014). Apart from the new shape of the globular amphora, there are often decorations comparable with older or contemporaneous

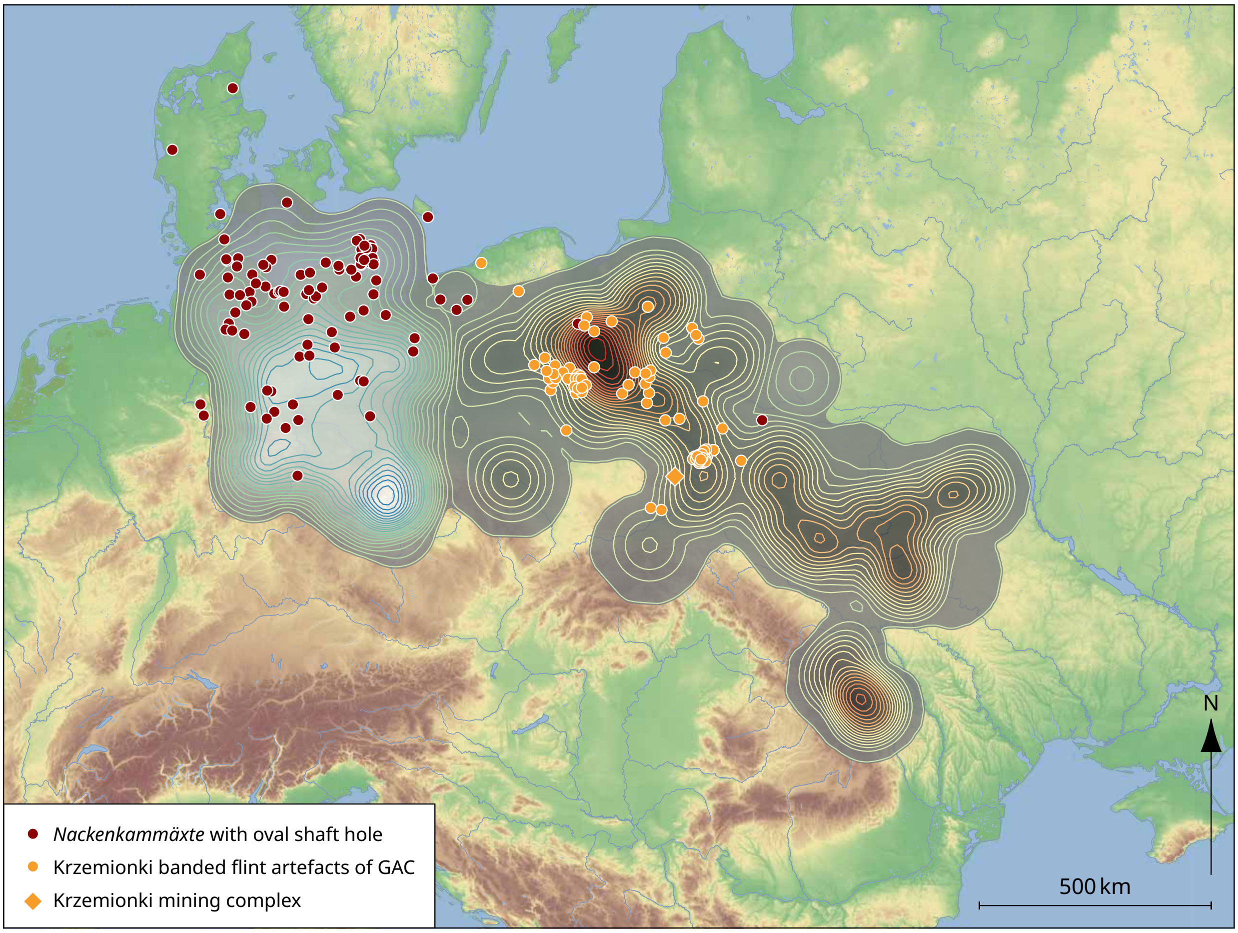

Figure 2. The 1st eigenvector of a Principal Component Analysis (PCA) of eigenvectors of the Correspondence Analysis (CA) for vessel types, decoration motifs and decoration techniques is used to illustrate the typological distances of GAC inventories (details in Müller 2023a). The GAC Elbe network and the GAC Vistula–Podolia network are visible. *Nackenkammäxte* or Krzemionki flint are two examples for the distribution pattern in the GAC Elbe and the Vistula–Podolia network (data: Müller 2023a, figs 65, 276; Schultrich 2022; Szymt 2017, fig. 22; drawing: Ralf Opitz and Johannes Müller).

groups of Funnel Beakers.[1] Globular amphorae are found from Podolia and Volyhnia in the east to the south-west Baltic in the west. Geographically, these are regions of the north central European lowlands, the northern low mountain zones and the western Pontic forest-steppe area (Figure 1). Globular amphorae are distributed over an area of 230,000 km², which contrasts with the "normal extent" of contemporaneous regional Neolithic groups (i.e. with a populated area of less than 10,000 km²; Wotzka 1997, 167 fig. 3).

Dissemination patterns and networks

Numerous spatial groupings of the large-scale Globular Amphora distribution area have been presented using different methodological approaches (Beier 1991; Szmyt 2003; Wiślański 1964). They are partly the result of differences in regional research traditions, whose delimitation is also due to recent language and national borders. Therefore, in a new analysis c. 2000 globular amphorae for which the reconstruction of the entire vessel body is available were compared with each other with regard to vessel form, decoration technique and decoration motifs (Müller 2023a). With separate correspondence analyses for the three categories mentioned, similar spatial patterns emerged, which could be fully described in a summarising principal component analysis. Figure 2 shows the result with the eigenvector values of the dominant PCA eigenvector. We interpret the representation of spatial typological differences as indications of different communication networks. Patterns of decoration and vessel forms, but also techniques of decoration are the result of local practices of pottery

1 In this context, there has recently been talk of so-called hybrid ceramics, for example in connection with regional central German Bernburg pottery (Woidich 2014).

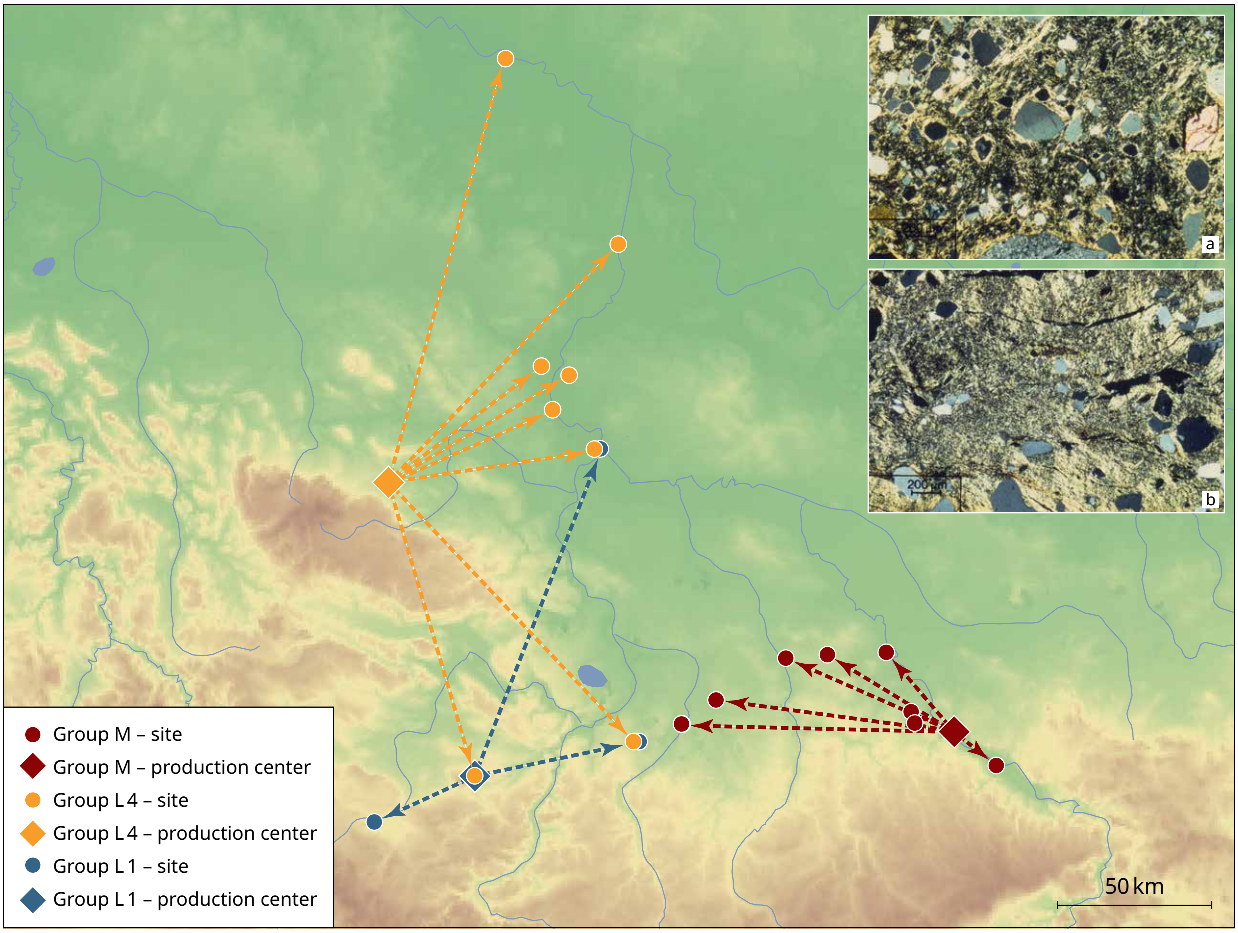

Figure 3. Both local production and exchange of GAC ceramics took place within a radius of at most 50 km. This is exemplified by the distribution pattern of the production groups L1 (volcanic trachyte "Leuchtenburg rock", "Großobringen"), L4 (kaolinised orthoclase with quartz inclusions, "Derenburg") and M (quartz porphyry outcrops or outcropping monzonitic rocks, "Meissen") (Lehmann 2000, 105 fig. 33, suppl. 16). In the case of magmatic materials, volcanic rock fragments, kaolinised orthoclase with quartz inclusions and metamorphic gneiss fragments are primarily used for GAC ceramics of the West Group. Key: a) E907 Pevestorf 19; b) E894 Schinne 1 (after Müller 2023a, figs 227–28; drawing: Ralf Opitz and Johannes Müller).

production, where learning traditions reflect the local environment and thus the *habitus*.

The distribution in the west, in the area of the Elbe catchment, is separate from the eastern distribution area, which reaches from the Lower Vistula to Podolia. The spatial coherence of the Elbe Group, but also of various areas of the Vistula–Podolia Group, can be interpreted as an indication of relatively closed and separate communication networks with different economic, cultural and social practices for which the ceramic objects were produced. Within the Elbe Group, eigenvector value differences between the Upper Elbe (especially Bohemia and Saxony), the Middle Elbe-Saale-Havel region and the south-west Baltic region indicate a north–south internal differentiation. In contrast to the uniform and delineated spatial structure of the Elbe network, the Vistula–Podolia network is divided into several larger sub-areas. We observe a focal point in the area of the Lower Vistula river bend, which is closely connected to the middle course of the Vistula (Kujawy and Chełmno region). The Vistula Group is connected with the other focal point, which is recognisable in the area of the Volhynian-Podolian plateau. The Siret Group is located a little apart, further south on the Moldavian plateau (Müller 2023a).

Apart from many typological similarities, there are differences between, for example, globular amphorae with primarily round bases in the Elbe network and those with primarily flat bases in the Vistula–Podolia network. Frequencies of decoration techniques (e.g. arch/angle incision versus cord technique) or decoration patterns (e.g. angle bands versus wave patterns) also differed. The Elbe and Vistula–Podolia networks can also be traced in non-ceramic find categories. For example,

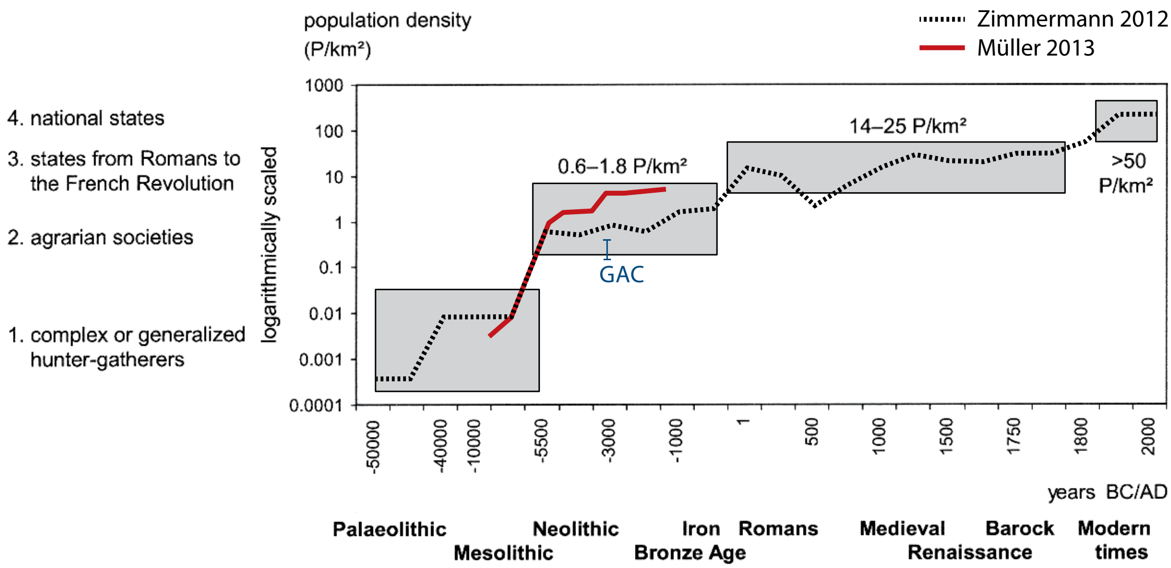

Figure 4. Relative population density in central Europe. In comparison with more general population calculations, the GAC values are at the lower end of those of prehistoric agrarian societies (Müller 2013, fig. 4; Zimmermann 2012, 252 fig. 1. Drawing: Ralf Opitz and Johannes Müller).

Krzemionki flint was exchanged in the eastern network, *Nackenkammäxte* (neck comb axes) with an oval shaft hole primarily in the west (Figure 2) (Balcer 1983; Balcer and Kowalski 1978; Schultrich 2022; Szmyt 2017).

The results of chemical-mineralogical ceramic analysis allow the reconstruction of the spatial size of production and distribution areas. All available studies currently prove that in no case was pottery transported further than about 50 km (Lehmann 2000; Müller 2023a). Thus, characteristic magmatic materials, for instance the porphyry from quartz porphyry outcrops or from outcropping monzonitic rocks near Meissen, the volcanic trachyte ("Leuchtenburg rock") from the area of Großobringen or the kaolinised orthoclase with quartz inclusions from the north Harz, are restricted to distances of at most two days' walk (Figure 3). The reconstruction of possible herding areas of Zauschwitz cattle in the east Harz region also corresponds to this spatial scale. For both cattle and humans, a certain, possibly seasonal mobility can be traced by strontium and oxygen isotope analyses. According to the current state of the baselines, the eastern Harz foreland could be considered the place of origin, for example, of two cattle. The variability in high-resolution isotopic signatures also argues for the mobility of humans in a corresponding radius of possibly 50 km (Gerling 2015, 230–41).

Accordingly, we conclude that the regional range of movement of both the people using globular amphorae and the animals they herd does not normally exceed this spatial scale. As we know from different ethnographic and archaeological examples, intercommunication between such microregional units can quickly lead to large-scale similarities in lifestyle and artefact design (see papers in Heitz and Stapfer 2017).

Settlement remains from only 41 excavated domestic sites suggest relatively small sizes of probably 5–15 inhabitants for Globular Amphora communities (Müller 2023a). If we extrapolate the GAC site numbers of particularly well documented areas (e.g. Potsdamer Land, Brandenburg; Osłonki microregion, Kujawy; Bachorzy/Zglowiiacky, Kujawy; Chomiasko-Wolicka microregion, Kujawy, see Beran and Richter 2014; Grygiel 2013; Nowaczyk 2017, 73 fig. 5; Rybicka 1995, 28–29 fig. 5. and tab. 4), a population density of about 0.5–0.8 P/km² can probably be assumed for the Globular Amphora areas, which corresponds to about 130,000 to 210,000 people. This lies at the lower end of the population densities that have been calculated for agrarian groups (Figure 4). Nevertheless, this gives us an approximate basic figure of how many people participated in the GAC networks mentioned above.

Chronology: emergence and regional developments

In a supra-regional consideration of the "Globular Amphora" phenomenon, the terminological differences between the regional chronological systems have to be taken into account. In some cases, the term "GAC" is used for phases that do not include globular amphorae and only display some ceramic typological similarities to GAC pottery. In contrast, we define Globular Amphora phases as those in which the globular amphora vessel type occurs.

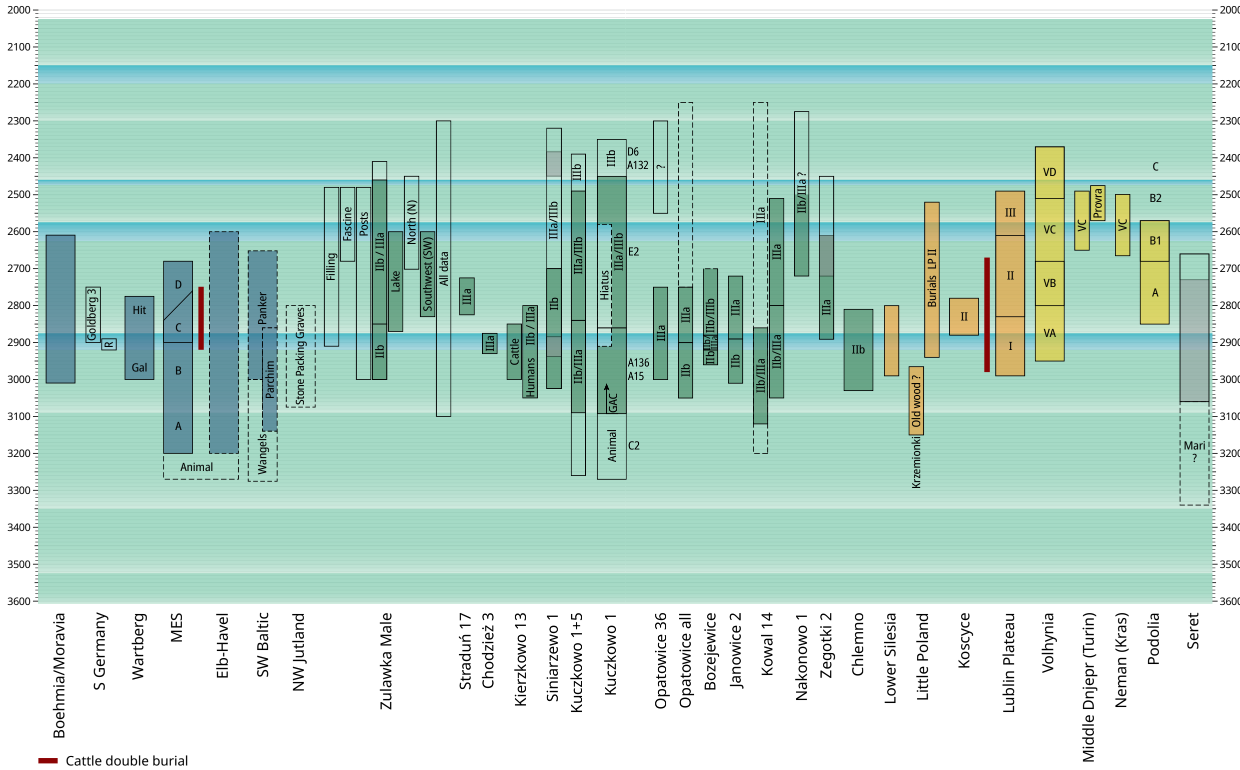

Figure 5. The comparison of Bayesian-modelled ^{14}C dates of individual sites, regional developments and supra-regional tendencies describes the emergence, duration and renewed disappearance of the classic GAC (Müller 2023a). ^{14}C-dated phases and assemblages with globular amphorae are marked in colour, ^{14}C-dated phases and assemblages without globular amphorae are not coloured. Blue: GAC Elbe network; other colours: Vistula–Podolia network. The slight colouring of the background displays the ^{14}C wiggle distribution in the calibration curve (mainly blue and light: steep parts of the curve, mainly greenish: flat parts). Uncertain dates (high standard deviation/possible reservoir effects) are marked in grey (data: Müller 2023a, fig. 165; drawing: Ralf Opitz and Johannes Müller).

In a new study, Bayesian modelling of ^{14}C dates relating to local, but also regional units was carried out accordingly. In a further step, individual dates were mapped across Europe (Müller 2023a). The comparison of the inventories is shown in Figure 5. Apart from some uncertainties in the Moldovan data, the following can be stated:

- The Globular Amphora phenomenon with classic globular amphorae is recognisable from c. 3200/3100 calBC in an area between the Middle Elbe and the bend of the Vistula.
- Classic globular amphorae spread quite rapidly around 3000 calBC in the southern area of the Elbe network and from 2950 calBC in the south-eastern area of the Vistula–Podolia network.
- The last classic globular amphorae are found in numerous areas at the latest around 2700 calBC. Only between Kujawy and Podolia are they known until c. 2500/2400 calBC.

The results (Figure 6) can be interpreted in different ways. From a cultural-historical point of view, the earlier idea of the inter-regional emergence of Globular Amphora practices between the Elbe and the Vistula is likely to be confirmed (e.g. Beier 1991; Wiślański 1964). Furthermore, it becomes clear that an "afterlife" of Globular Amphora practices is noticeable in the eastern regions, where an exchange with Yamnaya practices is visible (e.g. in the form of globular amphorae in Yamnaya graves or of the use of ochre in GAC graves; Szmyt 2000). This especially happens at a time when GAC practices are already a thing of the past in most regions.[2]

In many regions, globular amphorae exist simultaneously with other, especially TRB regional groups. The Middle Elbe-Saale area with Bernburg and GAC domestic sites has often been studied and discussed (Müller 2023b). While the GAC settlements tend to have

2 This contradicts ideas that the large-scale GAC phenomenon played a special role in the spread of Yamanya practices in central and northern Europe.

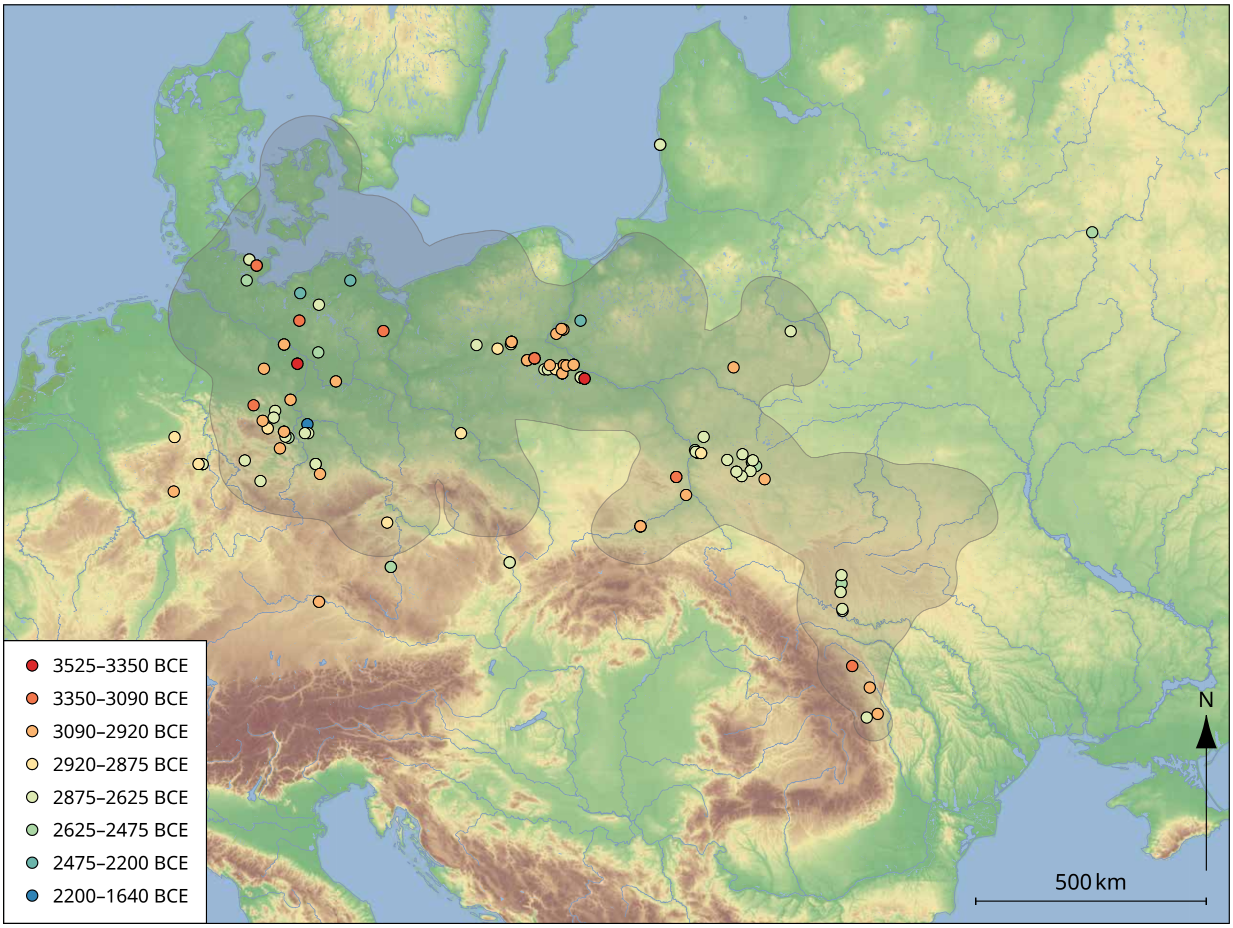

Figure 6. Spatial distribution of GAC ^{14}C dates: calibrated median ^{14}C-values indicated within the different calibration ranges of the calibration curve (after Müller 2023a, fig. 168; drawing: Ralf Opitz and Johannes Müller).

a strong orientation towards more fluvial lowland regions with a site distribution in the eastern area close to the Elbe and Mulde, Bernburg settlements are more oriented towards the circum-Hercynian loess areas close to the water (e.g. Beier 1988, 44; Ostritz 2000, 53–57; Woidich 2014, 94–95). This difference leads to statistically significant differences with regard to certain ecological factors: soil quality, orientation towards the water and also altitude above sea level (Figure 7). GAC graves, in contrast, are distributed throughout the entire area. There are also fortified settlements in which Globular Amphora pottery occurs in addition to Bernburg pottery.

A new chronological study, based on ornamental motifs and Bayesian modelling of calibrated ^{14}C dates, suggests a typo-chronological development in which the use of common ornamentation between Bernburg and Globular Amphora ceramics can be detected over at least two of the four GAC phases (Figure 8).[3] While, on the one hand, the simultaneous existence of different ceramic styles (and also, for example, of burial practices) is clear, on the other hand we recognise a hybridisation of different groups (Woidich 2014). The extent to which it plays a role that different groups practised aspects of a more pastoral or a more agrarian-oriented economy will be clarified below.

The example of the Middle Elbe-Saale region sheds light on the structural process of regional differentiation, which can also be seen in other regions. Overall, after a common emergence, the new GAC practices in the Middle Elbe and Lower Vistula area indicate a diversification that more strongly reflects the difference of the two supra-regional GAC networks described (Müller 2023a) (Figure 9).

3 The results correspond to an earlier chronological study (Müller 2001). There is no contradiction to the chronological study by Woidich (2014). While Woidich's basis is a differentiation according to decoration techniques, decorative motifs are used here.

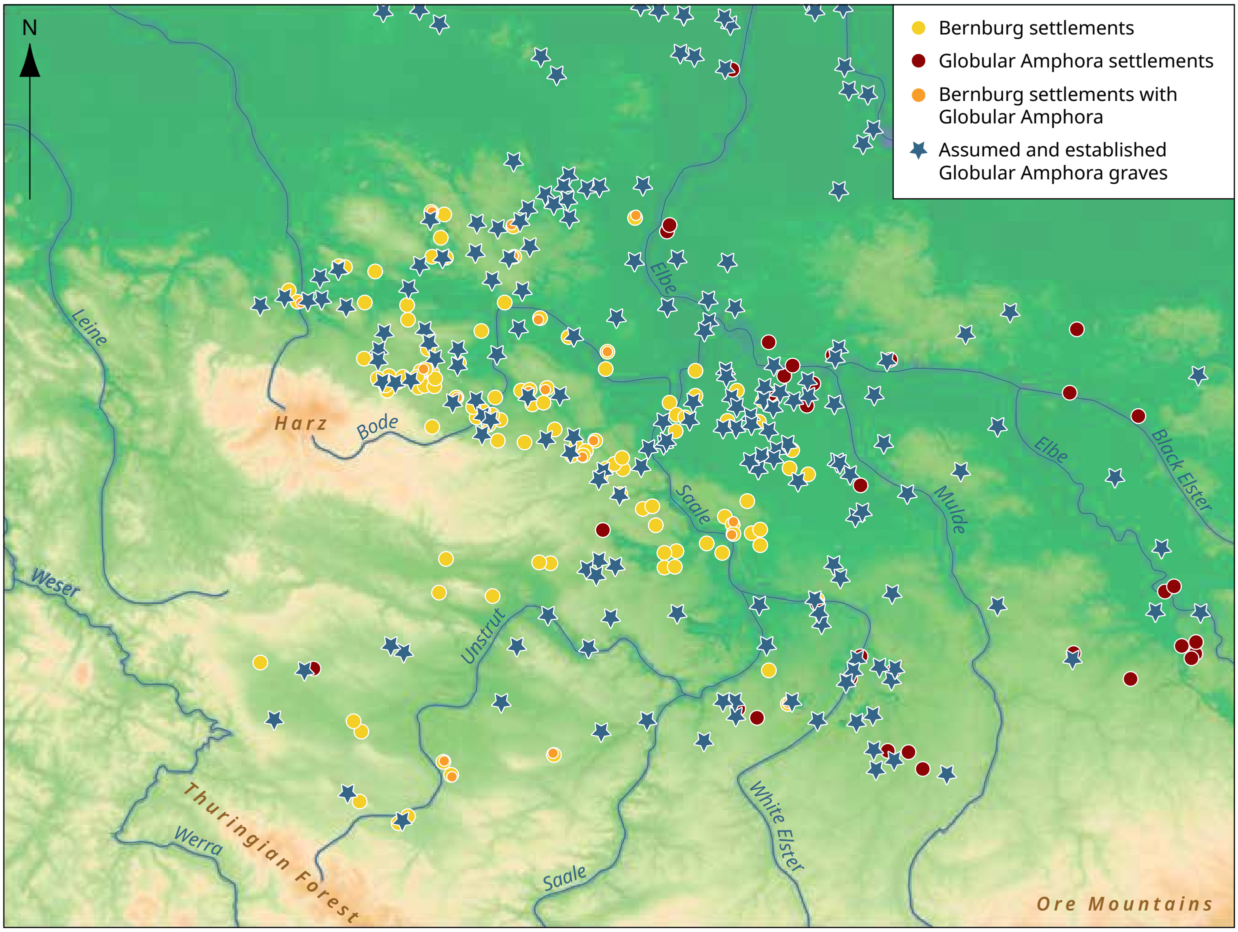

Figure 7. Domestic sites with Bernburg pottery, and settlement sites and graves with purely Globular Amphora material (after Müller 2023a, fig. 202; Woidich 2014, 203 fig. 67; drawing: Ralf Opitz and Johannes Müller).

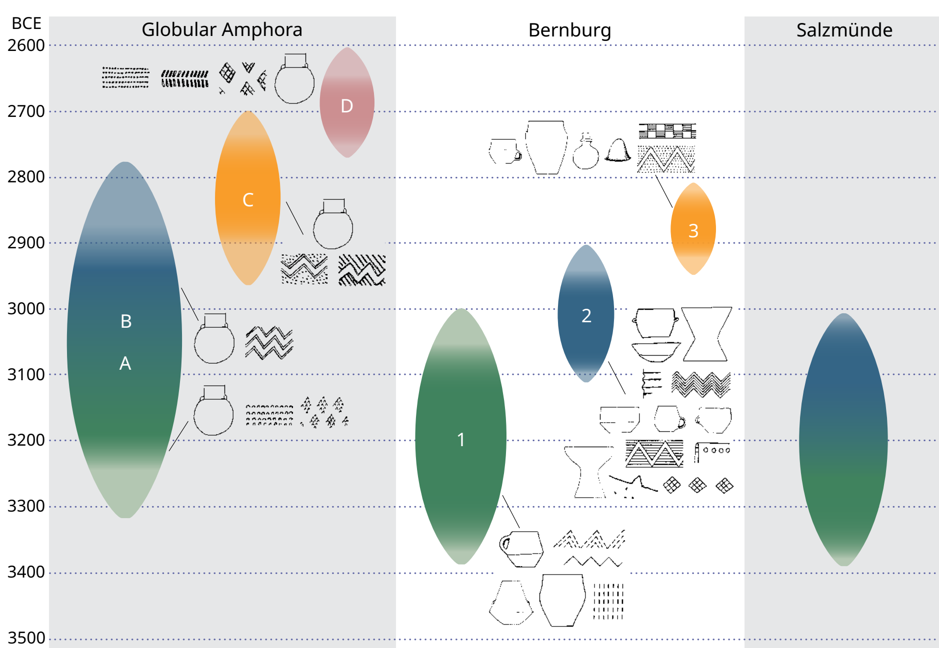

Figure 8. Middle Elbe-Saale region, development of the Globular Amphora and the Bernburg style (GAC A–D; Bernburg 1–3). The colour correspondences between the Globular Amphora, the Bernburg and the Salzmünde styles describe the similarities in decoration design, those between the Bernburg and the Salzmünde similarities in vessel types. The flowing colour changes mark the smooth typological transitions (after Müller 2023a, fig. 198; drawing: Ralf Opitz and Johannes Müller).

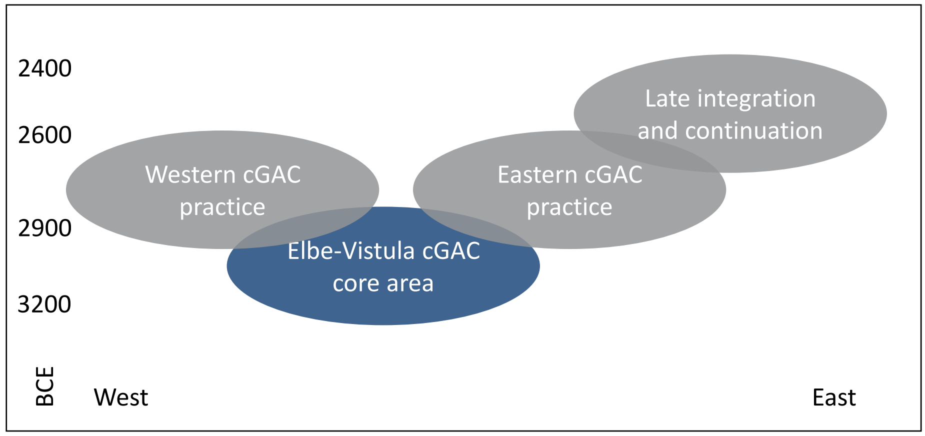

Figure 9. The interpretation of GAC development. cGAC indicates "classic GAC", i.e. phases and assemblages in which globular amphorae are present (drawing: Johannes Müller).

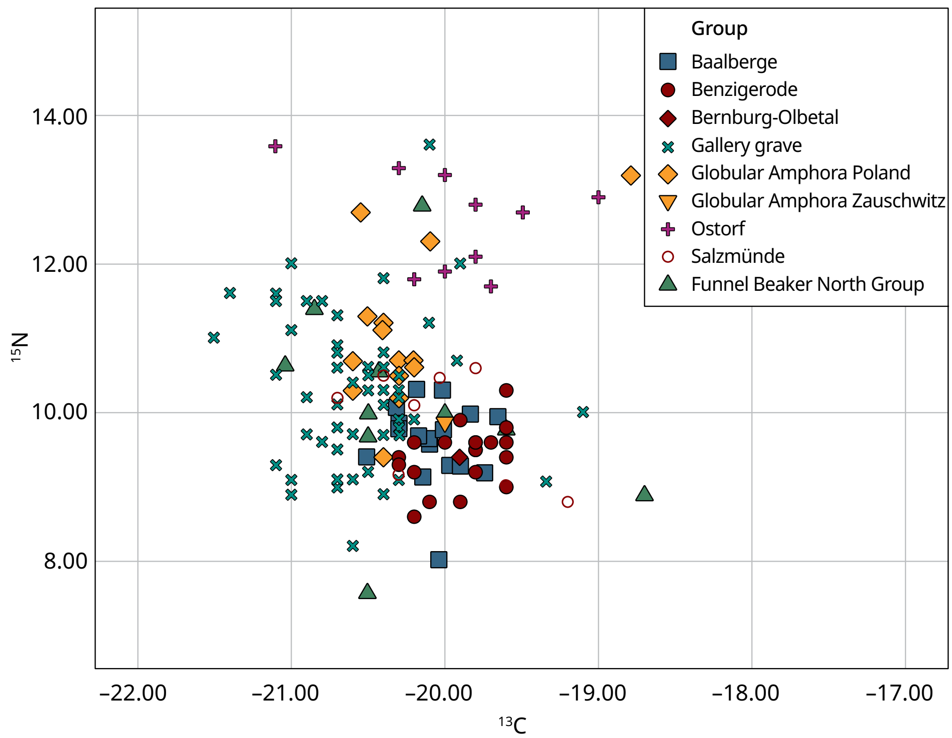

Figure 10. Scatterplot of ^{15}N/^{13}C isotopes for Bernburg and other societies, showing values from western German gallery and chamber graves, the cemetery at Ostorf and the TRB North Group. Bernburg values are from Benzingerode and Hundisburg-Olbetal; Salzmünde and GAC graves are from Lesser Poland and Zauschwitz. Clearly recognisable are the Bernburg, Salzmünde and GAC graves grouped in the main agrarian area (after Müller 2023a, fig. 201; drawing: Ralf Opitz and Johannes Müller).

Genetic continuity, kinship and families

The palaeogenetic studies published so far on 42 individuals directly associated with GAC range from Bohemia to western Ukraine and represent a large part of the GAC distribution (Müller 2023a). The comparison with central European predecessor societies proves "genetic continuity": GAC individuals basically do not differ from the preceding and contemporaneous farming societies. The high WHG proportion of 25 % on average, which seems to be typical for GAC individuals, is striking. However, a comparably high proportion is also known in analysed individuals of the western Wartberg group, the Řivnáč group[4] or also from isolated individuals of the TRB groups (Immel *et al.* 2021; Papac *et al.* 2021). In the western Ukrainian region, analyses of direct predecessor groups are lacking — but the analyses from Vertebra cave seem to indicate that the WHG proportion may have been much lower regionally. Thus, according to the current state of

4 In Bohemia, the individuals from Vliněvsi, crouched together in a former storage pit and labelled by Papac *et al.* (2021) as GAC-individuals, might belong to the Řivnáč culture (Dobeš *et al.* 2022). The only diagnostic cup associated with the burials is a variation of a Řivnáč type. Accordingly, the discussed admixture differences between Řivnáč and GAC individuals need to be questioned critically.

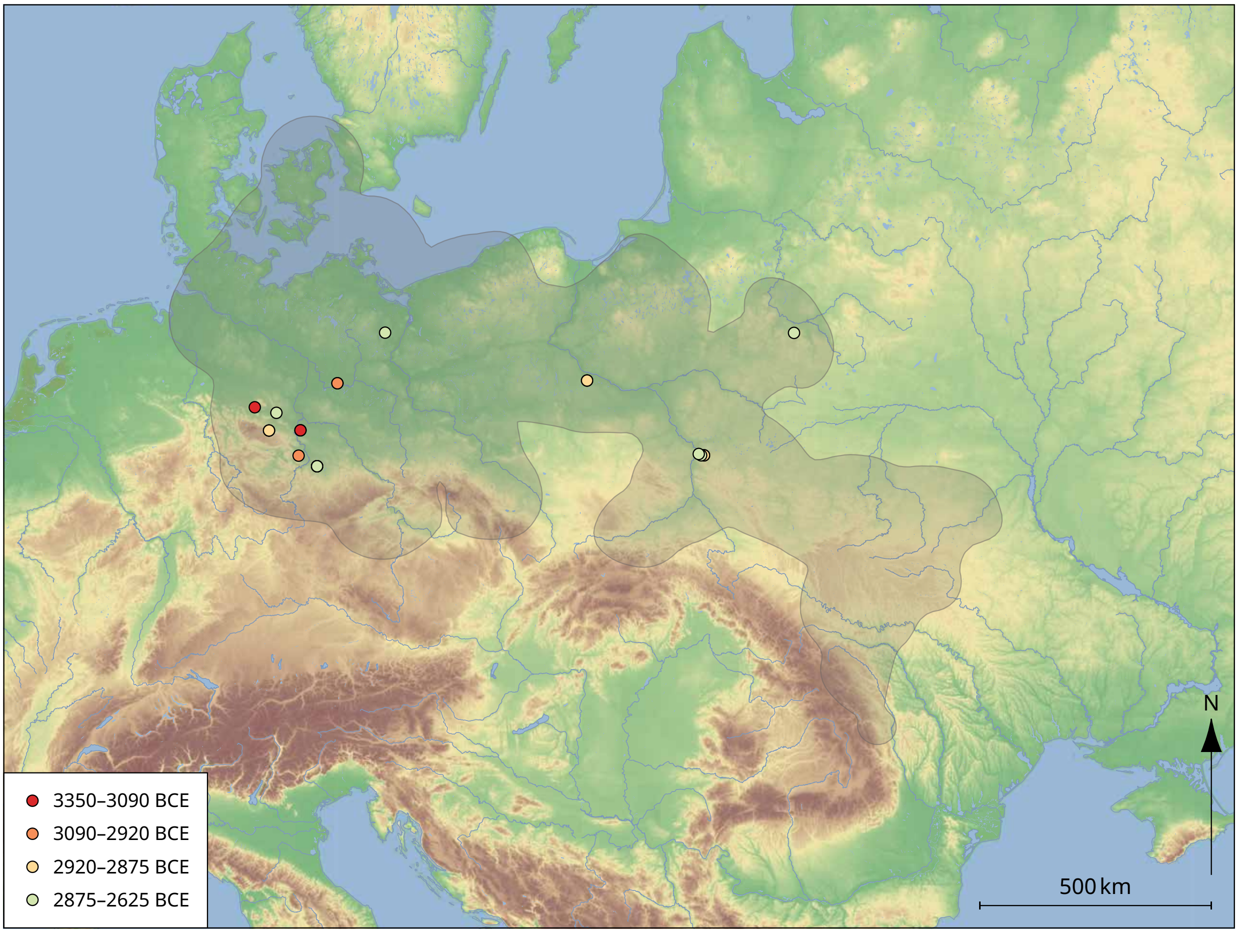

Figure 11. The distribution of ^{14}C-dated double cattle burials (median calibrated ^{14}C values mapped) (after Müller 2023a, fig. 181; drawing: Ralf Opitz and Johannes Müller).

research, western Ukraine is one of the few areas where GAC immigration and not local origin can be postulated on the basis of the palaeogenetic results.

Furthermore, the ^{15}N/^{13}C values do not reveal any significant differences between GAC and other local groups (Figure 10). The strontium values from the mass grave of Koszyce in Little Poland (Włodarczak *et al.* 2021) are also interpreted as reflecting local mobility within the range of approximately 50 km already mentioned above. Accordingly, we would argue for micro-regionally oriented economies.

Increasingly, kinship and family structures can be reconstructed. For the few examples where this is possible for Globular Amphora communities, the existence of nuclear families with the possibility of polygamy with patrilineality is indicated (summarised in Müller 2023a). This also corresponds to the known east-central European pattern. Tellingly, burials are organised according to biological kinship, which is not necessarily the case west of the GAC distribution area.[5] As a consequence, we can look more specifically for arguments as to how and why GAC arose in central Europe.

"Cattelisation" and separation?

Micro-regionally, one of the striking differences between GAC distribution areas is the different localisation of settlement remains. Thus, in some areas we observe a strong spatial separation between lowlands (with globular amphorae) and TRB remains on black earth (e.g. central Germany, see Figure 7), or the additional occupation of the pastorally usable hinterland by Globular Amphora communities (Silesia, Kujawy). Here, the model of an economic separation between more arable and more pastorally oriented groups is suggested, which eventually leads to the formation of a new socio-cultural *habitus* that begins to distinguish itself from

5 For example, collective graves containing, with only a few exceptions, genetically unrelated individuals are known from Niedertiefenbach and Altendorf.

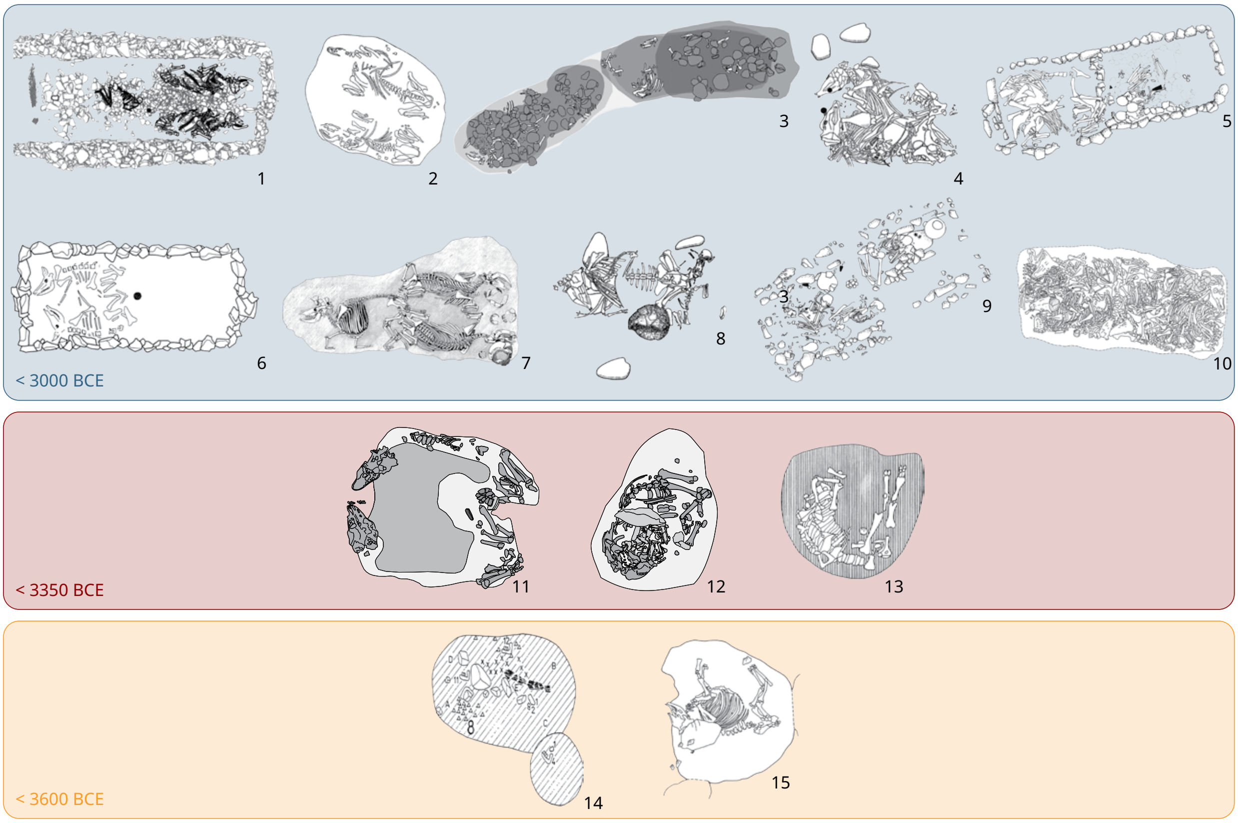

Figure 12. The changed practice of cattle burials. 1 Remlingen; 2 Derenburg; 3 Felchow 26; 4 Brzesc Kujawski 4; 5 Las Stocky H; 6 Plotha; 7 Zauschwitz; 8 Brzesc Kujawski 4; 9 Las Stocky G1; 10 Krasanaselky; 11 Niederwünsch; 12 Niederwünsch; 13 Kuczkowo 1-A136; 14 Zachow; 15 Zegotki 2 (after Müller 2023a, fig. 274; drawing: Ralf Opitz and Johannes Müller).

the agricultural groups that now become neighbours (Müller 2023a). While site distributions support such a model for GAC emergence, other arguments are of course also important.

As far as subsistence economy is concerned, the available isotopic analyses point to comparable food choices between GAC and non-GAC societies (Figure 10). However, ethnographically known symbioses between arable farmers and pastoralists show that in the case of mutual exchange of goods, diet does not necessarily have to differ (Amborn 1987). If we stay with the few analysed animal bone assemblages from GAC contexts, A. Kosko and M. Szmyt (2004) were already able to show for Kujawy that in contrast to the rather cattle-dominated TRB inventories, those of the GAC are characterised by a more balanced ratio of cattle, sheep/goat and pig. In central Germany, domestic sites with both Bernburg and GAC pottery also show a correspondingly more balanced ratio between the domestic animal species mentioned, while Bernburg settlements without globular amphorae show a cattle dominance (Höltkemeier 2020; Müller 2023a). The lack of systematic archaeobotanical analyses makes it difficult to assess the significance of plant cultivation for Globular Amphora communities. In principle, however, the isolated presence of querns in the Western Group and their larger numbers in Kujawy show that plant cultivation was important for GAC subsistence to a limited extent. In combination with the previous isotope results (see above), a broader subsistence base can therefore be assumed.

In contrast to the domestic sphere, however, the ritual sector is dominated by the worship or importance of cattle, especially of cattle teams. While we are able to archaeologically trace animal and cattle depositions, especially partial depositions, from c. 3700 calBC at the latest, the oldest radiometrically dated cattle double burials so far are from central Germany from c. 3350 calBC onwards (Figures 11–12). While in Niederwünsch or Profen such burials are still without GAC attributes, a ritual monopolisation of the practice of double cattle burials can be detected from c. 3000 calBC onwards in the entire Globular Amphora area. This is accompanied by the partial change and adaptation of votive offering places to animal depositions, where globular amphorae are integrated into an existing ritual practice (e.g. Zachow, Brandenburg; Müller 2023a).

It is striking that this monopolisation of double or multiple cattle burials by GAC groups obviously takes place throughout the entire GAC distribution area. For example, Nałęczów cattle and human graves in Lesser Poland and Lublin Land are a contemporaneous practice to that in the west.

In principle, a ritual monopolisation of an economically important aspect (cattle, wagons) indicates a process that creates identity. In fact, we can also recognise continuous changes and at least temporary monopolisations in other areas of material culture. Good examples are the GAC *Nackenkammäxte* with an oval shaft hole, which can be derived from TRB axes (Beran 2014), or the globular amphora vessels themselves, which can be derived from TRB amphorae.[6] Added to this are the emerging economic changes that make GAC communities seem more place-based and economically appropriating, but arguably with an emphasis on livestock herding. Accordingly, we would want to postulate here — at least for some areas of central Europe — that sedentary pastoralists separate themselves from the more place-bound agrarian communities.[7] This does not affect the strong regional differences between different Globular Amphora areas, which are due to the construction of supra-regional networks as well as economic adaptations to the locally and regionally very different environmental conditions.

Why and for what reason?

So far, we have descriptively reconstructed a historical process that began around 3200 BC in a sub-area of the TRB distribution and eventually led to the emergence of new, separate structures of a spatial, economic and ideological-ritual nature: the emergence of the supra-regional/"global" GAC phenomenon from 3000 BC at the latest. Why did this take place?

To answer this question, we should take a look at the preceding TRB societies. In various areas, we can see a centralisation of power, at least regarding the use of resources. This concerns a reduction in the number of megalithic tombs in northern Germany, as well as an increase of enclosures in central Germany. These processes, which have already been described several times (Müller 2001; Whittle 2018; Wunderlich 2019), are probably accompanied not only by an increase in social stratification but in the ritual sector also by an increase of weapons as grave goods, as opposed to items geared towards consumption (Müller 2011). The production of axes exclusively for the *rites de passage* to death also points to an increase in social tensions and insecurities. This probably crisis-like situation, which is amongst others also recognisable in the end of megalithic burial construction in northern Germany, is likely to coincide with a climatic deterioration. The shift of the North Atlantic Oscillation (NAO) towards the east obviously led to a shortening of the vegetation growth phase in the area between Kujawy and the Middle Elbe, which is also reflected in reforestation from about 3200 BC onwards (Dörfler *et al.* 2022; Grossmann *et al.* 2023).

In this phase of increasing social inequality on the one hand, and economic and political crisis on the other, separation processes such as those of the GAC from the TRB can be described as a possible (and also logical) consequence. In fact, we may be able to identify a social levelling mechanism in which, through separation, certain population groups develop new identities and, in the process, free themselves from the social grip of a more socially stratified society.[8] This would explain the attractiveness of the "GAC" model, which spread across large areas of central and eastern Europe in just a few generations.

Newly invented stimulants or medicinal substances also prove how diverse and positive the new social grammar could be. For example, lipid analyses of globular amphorae from a megalithic tomb in northern Germany (Weber *et al.* 2020) show that, in addition to dairy products, valuable sea buckthorn oils were given to the dead on their journey — the world's oldest proof of sea buckthorn oils can be attributed to the Globular Amphora communities.

Overall, the transformation process, which lasted only a few generations, resulted in new, initially irreversible structures and practices in social (e.g. reduced social stratification), cultural (e.g. the emphasis on individuality) and ecological (e.g. a micro-regionally organised livestock economy) spheres. In many areas, a specific cultural landscape emerges with burial grounds as focal points and smaller settlements (Szmyt 2017), part of the GAC *habitus*. A large-scale transformation did take place and formed the basic communication routes and social trends for the coming centuries.

6 It is important to emphasise the continuity of the burial architecture of earth or stone cist graves for human burials, already known before.

7 The difference becomes apparent in the reconstructed circulation area of the GAC cattle from Zauschwitz (> 50 km) and the local livestock in the non-enclosed Bernburg settlement of Hundisburg-Olbetal (<5 km; Gerling 2015, 230–41; Winter-Schuh *et al.* 2018).

8 This is one of the main mechanisms of ethnogenesis proposed by Hu (2023, 381–85). I am indebted to D. Hofmann for this suggestion.

Acknowledgements

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Parallel societies

Evidence for the co-existence of Late Funnel Beaker West and Early Corded Ware communities

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and S. Louise Olerud

Abstract

In this paper we argue for a long overlap between Funnel Beaker West and Corded Ware societies in the Netherlands and north-western Germany. Using Bayesian modelling, we re-examine the available radiocarbon dates for Funnel Beaker West and Corded Ware. The models indicate an overlap of at least 175 years between c. 2900 and 2725 calBC. This overlap is supported by archaeological cases in which Corded Ware and Funnel Beaker funerary and depositional practices are found to be contemporaneous, to occur at the same locations, or to exhibit specific, similar practices. We further examine this overlap in Corded Ware and Funnel Beaker West practices in the funerary and depositional domain. We find a recurring pattern of distinction and exemption in these highly symbolic practices, which we suggest best fits a scenario in which Corded Ware and Funnel Beaker West groups exist in parallel throughout the first half of the third millennium BC, with only occasional interaction. The precise nature of the (lack of) interaction between Corded Ware and Funnel Beaker societies remains open to interpretation. However, we show that local patterns are key to the interpretation of the transition as a whole. The overreliance on culture historical narratives in aDNA studies is prone to underestimate this variability, because samples are only taken from clear Corded Ware or Funnel Beaker West contexts, and not from exceptional ones. Therefore, we argue that systematic, detailed studies of funerary and depositional practices are crucial for understanding events in the third millennium BC and beyond.

Keywords: Funnel Beaker West, Corded Ware, Bayesian modelling, funerary and depositional practices, third millennium BC

Introduction

The transition from Funnel Beaker West groups to Corded Ware groups in the northern Netherlands and adjacent parts of north-western Germany is often characterised as a rapid, disruptive process occurring no later than 2750 calBC. Corded Ware traditions would supplant Funnel Beaker West ones in a matter of decades (Lanting and Van der Plicht 2000, 67–68), causing changes in funerary rites, ceramic style and landscape (Van Gijn and Bakker 2005, 304–05). This notion of a "fast and furious" transition feeds

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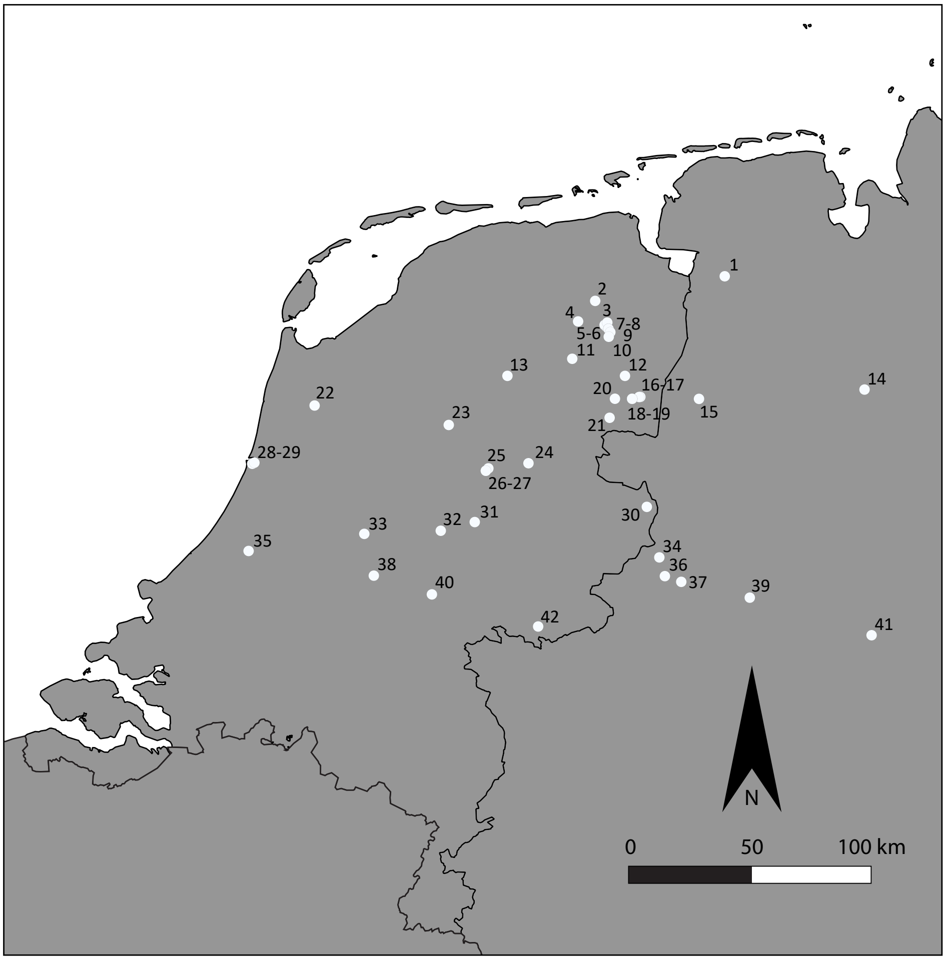

Figure 1. Overview of sites discussed in the text. 1 Leer-Westerhammerich; 2 Glimmer Es; 3 Annen-Holtkampen; 4 Zeijen; 5 Anlo-"Veekraal"; 6 Anlo; 7 Eext-Galgwanderveen; 8 Eext-Tumulus Visplas; 9 Eext-Bergakkers; 10 Eexterhalte; 11 Hijkerveld; 12 D32; 13 De Eese; 14 Visbek; 15 Emmeln 2; 16 Angelslo; 17 Emmen-Angelslo; 18 Noorbarge-Hoge Loo; 19 Noorbarge; 20 Kruidhaarsveld; 21 Dalen-Huidbergsveld; 22 Zandwerven; 23 Schokland-P14; 24 Dalfsen-Oosterdalfsen; 25 Hanzelijn-Oud; 26 Bedrijvenpark H2O; 27 Hattemerbroek; 28 Zeewijk-Oost; 29 Zeewijk; 30 Denekamp; 31 Vaassen; 32 Uddelermeer; 33 Baarn-De Drie Eiken; 34 Heek-Ammerter Mark; 35 Hazerwoude-Rijndijk Windturbinepark; 36 Heek-Averbeck; 37 Schöppingen-Haidberg; 38 Maarn-De Helm; 39 Gittrup; 40 Ede-Hotel Bosbeek; 41 Hunte 1; 42 Silvolde.

into broader narratives about the third millennium BC in Europe (Allentoft *et al.* 2015; Haak *et al.* 2015; Kristiansen *et al.* 2017; Olalde *et al.* 2018). Most recently, this characterisation was reiterated in archaeogenetic studies: a fast, disruptive transition is a perfect fit for a "massive migration" scenario (Kristiansen *et al.* 2017).

In this article, we present evidence against a rapid, disruptive transition between Funnel Beaker West and Corded Ware groups. The rapid transition scenario is anchored in problematic, culture historical views of Funnel Beaker West and Corded Ware, which the standard chronology for the area uncritically reproduces. We argue, on the basis of radiocarbon evidence and archaeological cases (Figure 1), that Funnel Beaker societies in the Netherlands and north-western Germany coexist with Corded Ware groups for several centuries, but probably interact little during this period. Such a scenario is not uncommon, and is known for the transition between Funnel Beaker North and Corded Ware traditions in Denmark (Iversen 2016; 2020), as well as for the co-existence of Bernburg, Globular Amphora and Schönfeld groups in central Germany (Furholt 2003a; Müller 2001; Wetzel 1979), and Globular Amphora and Corded Ware material in Poland (Włodarczak 2009; 2017).

This paper contributes to the growing evidence for the existence of "parallel societies" in the third millennium BC. These parallel societies are direct continuations from various regional groups, such as the Funnel Beaker West. The existence of parallel societies could explain the otherwise puzzling resurgence of Neolithic genetic signatures in individuals from the Bell Beaker period onward (Olalde *et al.* 2018; Papac *et al.* 2021).

A word about archaeological cultures

Funnel Beaker West and Corded Ware groups are well-known parts of the culture historical framework for north-western Europe. This framework regards archaeologically defined groups of material culture as bounded entities. In turn, these entities were held to be directly representative of past ethnic groups. While this view has been rightly criticised, the relation between an archaeologically visible material culture and the social entities behind it remains one of the big challenges of archaeology (e.g. Eisenmann *et al.* 2018; Frieman and Hofmann 2019; Jones 2007).

Crucially, recent ancient DNA (hereafter aDNA) studies initially appeared to confirm the above connection by identifying mass migrations from the Pontic Caspian steppe with the emergence of the Corded Ware culture in Europe (Allentoft *et al.* 2015; Haak *et al.* 2015). This led to archaeologists criticising aDNA studies as harking back to culture historical notions (Booth 2019; Eisenmann *et al.* 2018; Heyd 2017). While this discussion far surpasses the scope of this article, we think it is important to emphasise three different observations before continuing.

Firstly, subsequent aDNA studies have continued to confirm the above results. In some cases, culture historical classifications and groups of people do overlap. Throughout Europe, individuals buried in a Corded Ware fashion have steppe ancestry to some extent, while this ancestry was absent in individuals from earlier periods (Egfjord *et al.* 2021; Knipper *et al.* 2017; Olalde *et al.* 2018; Papac *et al.* 2021; Scorrano *et al.* 2021). Therefore, the Corded Ware culture, as originally envisioned by culture historical approaches, indeed reflects a group of people who migrated from the Pontic Caspian steppe. Moreover, these people are genetically distinct from Funnel Beaker groups who have mixed Neolithic farming and western hunter-gatherer ancestry (Allentoft *et al.* 2015, 168; Haak *et al.* 2015, 208).

Secondly, despite the coinciding of genetic and archaeological classifications, there is no a priori relation between biological ancestry and cultural identity in archaeology or aDNA studies (see Booth 2019, 5–6). Indeed, recent aDNA studies show that people buried in a Corded Ware fashion are genetically heterogeneous (see Booth 2019, 11; Papac *et al.* 2021; Shriner 2018). Similarly, the material culture associated with Corded Ware groups varies throughout Europe (Furholt 2014; 2020). This regional variability could relate to the vast geographical scale of the Corded Ware phenomenon, but also to the influence of earlier groups who occupied these areas and interacted with Corded Ware migrants (Furholt 2020, 10–11).

Thirdly, and most importantly, the above situation implies that a return to archaeological questions is necessary. What processes cause the migration seen in genetics and the changes in material culture reflected in the archaeological record to coincide? How do migrants and native groups interact? Some scholars argue for violent clashes and/or diseases decimating the indigenous Neolithic populations (Rascovan *et al.* 2019; Rasmussen *et al.* 2015; Schroeder *et al.* 2019; Valtueña *et al.* 2017), while others argue for peaceful assimilation over time through exogamy (Knipper *et al.* 2017; Mittnik *et al.* 2019; Scorrano *et al.* 2021). The most recent aDNA studies have started to address these questions by tracking genetic diversity over time in small regions (Mittnik *et al.* 2019; Papac *et al.* 2021). These studies show that distinct genetic groups initially lived apart, but increasingly mixed over time in some parts of Europe.

The present paper applies a practice perspective to the transition between Funnel Beaker West and Corded Ware groups. We assume, on the basis of the above aDNA papers, that entities such as Funnel Beaker West and Corded Ware represent respectively indigenous and migrating groups living in the north-eastern part of the Netherlands and the north-western parts of Germany during the third millennium BC (Allentoft *et al.* 2015, 168; Haak *et al.* 2015, 208). While no individuals from Funnel Beaker West or Corded Ware contexts in the Netherlands have been sampled for aDNA, we expect their genetic profiles to be roughly similar to those elsewhere. As such, we distinguish Funnel Beaker West and Corded Ware groups or communities throughout this paper. This refers to the overall correlation between genetic ancestries, material culture and particular practices (Bourgeois and Kroon 2017). However, this does not imply that we consider these groups as strictly bounded, monothetic entities, nor that the prehistoric people(s) living in these areas actively self-identified with a Funnel Beaker West or Corded Ware group identity (Jones 2007).

The chronological question — radiocarbon evidence

The culture historical framework for the Netherlands and north-western Germany proposes a strict chronological separation between Funnel Beaker West and Corded Ware material culture. Corded Ware would immediately follow Funnel Beaker West around 2750 BC (Lanting and Van der Plicht 2000). This framework rests on ceramic typology which was anchored in absolute time through radiocarbon evidence later on.

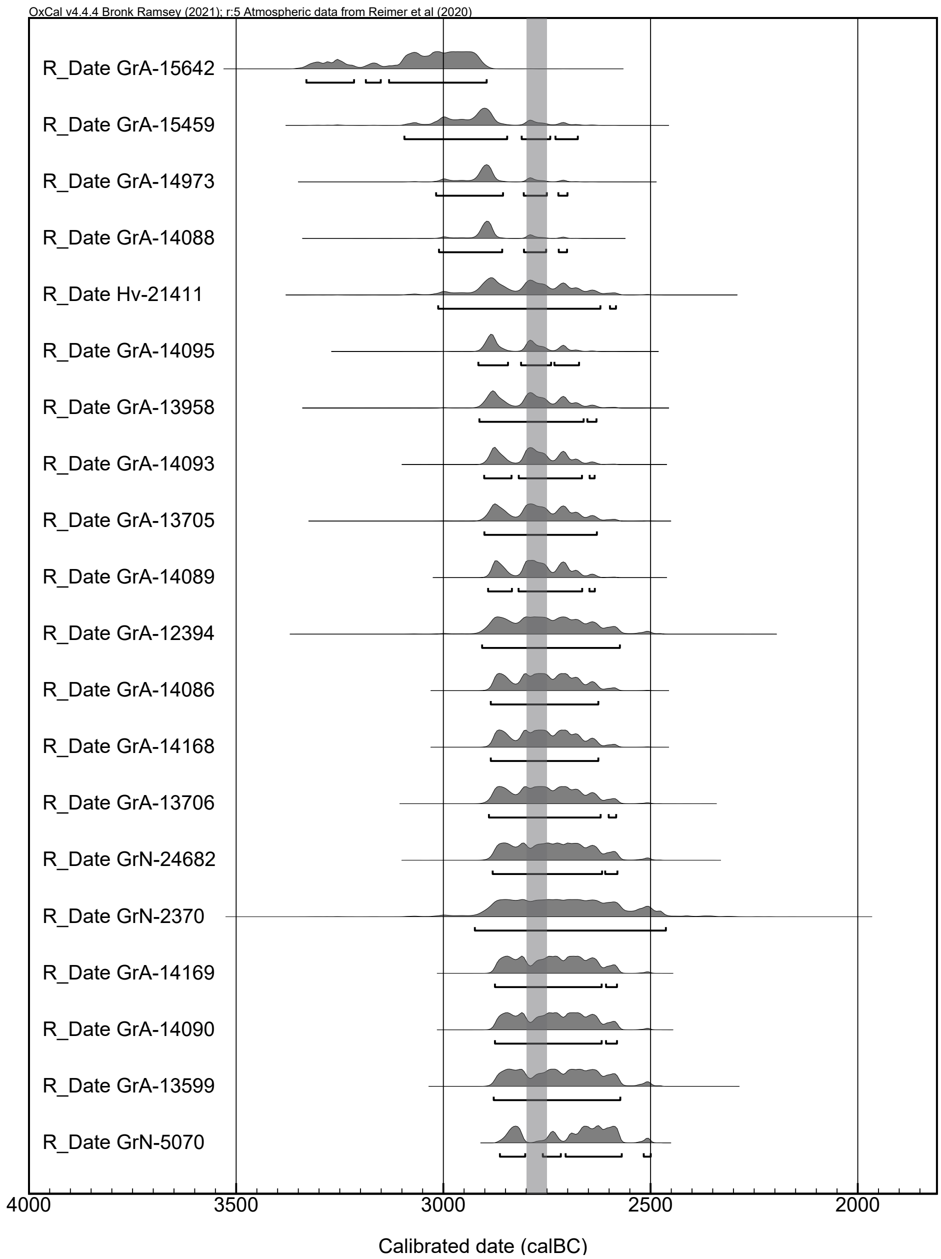

Figure 2. Calibrated radiocarbon dates of Funnel Beaker West cremation burials associated with late Havelte pottery. 2σ ranges, calibration using IntCal 2020 (Reimer *et al*. 2020) in OxCal 4.4 (Bronk Ramsey 2009). The majority of radiocarbon dates stem from cremated human remains and a few from charcoal fragments of the pyre remains. The grey vertical bar indicates the duration of the youngest Funnel Beaker West horizon according to the current chronology (Brindley 1986; 2022, 112). The calibrated radiocarbon dates do not concur with this range.

We argue that the initial typological distinction between Corded Ware and Funnel Beaker West ceramics distorted the radiocarbon evidence. The effort to construct a culture historical framework led archaeologists to frame the typological distinction between Funnel Beaker West and Corded Ware pottery as a chronological distinction. This framework was then imposed on the radiocarbon evidence (Lanting and Van der Plicht 2000). As a result, young Funnel Beaker West dates and old Corded Ware dates are systematically dismissed as contaminated or simply erroneous, because Funnel Beaker West and Corded Ware material must form a neat transition (Lanting and Van der Plicht 2000; but see Fokkens *et al.* 2016, 277–85 for a critical reassessment).

The strict temporal distinction between the Funnel Beaker West and Corded Ware groups does not hold up if we inspect the calibrated radiocarbon dates behind the chronology. For instance, several cremation burials[1] with ceramics from the youngest Funnel Beaker West horizon would fall between 2800 BC and 2750 BC according to ceramic typology (Brindley 2022, 112).

1 Note that the sandy soils of the Netherlands do not preserve skeletal remains, unless they have been burnt. This is therefore the only bone material available for radiocarbon dating.

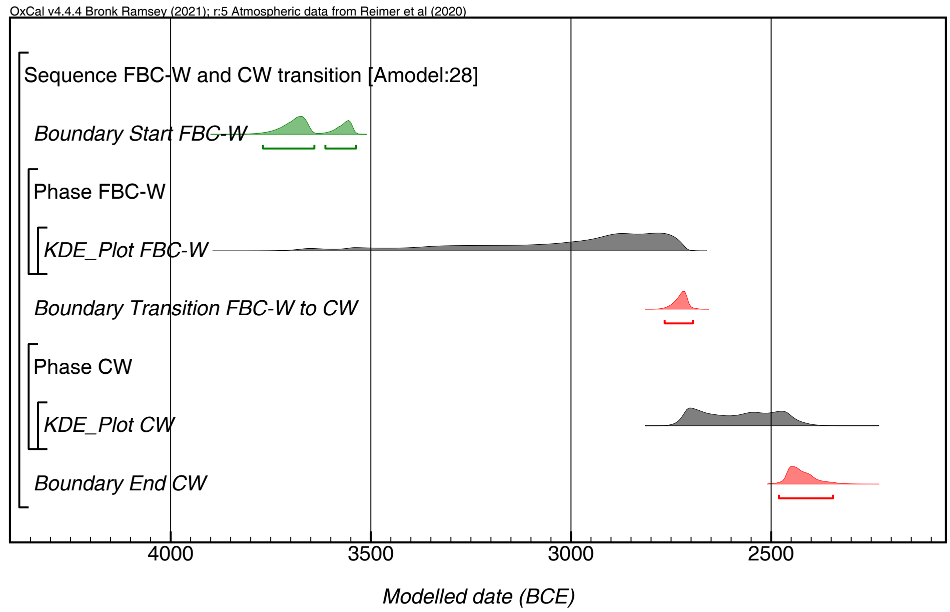

Figure 3. Bayesian analysis of radiocarbon dates for a hypothesised rapid transition between the Funnel Beaker West and Corded Ware cultures. The individual radiocarbon dates have been left out for readability. This model places the transition between 2767 and 2696 calBC. However, the agreement between model and base data is low (see top left corner).

However, radiocarbon dates of the human remains in these burials fall well into the third millennium BC (Figure 2) (Kroon 2024). In other words, the youngest Funnel Beaker West burials date to a period for which the presence of Corded Ware pottery is widely attested in north-west Europe (Furholt 2003b).

These cremation burials and their respective dates cast doubt on the narrative which sees Funnel Beaker West and Corded Ware as successive entities. The mismatch between radiocarbon dates and the standard chronology can be explained in two ways. Firstly, the dates could indicate a chronological overlap between Corded Ware assemblages and the youngest phases of Funnel Beaker West. Secondly, the mismatch could be attributed to the presence of plateaus in the calibration curve for this timeframe (Furholt 2003a). Hypothetically, the dated Funnel Beaker West burials could fall in the earliest part of their calibrated range (for example 2800–2750 calBC), and all Corded Ware burials in the later parts. Below, we employ a Bayesian framework to determine the likelihood of both scenarios (Bronk Ramsey 2009).

We collected a total of 84 radiocarbon dates from Funnel Beaker West (n=57) and Corded Ware (n=27) contexts in the Netherlands and north-western Germany. All radiocarbon dates have direct associations with Corded Ware or Funnel Beaker West pottery and stem from burials or closed contexts with pottery (see Appendix 1). We calibrated these dates in OxCal 4.4 with the IntCal20 curve (Bronk Ramsey 2009; 2017; Reimer *et al*. 2020) and tested two possible models of the transition from Funnel Beaker West to Corded Ware in a Bayesian framework. All age ranges are calibrated at a 2σ confidence level.

Model 1 represents the current chronological framework for Funnel Beaker West and Corded Ware material by placing both of these cultures in a sequence. In this sequence, the latter succeeds the former in a single event. In other words, *all* TRB dates *must* be older than *all* Corded Ware dates. Model 2 consists of the alternative scenario in which Funnel Beaker West and Corded Ware material can co-exist. This model calculates a likely start/end date of both. In both models we use Kernel Density Estimation (KDE) in combination with start/end date modelling to produce reliable estimates of the duration of both phases (Bronk Ramsey 2009; 2017). The Bayesian analysis subsequently determines the likelihood of either model given the available data.

The Bayesian analysis for model 1 (Figure 3) proposes a boundary date between Funnel Beaker West and Corded Ware at 2767–2696 calBC, which roughly concurs with the standard chronology (Lanting and Van der Plicht 2000). However, the model exhibits poor agreement between the proposed chronological sequence and the observational data (A_{model} = 28.4 %; Bronk Ramsey 2009, 356). In other words, there are too many radiocarbon dates for Funnel Beaker West material of which the calibrated age range is entirely younger than the calibrated age range of several Corded Ware samples. A rapid transition cannot be a likely explanation of the observed spread of radiocarbon dates. Therefore, this model should be rejected.

By contrast, the second model (Figure 4) does not impose a rapid transition between the Funnel Beaker West and Corded Ware phenomena, but simply calculates the most likely start and end dates for both on the basis of the available radiocarbon dates. This model allows for a potential overlap. The Bayesian analysis indicates

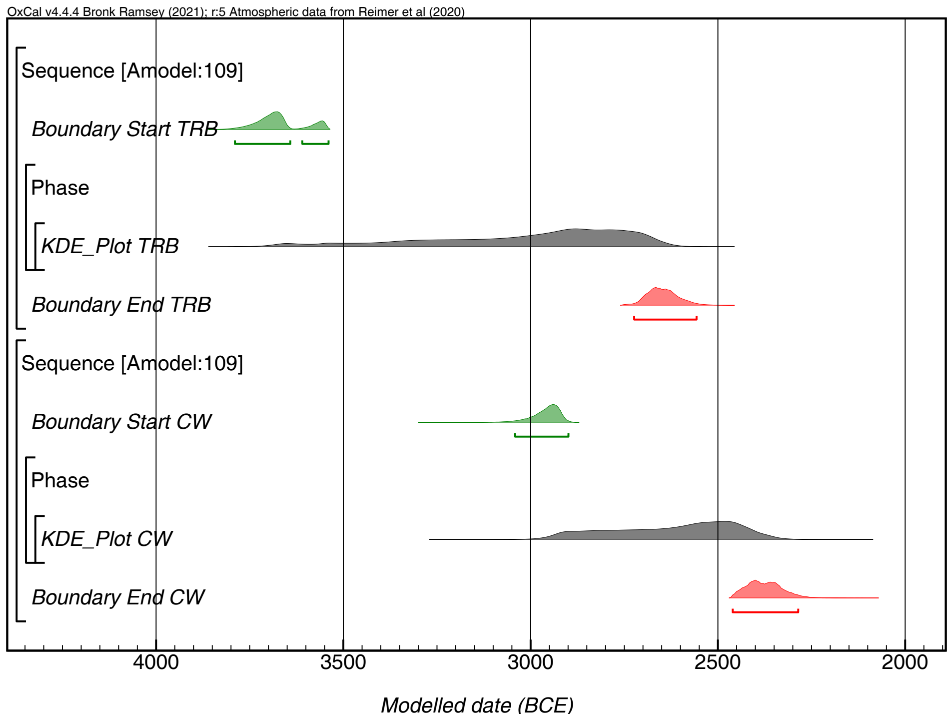

Figure 4. Bayesian analysis of radiocarbon dates for the Funnel Beaker West and Corded Ware cultures without an assumed, rigid boundary. The individual radiocarbon dates have been left out for readability. The Funnel Beaker West and Corded Ware cultures have been modelled as phases with independent boundaries (see key words on the left). The proposed start for the Funnel Beaker West culture is based on sparse data and should be ignored. The Bayesian analysis shows that the end date for the Funnel Beaker West culture post-dates the start date of the Corded Ware culture by almost two centuries. This model exhibits good fit with the observational data (cf. Figure 3).

that Funnel Beaker West material culture persists until 2724–2558 calBC, while Corded Ware traditions start around 3042–2900 calBC. Therefore, this model demonstrates a considerable overlap between the Funnel Beaker West and Corded Ware groups. The most conservative estimate for the duration of this overlap is c. 175 years, but a longer overlap is feasible. Contrary to model 1, the agreement between this model and the observed data is good (A_{model} = 108.5 %). As such, the radiocarbon evidence favours a long co-existence between Funnel Beaker West and Corded Ware societies in the Netherlands and north-western Germany.

The two models presented above demonstrate that it is far more likely that Funnel Beaker West and Corded Ware groups coexisted for a significant amount of time, than for one to have quickly supplanted the other. This quick transition scenario is simply untenable on the basis of the available radiocarbon dates. Therefore, we must envision a long period of cohabitation, lasting multiple centuries, between these two groups in the Netherlands and north-western Germany. In the next section, we show that this long period of cohabitation is evidenced in the archaeological record as well.

Archaeological evidence for the contemporaneity of Funnel Beaker West and Corded Ware groups

The focus of our argument is funerary and depositional practice. Generally, Funnel Beaker West and Corded Ware groups exhibit distinct practices in these highly symbolic contexts (see Bourgeois and Kroon 2017; Fontijn 2019 for a characterisation of these practices). However, several cases demonstrate that these distinct practices can on occasion spill over from one into the other, indicating contemporaneity, but also an intimate familiarity related to depositional and funerary practices. Therefore, we argue that this pattern of largely distinct, but on occasion identical practices supports a parallel existence of Corded Ware and Funnel Beaker West communities with only occasional interaction.

Funerary rites

The traditional contrast between Funnel Beaker West and Corded Ware traditions revolves around funerary practices. Funnel Beaker West practices involve communal burials in megalithic tombs, as well as individual burials in flat graves. These flat graves are often part of extensive

Figure 5. Funnel Beaker West burial no. 13 at the Dalfsen-Oosterdalfsen flat grave cemetery. Left: unedited photograph of the burial. Right: line drawing indicating the corpse silhouette (1); an undecorated bowl (2); and the strike-a-light comprising a marcasite ball and three flint flakes (3). The body is placed in a left-flexed position (head NE, facing SW) with the grave goods placed in front of the body (Van der Velde *et al*. 2022, 50–52). The excavators draw a parallel between such practices and those observed in Corded Ware burials (Van der Velde and Raemaekers 2022, 20). Image: Van der Velde 2022, fig. 9.1; image used with permission.

cemeteries (see Lanting and Brindley 2004, 92 for an overview). The most recently excavated example of such a flat grave cemetery is Dalfsen-Oosterdalfsen (Van der Velde *et al*. 2022). This site illustrates the systematic nature of Funnel Beaker West funerary practice. Dalfsen-Oosterdalfsen encompasses over a hundred Late Funnel Beaker West graves. The deceased individuals in these graves are interred in crouched positions, and the burials are furnished with pottery, flint and stone axes as grave goods (Figure 5) (Bouma and Van der Velde 2022, 34–35, 43–44).

Apart from flat grave cemeteries, Late Funnel Beaker West burials are also found in megalithic tombs. The construction of these monuments probably occurred during earlier Funnel Beaker West phases, but most megalithic tombs also show continued deposition of ceramic vessels, likely as grave goods for deceased individuals, into the later stages of the Funnel Beaker West culture (Bakker 1992; Van Gijn and Bakker 2005). Unfortunately, bone preservation inside megaliths is poor, and little to no unburnt skeletal remains are known from these tombs in the Netherlands.

Corded Ware funerary rituals in the Netherlands also exhibit a distinct set of practices. Inhumations are common, usually graves below barrows or more rarely flat graves. These inhumation burials can form larger alignments across landscapes (Bourgeois 2013). Moreover, Corded Ware burials involve highly standardised grave goods: battle axes, flint blades, flint axes and beakers are most common (Wentink 2020, 226). Similarly, the positioning of the bodies and grave goods is highly standardised, as is the case across the whole Corded Ware distribution area (Bourgeois and Kroon 2017).

It is clear that both Late Funnel Beaker West and Corded Ware communities bury their dead in accordance with well-established, distinctive practices. Yet these practices do not always neatly correspond to the distinction between Funnel Beaker West and Corded Ware material. We illustrate this with examples from megalithic tombs, flat grave cemeteries and the use of fire in flat graves.

Code-switching Corded Ware

A first funerary practice that transcends the Funnel Beaker West/Corded Ware boundary is the continued use of megalithic tombs by Corded Ware groups. Recent studies of the inventories of these megaliths show that Corded Ware vessels occur systematically within them (Brindley and Lanting 1992, 107–08; Drenth 2012; Jager 1985, 239; Van der Velde *et al*. 2019, 20; Van der Waals 1964, 39). These Corded Ware ceramics in megaliths have all been characterised as later re-use, detached from the initial Funnel Beaker West use of these megaliths by several centuries. However, the similarity extends beyond mere inclusion of vessels in a megalithic tomb.

Funnel Beaker West ceramics in funerary contexts predominantly consist of beakers, bowls and larger vessels referred to as tureens, tureen-amphorae or amphorae (Brindley 2022, 142 for recent tallies of vessels in megaliths and flat grave cemeteries; Lanting and Brindley 2004). By contrast, Corded Ware funerary contexts in the Netherlands contain nearly exclusively beakers (Wentink 2020, 48, tab. 4.1). Crucially, the Corded Ware vessels deposited in megalithic tombs break with Corded

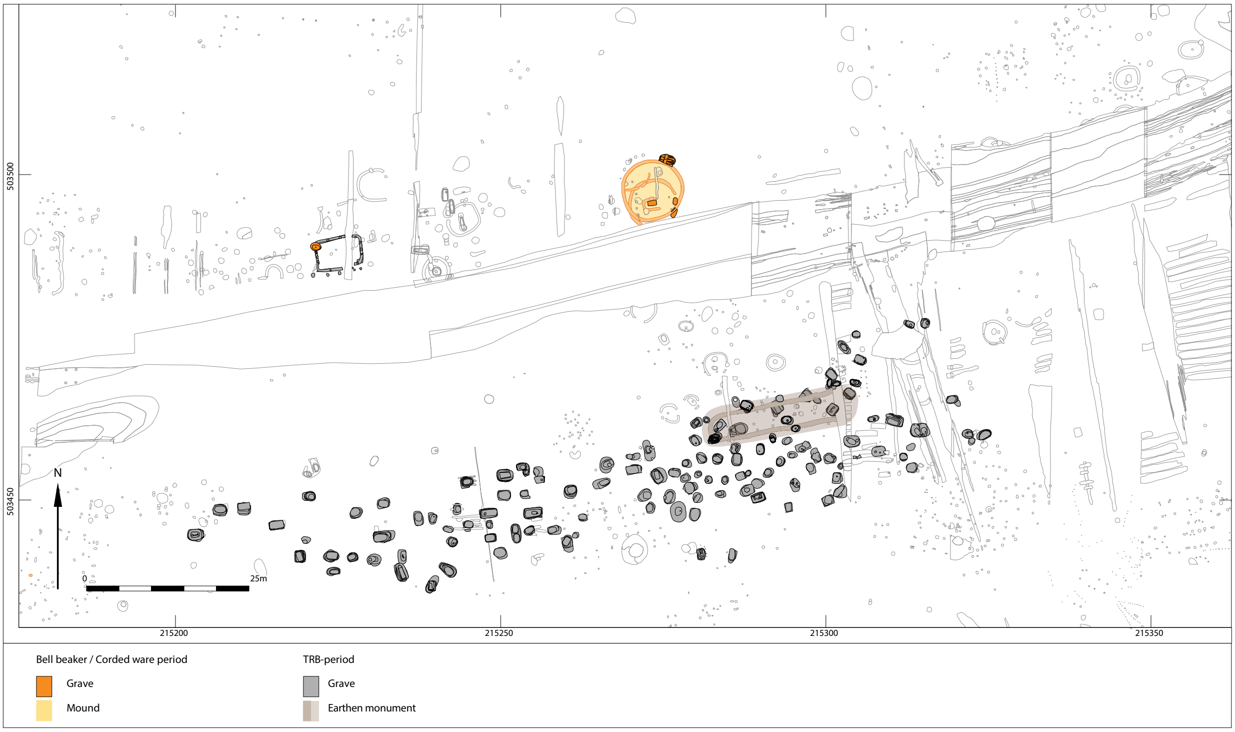

Figure 6. Map of the Funnel Beaker West flat grave cemetery at Dalfsen-Oosterdalfsen. The grey features are the Funnel Beaker West flat graves. Corded Ware and Bell Beaker burials (in orange) appear just north of the cemetery. A further cremation burial (burial 136) is situated at the far west end of the cemetery (left of the north arrow). The ^{14}C dates of this burial fall into the third millennium calBC (Poz-88040: 4205±35 BP; Poz-88702: 4240±35 BP; Bouma and Van der Velde 2022, tab. 3.1). Image: Van der Velde 2022, fig. 9.1; image used with permission.

Ware conventions. J.A. Bakker (1992, 59) shows that the Corded Ware vessels in megalithic tombs involve higher frequencies of amphorae and large vessels, such as short-wave moulded wares, along with beakers. He suggests the difference to "ordinary" Corded Ware burials might relate to the status of the deceased. However, we argue that the choice of these larger vessels equally resonates with Funnel Beaker West practices, where similar vessels are included in funerary deposits. The similarity in types implies that whoever deposited these Corded Ware vessels in these megaliths knew what was the right pottery to include (Fontijn 2019): not beakers, but amphorae and short-wave moulded ware, items extremely rare in Corded Ware burials in the region. This indicates knowledge of and adherence to Funnel Beaker West practices in the deposition of this Corded Ware material.

Angelslo-Emmerhout: the curious case of flat grave 14

One of the most clear-cut cases of contemporaneity between Corded Ware and Funnel Beaker West groups stems from the site of Angelslo-Emmerhout. A large-scale excavation of this site uncovered the remains of both Funnel Beaker West and Corded Ware burials, all of which are aligned on a single axis at least 400 m long (Arnoldussen and Scheele 2012). The best-known and most controversial of these burials is flat grave no. 14. It contains the remains of a cremated individual, along with partially heated and fragmented late Funnel Beaker West ceramics and a Corded Ware sherd (Bakker and Van der Waals 1973, 24–25; Waterbolk 1960). J.N. Lanting and J. van der Plicht in particular hotly contest that this is a closed context, insisting that the Corded Ware sherd must have been a later intrusion (Lanting and Van der Plicht 2000, 32, 66). However, the excavators explicitly mention that the upper part of the grave fill was homogeneous and did not show traces of disturbance (Bakker and Van der Waals 1973, 25). An additional argument presented by Lanting and Van der Plicht is that the Corded Ware sherd does not show signs of heating, while the Funnel Beaker West sherds do, again suggesting a later intrusion. However, the original excavators state that some Funnel Beaker West ceramics also lack signs of heating, and this was confirmed by later analysis (Drenth and Meurkens 2014, 303–04).

Whatever the case may be, charcoal fragments stemming from burnt branches within the pit were radiocarbon dated (GrN-5070, 4100±30 BP, calibrated 2864–2500 calBC), making this burial fully contemporaneous with the nine

Corded Ware burials found in close proximity. In fact, one of these Corded Ware burials was also radiocarbon dated to the same time period (charcoal branches from the primary burial underneath Tumulus VIII; GrN-6644, 4160±30 BP, calibrated 2879–2631 calBC). The presence of these flat graves and burial mounds indicates that this area was in use as a burial ground by communities using Corded Ware pottery and Funnel Beaker West pottery at the same time. The lack of intercutting and the careful spacing of burials along a single axis also suggest adherence to the same rules of where the deceased would be buried.

Angelslo-Emmerhout is not the only case where both Funnel Beaker West and Corded Ware style burials occur closely together. For example, Corded Ware and Bell Beaker barrows occur in close proximity to the Funnel Beaker West flat grave cemeteries at Uddelermeer (Bakker 1979, 105, 194–96), Kruidhaarsveld (Bakker 1979, 31; Van Giffen 1937, 74–77; Waterbolk 1958, 12–13), and Dalfsen-Oosterdalfsen (Bouma and Van der Velde 2022, 62–63). In particular the latter case is intriguing. Here a large Funnel Beaker West flat grave cemetery was uncovered with more than a hundred burials placed along a coversand ridge. To the north of this cluster of Funnel Beaker West graves several Corded Ware and Bell Beaker burials were discovered. The contemporaneity of these burials is difficult to establish, as only a single grave was radiocarbon dated. This grave (number 135) was the only cremation burial amongst the Funnel Beaker West group of graves and was dated to c. 2900–2670 calBC (two dates are available from the same cremated remains: Poz-88040, 4205±35 BP and Poz-88702, 4240±35BP, calibrated c. 2900–2670 calBC). This would make this grave contemporaneous to several Corded Ware burials that were also found here. Intriguing in this case is that the Corded Ware and Funnel Beaker West burials appear to be geographically separated from one another. The Corded Ware (and later Bell Beaker) burials are all located in an area 50 m to the north of the Funnel Beaker West cemetery (Figure 6), apparently respecting the confines of the latter (Bouma and Van der Velde 2022). This spacing of the burials, and contemporaneity with at least some of the Funnel Beaker West burials, suggests two distinct groups with different burial traditions respecting, but also opposing each other's funerary space.

These examples demonstrate that Corded Ware and Funnel Beaker West burials can appear as part of the same funerary space or — especially in the case of Dalfsen — just across the road from one another. Interestingly all these examples have been explained as mysterious continuities in practice (Arnoldussen and Scheele 2012, 157; Brindley and Lanting 1992, 135). However, an interpretation which sees Corded Ware and Late Funnel Beaker West communities as contemporaneous is a better explanation for these cases and is in fact better supported by the radiocarbon evidence.

And I bring you… fire

While there are interesting parallels between Funnel Beaker West and Corded Ware, as we described above, there is also a significant difference. The majority of Funnel Beaker West burials that can be reliably dated to the third millennium BC are cremation burials (Figure 2). Indeed, cremation was a key part of Late Funnel Beaker West burial rituals and potentially for Funnel Beaker communities in general (Blank 2021). These cremations do not only appear in flat graves, but also in megalithic tombs associated with Late Funnel Beaker West ceramics (Bakker 1992, 55, 93–94; Bakker and Van der Waals 1973, 27).

This practice of cremating the dead is extremely rare in Corded Ware contexts. There are only four known cases of Corded Ware cremation burials in the Netherlands: Baarn-De Drie Eiken (Drenth and Hogestijn 2014, 109; Wentink 2020, 135); Elderslo (Lanting 1973, 228); Vaassen (Drenth and Hogestijn 2014); and Zeijen "Jodenbergje" (Drenth and Hogestijn 2014, 108–09).

That is not to say that fire did not play a role in the funerary ritual of the Corded Ware. Indeed, there are many indications that the burial pit itself, or the wood used in the construction of a chamber, was set on fire prior to the inhumation (Wentink 2020, 202). This practice has been attested many times in the Netherlands through the regular presence of charcoal, burnt coffins and/or charred wooden structures in graves (e.g. Jager 1985, 211, 215–19, 229, 233) and may have been part of a broader practice across the Corded Ware sphere of rites (Nordqvist and Heyd 2020; Šebela 1999). Intriguingly, this practice is also well attested at the site of Dalfsen-Oosterdalfsen mentioned above, with eight Funnel Beaker West graves containing charred wooden coffins (Bouma and Van der Velde 2022, 40–41).

However, the importance of fire appears, generally speaking, greater in Funnel Beaker West rites when compared to Corded Ware ones. Cremation of deceased individuals returns more systematically with Bell Beaker groups, with 23 known cases of Bell Beaker cremations in the Netherlands, even if inhumations are more common (Hamburg *et al.* 2011, 258–60). As such, it would appear that the practice of cremating the dead makes a resurgence in Bell Beaker contexts. In the same vein, the inclusion of strike-a-lights in burials returns in Bell Beaker graves (Wentink 2020, 196); these were already a common artefact in Funnel Beaker West megaliths (Bakker 1979, 77). A similar point has been raised for flint arrowheads: common in Funnel Beaker West megalithic tombs, virtually absent in Corded Ware burials, and present again in Bell Beaker graves (Wentink 2020, 129–30).

Funnel Beaker West and Corded Ware burial traditions are distinct from a general point of view, with a small number of exceptions which blur the boundaries between the two. The apparent fusion between these distinct funerary practices in Bell Beaker contexts is highly relevant. We argue that the resurgence of Funnel Beaker funerary practices in Bell Beaker burials can best be explained through Funnel Beaker groups existing in parallel with Corded Ware societies throughout the first half of the third millennium BC. Such a resurgence is inexplicable if a fast, disruptive transition truncates Funnel Beaker societies around 2750 calBC, centuries before the first Bell Beaker groups. Moreover, the resurgence better fits patterns observed in recent aDNA studies (see discussion below).

Depositional practices

Selective deposition in Funnel Beaker West and Corded Ware societies follows a similar pattern of distinction and exemption as with funerary rites. We follow the definition of selective deposition by D. Fontijn (2002, 5–6; 2019, 26–29), who stresses that certain specific objects, with specific life biographies, are systematically deposited in specific places in the landscape.

Selective deposition is abundant in the Funnel Beaker West setting. In particular, there is a strong emphasis on axe depositions in both funerary contexts and wetlands. However, different types of axes were deposited in these contexts. Large, imported axes of flint, Alpine jade or copper in an unused state were deposited in wetlands. These items could be deposited alone or with items related to axe production: flint nodules, axe blanks and occasionally chisels. This depositional practice contrasts with the inclusion of small, heavily used flint axes in burials and megalithic tombs as grave goods (Van Gijn 2010, 131–34, 136; Visser 2021, 57; Wentink *et al.* 2011, 400–04). These practices were mutually exclusive: there are no large imported flint axes in megaliths, and there are no small used flint axes in wetland depositions.

Corded Ware selective deposition follows a different set of practices. Burials appear as the appropriate place to deposit objects, such as axes similar to those deposited in megalithic tombs. However, there is no distinction between local and imported objects: both appear together in funerary contexts, rather than in separate contexts as in the Funnel Beaker West case (Visser 2021, 58; Wentink *et al.* 2011, 405–06). Furthermore, in a few rare cases large imported axes are deposited in graves (Wentink 2020, 102–05), and not in wetlands as they would have been in a Funnel Beaker West context.

While Corded Ware and Funnel Beaker West groups clearly adhere to different depositional practices from a general point of view, there are exceptions which show these practices can occasionally spill over. Nine hoards of Corded Ware axes are known from landscape locations which are also the setting of Funnel Beaker West depositions. The axes involved differ from Funnel Beaker West axes commonly deposited in wetland contexts in that they are smaller, made of local flint, heavily used and sometimes accompanied by other flint tools such as scrapers or flint blades, but never by flint nodules or axe blanks (Visser 2021, 58; Wentink *et al.* 2011, 404–05). Corded Ware axes were also polished with soft material (e.g. hide/leather, water and sand), rather than on a sandstone slab as is typical for the Funnel Beaker West axes (Van Gijn 2010, 144). In addition to the location, there is also overlap in the treatment of the deposited items: both Funnel Beaker West and Corded Ware axe depositions involve treatment of the cutting edge with ochre prior to deposition (Wentink *et al.* 2011, 404). This treatment hints at a deeper understanding of what was supposed to be done with these axes prior to deposition, distinct knowledge on what was the *right* treatment (Fontijn 2019; Wentink *et al.* 2011).

Similar to the use of fire in funerary rites, Funnel Beaker West depositional practices appear to make a return during the Bell Beaker period. In particular, copper axes are deposited in wet contexts, a practice which reaches enormous heights during the Bronze Age (Fontijn 2002). A clear separation between specific objects in specific contexts appears to have been re-established, along a similar vein and logic as the Funnel Beaker West depositions (Fontijn 2019).

In sum, depositional practices exhibit a pattern similar to what we see in funerary rites. Funnel Beaker West and Corded Ware practices are, on the whole, different. However, there are a number of exceptional cases in which Corded Ware finds appear to adhere to Funnel Beaker West depositional practices in terms of location and treatment with ochre. Given that wetland depositions imply loss of items beyond retrieval, such precise adherence must imply intimate familiarity with Funnel Beaker depositional practices. Moreover, both Bell Beaker and later Bronze Age depositions show that Funnel Beaker West depositional practices persist into later periods, seemingly uninterrupted. This pattern is a direct analogy to the pattern in funerary practices (see above), and is best interpreted as an indicator of parallel existence of Late Funnel Beaker West and Corded Ware communities with only marginal interaction until Bell Beaker times.

Broader perspective: final remarks

In this paper, we argue for a long overlap between Funnel Beaker West and Corded Ware societies in the Netherlands and north-western Germany. Such a parallel existence best fits the radiocarbon evidence for this period, as well as the archaeological evidence for funerary and depositional practices. A re-examination of the available radiocarbon dates for Funnel Beaker West and Corded Ware contexts with Bayesian modelling indicates that both societies overlap for at least 175 years between c. 2900 and 2725 calBC. This overlap is further supported by archaeological cases in which Corded Ware and Funnel Beaker funerary and depositional practices are found to be contemporaneous, occur at the same locations or exhibit similar distinct practices.

Funerary and depositional practices in both societies are otherwise distinct in these crucial, symbolic realms of human action. However, this pattern of distinction is subject to various exceptions. There are Corded Ware axes deposited in accordance with Funnel Beaker depositional practices, Funnel Beaker cremation burials with Corded Ware material culture, and Corded Ware pottery deposited in megaliths in accordance with Funnel Beaker West traditions, to name but a few exceptions.

This recurring pattern of distinction and exemption, combined with a resurgence of Funnel Beaker West practices during Bell Beaker times, best fits a scenario in which Corded Ware and Funnel Beaker West groups exist in parallel, with interactions being an exception throughout the first half of the third millennium BC. Only with the advent of the Bell Beaker period do we see a clear mixture of Funnel Beaker West and Corded Ware practices, both in the sphere of funerary rites and in selective deposition.

It must be stressed that such a parallel existence of Funnel Beaker West and Corded Ware groups is by no means unusual in a broader, European context. R. Iversen (2016; 2020) demonstrates that Funnel Beaker North and Corded Ware communities in Denmark follow a similar trajectory of parallel coexistence. This coexistence would lead to an elaborate “creolisation process” in which there is a continuation of Funnel Beaker North practices with Corded Ware material culture. Similarly, various European regions yield indications of parallel coexistence between older Neolithic societies and Corded Ware groups as distinct entities. Examples are the Bernburg, Globular Amphora and Schönfeld groups in central Germany (Furholt 2003a; Müller 2001; Wetzel 1979), as well as Globular Amphora settings in Poland (Włodarczak 2009; 2017; see also Müller this volume; Szmyt this volume) and the Vlaardingen culture closer to home (Beckerman 2015).

The widespread occurrence of parallel societies in the third millennium BC can explain the increased admixture of Neolithic ancestry in Bell Beaker compared to Corded Ware individuals, as observed in recent aDNA studies (Papac *et al.* 2021). This resurgence implies the existence of groups with initially minimal interbreeding, who over time became increasingly mixed. The evidence for the existence of distinct Corded Ware and Funnel Beaker West practices in funerary and depositional domains with minimal cross-over would fit such a scenario.

At the same time, the present paper is a cautionary tale for overreliance on culture historical narratives in aDNA studies. A sample design which focuses on the classical exponents of traditional archaeological cultures is prone to underestimate variability. This is particularly problematic when a funerary practice which involves cremation burials obscures the total genomic variability for a given region and period.

The precise nature of the (lack of) interaction between Corded Ware and Funnel Beaker societies remains open to interpretation (see Iversen 2020; Needham 2005 for discussions on possible scenarios). Crucially, these interpretations should not assume this process to be homogeneous for any given area. As this paper shows, minor, local exceptions relating to the choices of groups of mourners, or the practitioners of depositions, are key to the interpretation of the transition as a whole. This emphasises the importance of practices for understanding events in the third millennium BC and beyond. Systematic, detailed studies of funerary and depositional practices enable archaeologists to move beyond culture historical frameworks and to directly address the pivotal questions of the palaeogenetic revolution (Booth 2019).

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Appendix 1. List of Funnel Beaker culture and Corded Ware culture ^{14}C dates and their archaeological context. FBC= Funnel Beaker culture; CW= Corded Ware culture.

Site	Lab code	Radiocarbon age	Sigma	Arch. culture	Association	Material	Source
Heek-Averbeck F25	GrN-11763	4980	60	FBC	From infill of grave with ceramics	Charcoal	Brindley 1986, 105; Lanting and Van der Plicht 2000, 65
Gittrup F440	GrN-12262	4920	70	FBC	From infill of grave with ceramics	Charcoal	Brindley 1986, 105; Lanting and Van der Plicht 2000, 66
Heek-Averbeck F34	GrN-11765	4890	80	FBC	From infill of grave with ceramics	Charcoal	Brindley 1986, 105; Lanting and Van der Plicht 2000, 66
Heek-Ammerter Mark F32	GrN-16492	4700	40	FBC	From grave with ceramics	Charcoal	Lanting and Van der Plicht 2000, 65
Heek-Ammerter Mark F1052	GrN-16494	4680	60	FBC	From grave with ceramics	Charcoal	Lanting and Van der Plicht 2000, 65
Schokland-P14	UtC-1921	4630	70	FBC	On decorated sherd	Charred residue	Lanting and Van der Plicht 2000, 67
Slootdorp-Kreukelhof	GrA-102	4570	30	FBC	From a TRB camp	Charred plants	Lanting and Van der Plicht 2000, 67
Heek-Ammerter Mark F1444/85	GrN-17308	4565	65	FBC	From central post in a house associated with ceramics	Charcoal	Lanting and Van der Plicht 2000, 65
Odoorn-D32 "vlakgraf"	GrN-2221	4550	80	FBC	From pit with ceramics, associated with megalith	Charcoal	Lanting and Van der Plicht 2000, 65
Schöppingen-Haidberg	GrN-16040	4550	60	FBC	From multiple cremation burial with ceramics	Cremation (human bone)	Lanting and Van der Plicht 2000, 65
Lavenstedt Ks FL. F	ERL 14449	4537	44	FBC	From occupation layer	Charcoal	Gerken 2012, 245 as quoted in Mennenga 2017, 311
Heek-Averbeck F4	GrN-9202	4520	35	FBC	From grave fill with a finds concentration incl. ceramics	Charcoal	Finke 1983 as quoted in Brindley 1986, 105; Lanting and Van der Plicht 2000, 65
Gittrup F707	GrN-12263	4490	60	FBC	From grave with ceramics	Charcoal	Brindley 1986, 105
Heek-Averbeck F38a	GrN-11766	4480	60	FBC	From infill of grave with ceramics	Charcoal	Finke 1983 as quoted in Brindley 1986, 105; Lanting and Van der Plicht 2000, 65
Emmeln 2	Poz-64311	4470	35	FBC	Find from megalith with ceramics from multiple phases	Charcoal	Menne 2018, 32–33
Dalen-Huidbergsveld	GrN-18785	4460	80	FBC	From coffin in a grave which contained ceramics	Charcoal	Kooi *et al*. 1989 as quoted in Lanting and Van der Plicht 2000, 66
Visbek Flachgrab 1	Poz 71757	4460	40	FBC	From stone packing grave, with ceramics and flint among stone packing	Animal bone	Mennenga 2017, 153, 312
Emmeln 2	Poz-64310	4440	30	FBC	Find from megalith with ceramics from multiple phases	Charcoal	Menne 2018, 32-3
Anlo-"Veekraal"	GrN-1855	4420	55	CW	From coffin with ceramics inside	Charcoal	Jager 1985 nr 26; Lanting and Van der Plicht 2000, 74; Waterbolk 1960

Site	Lab code	Radiocarbon age	Sigma	Arch. culture	Association	Material	Source
Angelslo settlement pit 5	GrN-4200	4415	65	FBC	From pit with ceramics	Charcoal	Bakker and Van der Waals 1973 as quoted in Brindley 1986, 105; Lanting and Van der Plicht 2000, 66
Anlo	GrN-1824C	4410	60	FBC	From pit with ceramics	Charcoal	Waterbolk 1960; Brindley 1986, 105; Lanting and Van der Plicht 2000, 66
Heek-Averbeck F27	GrN-11764	4400	60	FBC	From infill of grave with ceramics	Charcoal	Finke 1983 as quoted in Brindley 1986, 105; Lanting and Van der Plicht 2000, 65
Leer-Westerhammerich cremation 620	GrA-15642	4390	60	FBC	From burial with ceramics	Cremation (human bone)	Lanting and Van der Plicht 2000, 67
Uddelermeer	GrM-26730	4387	27	FBC	Cremation with ceramics	Cremation (human bone)	Kroon (unpublished)
Glimmer Es	GrN-6156	4380	40	FBC	Charcoal concentration, from possible wall structure of a pit; pit contains ceramics	Charcoal	Brindley 1986, 105; Lanting 1975 as quoted in Lanting and Van der Plicht 2000, 66
Angelslo settlement pit 5	GrN-4201	4380	75	FBC	From pit with ceramics	Charcoal	Bakker and Van der Waals 1973 as quoted in Brindley 1986, 105; Lanting and Van der Plicht 2000, 66
Hunte 1	KIA-23204	4348	30	FBC	From vessel	Charred residue	Grootes 2007, 541–43 as quoted in Hamburg *et al.* 2011, 281–83, footnotes 8–10
Hunte 1	KIA-23207	4331	29	FBC	From vessel	Charred residue	Grootes 2007, 541–43 as quoted in Hamburg *et al.* 2011, 281–83, footnotes 8–10
Emmeln 2	Poz-68248	4330	35	FBC	Find from megalith with ceramics from multiple phases	Human bone	Menne 2018, 32–33
Zandwerven	GrA-116	4320	60	CW	On sherd	Charred residue	Lanting and Van der Plicht 2000, 78
Angelslo settlement pit 7	GrN-5767	4315	60	FBC	From pit with ceramics	Charcoal	Bakker and Van der Waals 1973 as quoted in Brindley 1986, 105; Lanting and Van der Plicht 2000, 66
Noordbarge	GrA-15459	4290	60	FBC	From burial with ceramics	Cremation (human bone)	Lanting and Van der Plicht 2000, 67
Leer-Westerhammerich cremation 68	GrA-14973	4275	45	FBC	From unfurnished burial	Cremation (human bone)	Lanting and Van der Plicht 2000, 67
Leer-Westerhammerich cremation 581	GrA-14088	4270	40	FBC	From burial with ceramics	Cremation (human bone)	Lanting and Van der Plicht 2000, 67
Hattemerbroek, Bedrijventerrein Hattemerbroek-Zuid	GrA-41638	4260	35	FBC	From vessel	Charred residue	Hamburg *et al.* 2011, 120
Nottuln	GrN-12414	4240	60	FBC	From layer in upper fill of a Michelsberg ditch with FBC ceramics	Charcoal	Eckert 1986 as quoted in Brindley 1986, 105; Lanting and Van der Plicht 2000, 66
Dalfsen cremation grave 135	Poz-88702	4240	35	FBC	From burial	Cremation (human bone)	Bouma and Van der Velde 2022, 35
Leer-Westerhammerich	Hv-21411	4235	70	FBC	From burial with ceramics, associated with GrA-13706 and GrN-24682	Charcoal	Lanting and Van der Plicht 2000, 67
Leer-Westerhammerich cremation 580	GrA-14095	4235	40	FBC	From burial with axe	Cremation (human bone)	Lanting and Van der Plicht 2000, 67

Site	Lab code	Radiocarbon age	Sigma	Arch. culture	Association	Material	Source
Emmen-Angelslo flat grave 14	GrA-16021	4230	60	FBC	From burial with ceramics	Cremation (human bone)	Lanting and Van der Plicht 2000, 66
Hattemerbroek, Bedrijventerrein Hattemerbroek-Zuid	GrA-41639	4230	35	FBC	From vessel	Charred residue	Hamburg *et al*. 2011, 120
Emmen-Angelslo flat grave 3	GrA-13958	4220	50	FBC	From burial with ceramics	Cremation (human bone)	Lanting and Van der Plicht 2000, 66
Emmeln 2	Poz-68249	4220	35	FBC	Find from megalith with ceramics from multiple phases	Human bone	Menne 2018, 32–3
Noordbarge-Hoge Loo	GrN-6724	4210	40	CW	Lower infill of a burial with battle axe	Charcoal	Lanting and Van der Plicht 2000, 75
Leer-Westerhammerich cremation 578h	GrA-14093	4205	40	FBC	From burial with multiple cremations and ceramics, associated with GrA-14086	Cremation (human bone)	Lanting and Van der Plicht 2000, 67
Dalfsen cremation grave 135	Poz-88040	4205	35	FBC	From burial	Cremation (human bone)	Bouma and Van der Velde 2022, 35
Emmen-Angelslo flat grave 1	GrA-13705	4200	50	FBC	Cremation with sherds in infill	Cremation (human bone)	Lanting and Van der Plicht 2000, 66
Leer-Westerhammerich cremation 585	GrA-14089	4190	35	FBC	From burial with ceramics	Cremation (human bone)	Lanting and Van der Plicht 2000, 67
Leer-Westerhammerich cremation 602	GrA-12394	4180	70	FBC	From burial with ceramics	Cremation (human bone)	Lanting and Van der Plicht 2000, 67
Leer-Westerhammerich cremation 578b	GrA-14086	4170	40	FBC	From burial with multiple cremations and ceramics, associated with GrA-14093	Cremation (human bone)	Lanting and Van der Plicht 2000, 67
Leer-Westerhammerich cremation 600	GrA-14168	4170	40	FBC	From burial with ceramics	Cremation (human bone)	Lanting and Van der Plicht 2000, 67
Leer-Westerhammerich cremation 604	GrA-13706	4170	50	FBC	From burial with ceramics, associated with Hv-21411 and GrN-24682	Cremation (human bone)	Lanting and Van der Plicht 2000, 67
Ede-Hotel Bosbeek	GrN-6129	4165	55	CW	From infill of grave furnished with a CW beaker, a flint blade and a facetted battle axe. Charcoal concentration especially in western end along the side of the grave pit	Charcoal	Modderman 1954, 41–44 as quoted in Lanting and Van der Plicht 2000, 75
Vaassen Tumulus III	GrN-6369	4165	40	CW	Charcoal concentration from infill of ditch around a disturbed grave furnished with a battle axe and a flint blade, and probably a CW beaker and a greenstone axe	Charred twigs	Lanting and Van der Waals 1971 as quoted in Lanting and Van der Plicht 2000, 75

Site	Lab code	Radiocarbon age	Sigma	Arch. culture	Association	Material	Source
Annen-Holtkampen	GrN-11918	4165	30	CW	From infill of a grave furnished with a CW beaker. A ZZ beaker was found higher up in fill	Charcoal	Lanting and Van der Plicht 2000, 76
Emmen-Angelslo flat grave 4	GrA-13600	4160	50	FBC	From burial with ceramics	Cremation (human bone)	Lanting and Van der Plicht 2000, 66
Emmen-Angelslo	GrN-6644	4160	30	CW	From post in burial with ceramics	Charcoal	Drenth and Lanting 1991, 110 as quoted in Lanting and Van der Plicht 2000, 76
Leer-Westerhammerich	GrN-24682	4150	50	FBC	From burial with ceramics, associated with GrA-13706 and Hv-21411	Charcoal	Lanting and Van der Plicht 2000, 67
Angelslo flat grave 3	GrN-2370	4145	100	FBC	From cremation burial with ceramics	Charcoal	Bakker and Van der Waals 1973 as quoted in Brindley 1986, 105; Lanting and Van der Plicht 2000, 67
Eext - tumulus Visplas	GrN-6727	4145	30	CW	From post in feature surrounding burial with ceramics	Charcoal	Lanting and Van der Plicht 2000, 75
Leer-Westerhammerich cremation 602	GrA-14169	4140	40	FBC	From burial with ceramics	Cremation (human bone)	Lanting and Van der Plicht 2000, 67
Leer-Westerhammerich cremation 203	GrA-14090	4140	40	FBC	From unfurnished burial	Cremation (human bone)	Lanting and Van der Plicht 2000, 67
Maarn-De Halm	GrN-7802	4140	50	CW	Charcoal concentration from ditch of a "beehive grave" furnished with a CW beaker, a flint axe, a flint blade and a battle axe	Charcoal	Lanting and Van der Plicht 2000, 75
Emmen-Angelslo flat grave 5	GrA-13599	4130	50	FBC	From burial with ceramics	Cremation (human bone)	Lanting and Van der Plicht 2000, 67
Keinsmerbrug	GrA-48396	4130	60	CW	From occupation layer	Charred grain	Smit 2012, 21 as quoted in Fokkens *et al*. 2016, 87
Angelslo flat grave 14	GrN-5070	4100	30	FBC	From cremation burial with ceramics	Charred sticks	Bakker and Van der Waals 1973 in Brindley 1986, 105
Zeewijk-West	GrA-56014	4100	40	CW	From vessel	Charred residue	Smit 2014, 35 in Fokkens *et al*. 2016, 80
Hattemerbroek, Bedrijventerrein Hattemerbroek-Zuid graf 3	GrA-41646	4075	30	CW	From infill of grave of one or more individuals (one the basis of discolorations, no skeletal elements preserved), perhaps placed on bed of twigs, with two CW beakers, a flint axe, a pseudo-Grand Pressigny dagger, 6 flint flakes and a flint blade; in upper fill a sherd, 2 flint cores and a Bell Beaker	Charcoal	Hamburg *et al*. 2011, 125 as quoted in Fokkens *et al*. 2016, 146 tab. 7.7
Baarn-De Drie Eiken	GrA-14965	4065	45	CW	From burial with ceramics	Cremation (human bone)	Lanting and Van der Plicht 2000, 76

Site	Lab code	Radiocarbon age	Sigma	Arch. culture	Association	Material	Source
Aartswoud	GrN-12015	4055	40	CW	From ash layer in occupation layer	Charcoal	Lanting and Van der Plicht 2000, 78
Zeewijk-West	GrN-56013	4030	40	CW	On ceramic vessel	Charred residue	Smit 2014, 35 as quoted in Fokkens *et al*. 2016, 80
Keinsmerbrug	GrA-47383	4025	40	CW	From occupation layer	Charred grain	Smit 2012, 21 as quoted in Fokkens *et al*. 2016, 87
Eexterhalte	GrA-12384	4005	60	CW	From burial with flint	Human bone	Harsema 1977 as quoted in Lanting and Van der Plicht 2000, 76
Keinsmerbrug	GrA-47380	4000	40	CW	From occupation layer	Charred grain	Smit 2012, 21 as quoted in Fokkens *et al*. 2016, 87
Keinsmerbrug	GrA-47381	3995	40	CW	From occupation layer	Charred grain	Smit 2012, 21 as quoted in Fokkens *et al*. 2016, 87
Keinsmerbrug	GrA-47377	3970	40	CW	From occupation layer	Charred grain	Smit 2012, 21 as quoted in Fokkens *et al*. 2016, 87
Keinsmerbrug	GrA-47382	3965	40	CW	From occupation layer	Charred grain	Smit 2012, 21 as quoted in Fokkens *et al*. 2016, 87
Eext-Bergakkers	GrN-6349	3945	40	CW	From coffin with ceramics inside	Charcoal	Lanting and Van der Plicht 2000, 75
Eext-Galgwanderveen	GrN-6635	3940	40	CW	From charred wooden coffin in burial with ceramics	Charcoal	Jager 1985, nr 34 as quoted in Lanting and Van der Plicht 2000, 75
Eext-Galgwanderveen	GrN-6368	3935	35	CW	From charred furnishing of burial with ceramics	Charcoal	Jager 1985, nr 34 as quoted in Lanting and Van der Plicht 2000, 75
Zeewijk-West	GrN-15565	3925	40	CW	Fragment from occupation layer	Bone (species indet)	Lanting and Van der Plicht 2000, 79; Smit 2014, 35 as quoted in Fokkens *et al*. 2016, 80
Puttershoek-Sportlaan	GrA-12299	3920	60	CW	From ceramic vessel	Charred residue	Lanting and Van der Plicht 2000, 79
Zeewijk-Oost	GrN-18488	3910	50	CW	Outer ring of oak posts from house plan	Worked wood	Lanting and Van der Plicht 2000, 79; Smit 2014, 35 as quoted in Fokkens *et al*. 2016, 80

Same old, same old?

Fisher-hunter-gatherer graves, burials and mortuary practices in the late fourth and early third millennium BC northern and eastern Baltic Sea region

Marja Ahola

Abstract
From the later part of the fourth millennium BC, eastern Fennoscandia and the eastern Baltic were inhabited by pottery-using forager groups that relied strongly on freshwater foods. These peoples lived in large multi-room houses located by bodies of water, and occasionally buried their dead in ages-old cemeteries or in settlements that may still have been in use. In this paper, I explore the cosmology of these peoples by investigating graves and burials discovered from the region, and by comparing this detailed data to coeval forager mortuary practices east and west of the study area. I argue that the fisher-hunter-gatherer peoples of the European forest zone understood the world in a very similar way. Aside from following the same, ancient core mortuary practices, a shared cosmology seems to materialise in the way these peoples used, circulated and discarded specific objects, such as amber buttons, pottery vessels and axes, according to specific rules. These shared ritual practices likely acted as an important venue of interaction for the people dwelling, moving and migrating in this part of the world during the "age of destruction".

Keywords: fisher-hunter-gatherers, northern Fennoscandia, eastern Baltic, mortuary practices, ritual practices

Introduction
During the fourth millennium BC, the European forest zone from middle Russia to eastern Fennoscandia and from the Baltic states to northern Scandinavia was inhabited by pottery-using forager groups. In general, these peoples occupied village-like concentrations of semi-subterranean houses that were commonly located by water, indicating the importance of water transport and aquatic resources (Mökkönen 2009; 2011). This is supported further by archaeological finds of fishing equipment and by dietary isotopes from human remains, as well as lipids from pottery vessels (e.g. Cramp *et al.* 2013; Meadows *et al.* 2018; Simčenka *et al.* 2022; Tõrv and Eriksson 2023). Aside from the importance of aquatic resources and environments, this period is marked by the presence of long-distance gift-giving or trade networks in which foreign materials

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Figure 1. V-perforated amber buttons from Finland. Photo: M. Haverinen / Finnish Heritage Agency (CC BY 4.0).

Figure 2. Karelian type adzes made of lake Onega metatuff. Photo: M. Ahola.

— such as lake Onega slate or metatuff, Baltic amber, natural copper and good quality flint — travelled back and forth between northern Fennoscandia and the eastern Baltic, and even all the way to the Urals (Ahola *et al.* 2022; Carpelan 1999; Kriiska 2015; Nordqvist and Herva 2013). All in all, even if “Mesolithic” from the perspective of subsistence, these phenomena are indicative of a so-called “Neolithic way of thinking” — that is, becoming increasingly aware of the richness of the material world (Herva *et al.* 2014).

From the mid-fourth millennium BC onwards — during “the eve of destruction” — some gradual changes take place. For example, large multi-room house pits become more common (Mökkönen 2009; 2011) while dietary isotopes show a greater reliance on freshwater foods than in any other phase (Meadows *et al.* 2018; Piliciauskas *et al.* 2017; Simčenka *et al.* 2022; Tõrv and Eriksson 2023). These results are again backed by both archaeological finds of fish bones, stationary wooden fishing structures and different fishing equipment (e.g. Koivisto 2017; Schmölcke *et al.* 2016) as well as pottery vessel content analysis (Heron *et al.* 2015). At the same time, various asbestos- and organic-tempered wares (e.g. Gerasimov *et al.* 2019; Herva *et al.* 2014; Mökkönen and Nordqvist 2018), v-perforated amber buttons (Gimbutas 1985; Loze 1975; 1999) (Figure 1) and so-called Russian Karelian type axes and adzes (Figure 2), made of greenish metatuff originating from the western shores of lake Onega (Tarasov and Nordqvist 2021), appear in the archaeological record. Remarkably, these items and raw materials were not only produced *en masse* but exported over 1000 km from their production workshops or quarries, suggesting emerging complexity and low-level social inequality stemming from centralisation of resources (Bērziņš and Čakare 2022; Gerasimov *et al.* 2019; Loze 1999; Tarasov and Nordqvist 2021). Furthermore, as these artefacts and materials did not travel alone, it is reasonable to assume that a high degree of human mobility also existed.

In this paper, I explore the mid fourth/early third millennium BC long-distance network from the perspective of mortuary practices. Indeed, even though the human remains from this period and region have been commonly subjected to modern bioarchaeological analyses during the past decade or so (e.g. Jones *et al.* 2017; Mathieson *et al.* 2018; Meadows *et al.* 2018; Piličiauskas *et al.* 2017; Saag *et al.* 2017; Simčenka *et al.* 2022), less attention has been paid to the ways these peoples buried their dead (see however Macāne and Nordqvist 2019; Tõrv 2016; Zagorska 2001). However, aside from providing information about ritual practices and cosmology, graves and funerary practices are also a good source to explore a transmission of ideas in the context of movement and migration (Ahola 2020). This is because people tend to carry the cosmological beliefs and practices — anchors of collective identity and distinction — with them while moving. Accordingly, in a place and time marked by movement of people and artefacts, we should also be able to see the movement of ideas, beliefs and ritual practices. Consequently, in this paper I have compiled all published data from hunter-fisher-gatherer burials dating from the mid fourth to the mid third millennium BC from the northern and eastern Baltic Sea region. By comparing this data to both early fourth millennium BC mortuary traditions recorded from the region, and to coeval hunter-gatherer mortuary practices east and west of the area of interest, I argue that while these practices partly continue ages-old traditions, they also introduce new elements that mark this particular period in time.

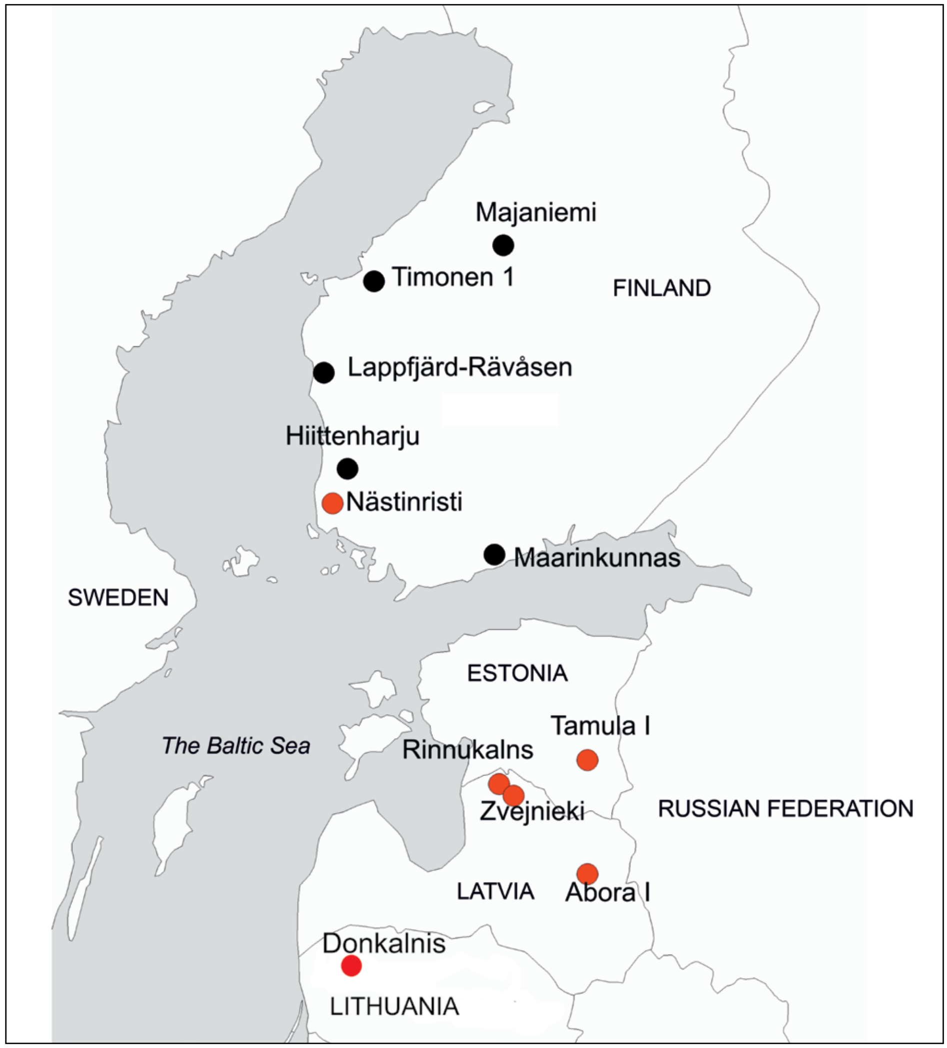

Figure 3. Locations of fisher-hunter-gatherer burial sites from the study region and period. Red: cemeteries; black: isolated burials. Map: M. Ahola. Background map: Natural Earth.

Looking back: early fourth millennium BC hunter-fisher-gatherer mortuary practices in north-eastern Europe

To understand the hunter-fisher-gatherer mortuary practices persisting from the mid fourth millennium BC onwards in the northern and eastern Baltic Sea region, we need to look back and see what happened in the realm of death traditions some 500 years before. The hunter-gatherer burial record of the early fourth millennium BC consists of isolated burials, settlement burials and cemeteries (Ahola 2019; Butrimas 2002; Macāne and Nordqvist 2019; Simčenka *et al.* 2022; Tõrv 2016). There are several smaller cemeteries known from Finland, Estonia, Latvia and Lithuania, but "the" burial ground of the period is Zvejnieki in northern Latvia (Meadows *et al.* 2018; Zagorskis 2004) (Figure 3). This cemetery was already in use during the Mesolithic, and continued through the fifth and fourth millennium BC. To date, over 300 hunter-fisher-gatherer inhumations have been excavated from this site.

In general, graves and burials from the first part of the fourth millennium BC continue the core mortuary practices recorded from the Mesolithic and even from the Palaeolithic: the deceased — individuals of both biological sexes and different age categories — were interred either individually or collectively (Ahola 2019; Tõrv 2016; Zagorska 2006; Zagorskis 2004, 75). The dead were carefully positioned in the grave, and although a variety of body positions are documented, extended supine position seems to dominate the material (Tõrv 2016; Zagorskis 2004). From time to time, plentiful ochre was used to dye the grave pit, a body container, or for example parts of the dead body (Ahola 2019, 45; Zagorska 2008). In the case of Zvejnieki, charcoal-rich soil from a nearby Mesolithic settlement site was also used to surround the dead bodies or to fill the grave from the seventh millennium BC onwards (Larsson *et al.* 2017; Zagorska *et al.* 2018, 110).

At the same time, some changes also occur. For example, compared to the Mesolithic hunter-gatherer burials, the buried individuals dating to the early fourth millennium BC were more commonly wrapped (Nilsson Stutz 2006), while animal tooth pendants were not as common as before (Zagorskis 2004, 75). Instead, the dead were given a regulated set of grave goods consisting mainly of amber pendants and flint artefacts along with a variety of tools and other items made of bone, antler and clay (Ahola 2017; Zagorska *et al*. 2018; Zagorskis 2004, 75). Remarkably, in the case of some burials, the face of the deceased has also been covered with ochre-stained clay, and amber rings or pendants placed over the eyes, suggesting the presence of a mask (Edgren 2006; Nilsson Stutz *et al*. 2013; Zagorska 2001, 112). Furthermore, at the Zvejnieki cemetery, collective burials become more common (Zagorska 2001), while black soil containing Mesolithic settlement debris was again used to fill or colour the graves (Larsson 2017; Zagorskis 2004, 75). As some graves were also dug through older ones, a connection to the past generations, or the sites themselves, was likely an important part of the burial custom (Ahola 2019, 64–65; Larsson 2017; Larsson *et al*. 2017; Nilsson Stutz *et al.* 2013).

Curiously, pottery is not very common in early fourth millennium BC hunter-fisher-gatherer burials. If present, it is often somehow anomalous: it is placed upside down, consists of rim sherds of one or several vessels, or vessel bases (Ahola 2017, 207–08). Quite often the discovered vessels are not intact either but represent partial vessels. For example, the only early fourth millennium BC vessel from the Zvejnieki cemetery was discovered crushed, with the sherds positioned over the chest regions of two different individuals (Zagorskis 2004, 37), while at the sites of Vaateranta and Säterigatan in Finland, rim sherds from one or several vessels were used to line the walls of the graves (Ahola 2017, 207). It thus seems that pottery was perhaps considered somehow special, and while it is commonly discovered in settlement sites, it was not a common grave gift. Remarkably, the same reasoning seems to apply to stone axes and adzes, which are even more rarely encountered in hunter-gatherer burials dating to early fourth millennium BC (Ahola 2017, 208). In other words, even though they were common grave finds elsewhere in Europe, they were not a part of the fisher-hunter-gatherer burial customs of the early fourth millennium BC.

Hunter-fisher-gatherer graves, burials and mortuary practices from the mid fourth to the mid third millennium BC in the northern and eastern Baltic Sea region

Now that we have set the scene, it is time to see whether the changes occurring in hunter-fisher-gatherer lifeways of the mid fourth millennium BC can be seen also in the burial realm. To do so, I have collected all available data of graves and burials dating roughly from 3500–3000/2500 BC from modern-day Finland, Estonia, Latvia and Lithuania (Table 1). The data were collected solely from written sources (i.e. publications and field reports) and no new excavations or analyses were conducted.

Burying the dead

According to my research, 40 graves from eleven sites dating roughly from the mid fourth to the mid third millennium BC have been excavated in the northern and eastern Baltic Sea region (Table 1; Figure 3). Although the data sample is small, some clear patterns seem to emerge from the material. For example, similarly to the preceding periods, these graves represent individual burials of both adults and children of both biological sexes. Although some multiple burials exist, most of the graves contain the remains of a single individual in extended supine position. However, other burial positions — such as flexed or prone position — also occur. As remains of wooden poles, platforms, ochre, charcoal-rich soil and pieces of bark are present in the inventory of some burials (e.g. Tamula 1, Zvejnieki and Nästinristi), it seems that — at least occasionally — the graves were constructed carefully, and the buried individuals wrapped, or covered with soft containers (for an excellent case study of such practice from Tamula 1, see Tõrv 2015).

Location-wise, most of the graves have been discovered in cemeteries located in, or next to, a settlement site, making this the most common burial practice. Interestingly, some of these sites (e.g. Tamula 1, Zvejnieki and Donkalnis) had been used as burial sites already hundreds — or even thousands — of years before (Butrimas 2002; Meadows *et al.* 2018; Simčenka *et al.* 2022; Tõrv 2016; Zagorskis 2004), suggesting that they were important, well-known places for the communities dwelling in the region. However, despite their long periods of use, burials did not occur at these sites frequently. For example, there are three inhumations from Tamula 1 (Figure 3) that date to the earlier part of the fourth millennium BC, six dating from the mid fourth to the turn between the third and fourth millennia BC and three dating to the early third millennium BC (Tõrv 2016, 186–87). Similarly, only three of the 40 AMS-dated (and corrected for dietary freshwater and marine reservoir effects) burials from the Zvejnieki cemetery have been dated to the second half of the fourth millennium BC (Meadows *et al.* 2018), while a couple more graves could be given a relative date within this period or after, either according to stratigraphy or burial finds (Zagorska 2006; Zagorskis 2004). It must be noted, however, that the AMS-dated burials represent only a fraction of the over 300 burials excavated from the site, and some of the undated burials lacking grave goods could also date to the latter half of the fourth millennium BC or younger.

In the case of the Abora I site, corrected AMS dates suggest a late third to early second millennium date

Site	Country	Burial no	Calibrated and reservoir effect corrected date (calBC; 2σ)	Calibrated date 2σ	Relative dating	Location	Buried individual(s) and inner structures	Material culture of death	Reference
Abora I	Latvia	3–4,6	c. 3080–2896 (burial 6)			Cemetery on a settlement site	Multiple burial of one male (burial 3) and two females (burials 4 and 6). Burial 3: extended supine position; burial 6: crouched position; burial 4: possibly sitting position	Burial 3: 1 flint knife, 1 slate arrowhead, 27 v-perforated amber buttons, 1 piece of amber, 1 animal tooth, 1 bone pendant. Burial 4: 2 animal tooth pendants, 1 bone pendant. Burial 6: 2 amber pendants, 1 animal tooth pendant	Legzdiņa and Zariņa 2023; Macāne and Nordqvist 2021
Abora I	Latvia	12–14	c. 2910–2782 (burial 12)			Cemetery on a settlement site	Poorly preserved multiple burial of three children, of which two likely in a crouched position.	*none*	Legzdiņa and Zariņa 2023; Macāne and Nordqvist 2021
Donkalnis	Lithuania	1	c. 3520–3140			Cemetery	Adult female in extended supine position, head to the north	Small amounts of ochre	Butrimas 2012; Simčenka *et al.* 2022
Donkalnis	Lithuania	7	c. 3520–3370			Cemetery	Older male in extended position	1 stone arrowhead, 1 bear mandible, 1 bear tooth	Butrimas 2012; Simčenka *et al.* 2022
Hiitten-harju	Finland				c. 3200–2400	Settlement site	Unknown (no preserved human bones)	Sherds of Pyheensilta Ware (in the fill), ochre	Ahola 2019
Lappfjärd-Råvåsen	Finland				c. 3500–3000	Settlement site	Unknown (no preserved human bones)	1 composite fish hook (?), 1 v-perforated amber button, small amounts of ochre	Ahola 2019
Maarin-kunnas	Finland				c. 3500–3000	Settlement site	Unknown (no preserved human bones)	1 v-perforated amber button	Ahola 2019
Majanie-mi	Finland				c. 3250–2500	Settlement site	Unknown (no preserved human bones)	Sherds of Pölja Ware (in the fill), ochre.	Ahola 2019
Nästinristi	Finland	I		c. 3524–2875		Cemetery on a settlement site	Unknown (no preserved human bones), ochre and small pieces of charred birch bark in the burial layer	Several stone discs in an arch-shaped formation in the pit fill; 1 pottery sherd, 1 quartz artefact, 1 quartz flake in burial layer next to a small ochre feature. Settlement residue (burnt osseus material and tiny pottery sherds) in burial fill; pit covered with a stone setting	Vikkula 1987
Nästinristi	Finland	II		c. 3972–3370		Cemetery on a settlement site	Unknown (no preserved human bones). Charred remains of a wooden inner structure at the base of the pit	1 stone disc and small amounts of ochre in pit fill; pit covered with a stone setting with a hearth at one end	Vikkula 1987

Table 1. Fisher-hunter-gatherer burials in the northern and eastern Baltic Sea region between 3500 and 2500 BC (continued on the following pages).

Site	Country	Burial no	Calibrated and reservoir effect corrected date (calBC; 2σ)	Calibrated date 2σ	Relative dating	Location	Buried individual(s) and inner structures	Material culture of death	Reference
Nästinristi	Finland	III			c. 3600–3300	Cemetery on a settlement site	Unknown (no preserved human bones)	Small amounts of ochre. Pit covered with a stone setting, two hearths located at opposite ends of the stone setting	Vikkula 1987
Nästinristi	Finland	V			c. 3600–3300	Cemetery on a settlement site	Unknown (no preserved human bones). Charred remains of a wooden inner structure at the base of the pit	*none*	Vikkula 1987
Nästinristi	Finland	VI			c. 3600–3300	Cemetery on a settlement site	Unknown (no preserved human bones)	*none*	Vikkula 1987
Nästinristi	Finland	VIII			c. 3600–3300	Cemetery on a settlement site	Unknown (no preserved human bones)	*none*	Vikkula 1987
Nästinristi	Finland	IX			c. 3600–3300	Cemetery on a settlement site	Unknown (sparse fragments of poorly preserved unburnt bones). Charred remains of a wooden inner structure at the base of the pit	1 broken pottery vessel (probably placed on top of 3 natural stones in the middle of the burial feature), 2 stone discs. Burial covered with a stone setting, pit fill contained settlement debris (e.g. stone discs and flakes, pottery sherds)	Vikkula 1987
Nästinristi	Finland	X			c. 3600–3300	Cemetery on a settlement site	Unknown (no preserved human bones). Charred remains of a wooden inner structure at the base of the pit	Small amount of yellowish ochre, 1 small stone adze, pottery sherds, 1 stone disc with unfinished perforation. Burial covered with a stone setting containing settlement debris (small pottery sherds, stone flakes and stone discs)	Vikkula 1987
Riņņu-kalns	Latvia	1852	c. 3550–3100			Shell midden	Adult male in supine position	*none*	Brinker *et al*. 2020; Lübke *et al*. 2016
Riņņu-kalns	Latvia	2039	c. 3450–2900			Shell midden	Juvenile of undetermined sex in supine position with slightly bent legs	Concentration of fish scales and bones underneath the right hand	Brinker *et al*. 2020; Lübke *et al*. 2016
Riņņu-kalns	Latvia	2017/1	c. 3450–3000			Shell midden	Adult male in supine position	Fish soup? (small fish bones around head)	Brinker *et al.* 2020
Riņņu-kalns	Latvia	2018/2		c. 3641–3383	c. 3400–2900	Shell midden	Infant in prone position	*none*	Brinker *et al.* 2020
Tamula I	Estonia	I	c. 3350–2630			Cemetery on a settlement site	Older female in flexed position, decayed organic support from the pelvis; grave likely re-opened	2 bone arrowheads, 1 pottery sherd by the head, unworked stones	Jaanits 1957; Kriiska *et al*. 2007; Tõrv 2016

Site	Country	Burial no	Calibrated and reservoir effect corrected date (calBC; 2σ)	Calibrated date 2σ	Relative dating	Location	Buried individual(s) and inner structures	Material culture of death	Reference
Tamula I	Estonia	III	c. 3630–2840			Cemetery on a settlement site	Adult male (?) in flexed position	Animal tooth pendants, fragments of spearheads, pottery sherds near the body, 1 unworked oval stone	Jaanits 1957; Tõrv 2016
Tamula I	Estonia	VI	c. 3030–2520			Cemetery on a settlement site	Adolescent in supine position	1 hammer stone, animal tooth pendants	Jaanits 1957; Tõrv 2016
Tamula I	Estonia	IX	c. 3510–3110			Cemetery on a settlement site	Adult male (?). Wooden branches in grave (possible soft container for the body)	1 small slate chisel and 2 two tubular beads under skull; several animal tooth pendants next to head and in pelvic region	Jaanits 1957; Tõrv 2016
Tamula I	Estonia	X	c. 3620–2750			Cemetery on a settlement site	Adult female (?). Wooden branches in grave (possible soft container for the body)	6 pieces of amber under skull, 1 amber pendant and 1 amber piece beneath spine, 1 bone pendant in the shape of a small bird, fragments of bone sculptures, several animal tooth pendants, bone arrowheads, fragmented bone shovel (?) with bird-head handle, 1 v-perforated amber button (in fill)	Jaanits 1957; Tõrv 2016
Tamula I	Estonia	XI	c. 3090–2910			Cemetery on a settlement site	Adult male (?) in supine position. Wooden branches in grave (possible soft container for the body)	1 stone chisel next to right arm, 1 v-perforated amber button between thighs, several animal tooth pendants and bone beads on body, 1 unworked stone, 1 unidentified bone artefact	Jaanits 1957; Tõrv 2016
Tamula I	Estonia	XVIII	c. 3350–2630			Cemetery on a settlement site	Older female in supine position	*none*	Jaanits 1957; Tõrv 2016
Tamula I	Estonia	XIX	c. 3630–2790			Cemetery on a settlement site	Adult male (?)	2 bird-shaped bone plates, some bird bone beads, some tooth pendants. Fragments of amber and 1 amber bead discovered some centimetres from the body	Jaanits 1957; Tõrv 2016
Tamula I	Estonia	XXI	c. 3750–2930			Cemetery on a settlement site	Adult male (?) in flexed position (“sleeping position”), likely wrapped. Wooden pole in grave	*none*	Jaanits 1957; Tõrv 2016
Tamula I	Estonia	XXII	c. 3010–2570			Cemetery on a settlement site	Older male (?) placed in a bark container. Additional structure behind the back	*none*	Tõrv 2016

Site	Country	Burial no	Calibrated and reservoir effect corrected date (calBC; 2σ)	Calibrated date 2σ	Relative dating	Location	Buried individual(s) and inner structures	Material culture of death	Reference
Tamula I	Estonia	XXIII	c. 3800–2970			Cemetery on a settlement site	Adult of undetermined sex	*none*	Tõrv 2016
Timonen 1	Finland				c. 3500–3000	settlement site	Unknown (no preserved human bones)	1 v-perforated amber button, small amounts of ochre	Ahola 2019
Zvejnieki	Latvia	198			c. 3650–3000 or after (on top of burial 201)	Cemetery	Completely destroyed burial of an older female	1 composite fish hook, 1 wild boar tusk, 1 fragmentary beaver incisor	Zagorskis 2004
Zvejnieki	Latvia	194			c. 3500–3000	Cemetery	Damaged burial of an infant	1 flint artefact at waist, 3 v-perforated amber buttons at right humerus, 16 amber beads at pelvis, charcoal-rich earth from nearby settlement	Zagorskis 2004
Zvejnieki	Latvia	195			c. 3500–3000	Cemetery	Adult male in extended supine position	1 v-perforated amber button in fill	Zagorskis 2004
Zvejnieki	Latvia	199	c. 3650–3000			Cemetery	Older female in extended prone position	7 sherds of a Piestina Ware vessel under head and left shoulder	Meadows *et al*. 2018; Zagorskis 2004
Zvejnieki	Latvia	269–269a			c.3500–3000	Cemetery	Adult male in supine position (269) and disarticulated bones of another adult individual (269a)	Rim sherd and body sherd of a single Piestina Ware vessel over lumbar vertebrae and left side of pelvis of individual 269; 1 body/basal sherd of Piestina Ware near individual 269a	Zagorskis 2004
Zvejnieki	Latvia	201	c. 3650–3000			Cemetery	Completely destroyed burial of a child underneath another burial	5 flint spear- and arrowheads, 5 flint scrapers and modified flakes, 2 bone awls, 1 roe deer antler with rounded tip, 2 fragmented amber pendants, 1 beaver incisor. Small amounts of ochre and black earth from nearby Mesolithic settlement in the pit fill	Meadows *et al*. 2018; Zagorskis 2004
Zvejnieki	Latvia	212			c. 3500–3000	Cemetery	Adult male in extended supine position	43 amber beads/v-perforated buttons around neck and on pelvis and femora	Zagorskis 2004
Zvejnieki	Latvia	228	c. 3800–3300			Cemetery	Older male in extended supine position	17 V-perforated amber buttons over chest, 2 bird figurines and 2 anthropomorphic figurines near head, 1 miniature bone arrowhead over chest, Mesolithic settlement material in pit fill	Meadows *et al*. 2018; Zagorskis 2004

for most of the dated inhumations (Legzdiņa and Zariņa 2023). Because many burials still lack radiocarbon determinations, some of the undated inhumations might also date to an earlier phase of use. The dating of the Nästinristi site in western Finland (Figure 3) is even vaguer, with only a couple of radiocarbon determinations from the 1970s, but it seems that this site was in use roughly from the middle to the late fourth millennium BC[1] (Vikkula 1987). Of the other sites, four inhumation burials dating to the second half of the fourth millennium BC are known from the Riņņukalns shell midden site in Latvia (Brinker *et al.* 2020), while the remaining sites consist of single burials on settlements in Finland (Ahola 2019, supplementary material 1).

In addition to inhumation burials, some isolated human bones dated to the period in question have also been collected from fisher-hunter-gatherer settlement sites (Piličiauskas *et al.* 2017; Tôrv 2016). Although the number of bones is low, most of these finds seem to represent skull fragments such as mandibles and frontal bones. For example, several skull fragments of adults and children have been unearthed from the large settlement complex of Šventoji in Lithuania (Piličiauskas *et al.* 2017, 1423) while a frontal bone and a mandible from an adult individual have been collected from the Kõljala site in Estonia (Tõrv 2016, tab. 20). A disarticulated human maxilla has also been discovered at the Riņņukalns shell midden (Brinker *et al.* 2020, 12). Interestingly, along with human skulls, several seal crania have also been unearthed from Šventoji (Osipowicz *et al.* 2020). According to use-wear analyses, these crania were attached to unspecified objects, or possibly to the body, and show evidence of well-developed use damage on the surfaces. Consequently, Osipowicz and colleagues (2020) suggest that these skulls were used during ritual practices, possibly in a similar way to that suggested for the antler frontlets known from several Mesolithic sites (see Little *et al.* 2016).

Remarkably, a somewhat similar practice has been noted among the hunter-fisher-sealer peoples associated with the Pitted Ware culture (henceforth PWC; c. 3200–2300 BC), who inhabited the western and southern coastal areas and islands of the Baltic Sea (Lindström 2020; Ståra 2001). According to T. Lindström (2020), the groups associated with the PWC also clearly treated skulls of humans and animals differently from other skeletal elements. For example, PWC inhumation graves might lack crania or entire skulls, while numerous cranial and mandibular fragments were scattered in cultural layers or deposited in hearths and pits. At the same time, animal skulls were also treated following special practices. For example, at the site of Jettböle in the Åland Islands (Finland), skulls of harp seals and porpoises were placed with a complete pottery vessel and covered with stones (Storå 2001, 38–39). As this deposit showed no evidence of later disturbances, it seems to represent a votive deposit or some other ritual activity. All in all, it seems reasonable to assume that the crania of humans and non-human agents alike were considered somehow special around the Baltic Sea region during this period. In fact, as inhumation burials in the northern and eastern Baltic Sea region are scarce, it could be possible that an underground burial was not the normative way to treat the dead. On the contrary, other mortuary practices — perhaps representing the way hunted animals were butchered, skinned and deposited — also existed (e.g. Nilsson Stutz 2014, 721–23).

Dressing the dead

Turning next to material culture, and specifically to the grave finds, it is evident that gradual changes occur from c. 3500 BC onwards. When exploring the occurrence of specific artefact types and materials per burial, personal ornamentation — especially v-perforated amber buttons — is the most common grave find (Figure 4). Curiously, the number of amber buttons varies between burials, with some containing only one single button while others have been furnished with a dozen or more. For example, 15 buttons along with other artefacts were positioned with an older male buried in Zvejnieki grave 228 (Zagorskis 2004, 38) while 27 v-perforated amber buttons of different shapes were buried with an adult male at Abora I (Macāne and Nordqvist 2019, supplementary material). Comparing the early fourth millennium BC burials, the amount of stone and antler tools seems to be lower than before. Instead of tools, the occasional antler and bone artefacts represent anthropomorphic or zoomorphic figurines or pendants, most often depicting birds (Tõrv *et al.* 2017). It must also be considered that the preservation of unburnt organic materials is poor in Finnish Stone Age contexts (see Ahola 2019), and in reality, the amount of e.g. animal tooth pendants could have been higher. Stone discs are encountered only in the Nästinristi graves and can thus be interpreted as a local phenomenon.

Remarkably, the material culture of death encountered in the northern and eastern Baltic Sea region has close parallels in the east, among the hunter-fisher-gatherer groups associated with the middle-Russian Volosovo culture (c. 3500–2700 BC). Indeed, v-perforated amber buttons, animal tooth pendants and

1 The radiocarbon determinations obtained from Nästinristi grave II (Table 1) suggest a slightly earlier date for the cemetery. However, as the dated material was wood charcoal from the grave structure, the older date could also be indicative of an old wood effect. Relative dating according to pottery typology suggests that the cemetery was used c. 3600–3300 calBC (Vikkula 1987).

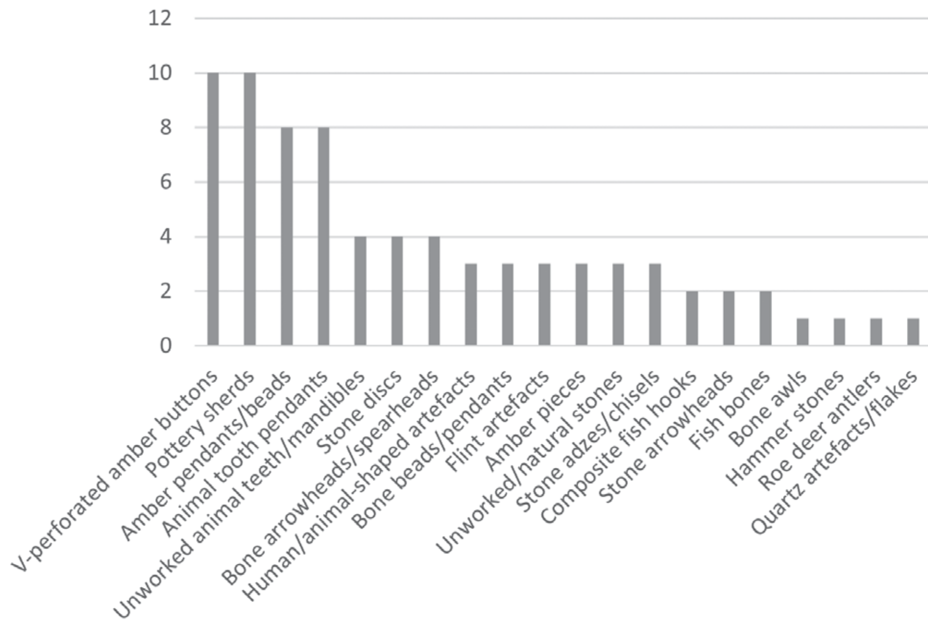

Figure 4. Number of artefact types per burial. Graph: M. Ahola.

occasional zoomorphic antler or bone figurines (mostly birds) are also known from Volosovo graves[2] (Kashina and Kaverzneva 2021; Kostyleva and Utkin 2010; Macāne *et al.* 2019; Utkin 1993; Zagorska 2001). As further examples of similar artefacts can also be found from north-western Russia, e.g. from the cemeteries of Kontchanskoe, Repishch and Ilovets 1, the tradition of using these specific items and materials in burial rituals covered not only the Baltic Sea region, but large parts of the European forest zone (Utkin 1993, 57).[3] Within this tradition, v-perforated amber buttons and other personal ornamentation clearly played a significant role.

Personal ornamentation aside, the use of pottery sherds occurs in these burials. Although accidental inclusion from e.g. the infilling of the grave cannot be completely ruled out, the vessel sherds discovered from graves dating to the period 3500–3000/2500 BC seem to be connected with specific body parts, such as the head or the pelvis (Table 1). For example, in Zvejnieki burial 199 the sherds were discovered under the head and left shoulder of the deceased (Zagorskis 2004, 36) while in Zvejnieki burial 269 two sherds were located in the pelvic region of the intact burial and a single body/basal sherd was associated with the disarticulated body parts buried in this grave (Zagorskis 2004, 45). Likewise, the single pottery sherd discovered in the Tamula burial I was located near the head of the deceased (Kriiska *et al.* 2007, fig. 5). In some cases, large amounts of sherds have also been discovered in the fills of the burials (Table 1: Hiittenharju, Majaniemi).

Interestingly, this tradition again has clear parallels with PWC ritual practices. Indeed, just as in the northern and eastern Baltic Sea region hunter-fisher-gatherer graves, pottery is only rarely deposited in PWC graves (Larsson 2009). Although some burials do include miniature vessels, these items are not placed at the base of the grave, but in the fill, which often also includes pottery sherds. However, the rare pottery finds from the burial level consist of vessel bases placed upside down, and of single sherds that have most commonly been placed next to the body of the deceased (Larsson 2009, 347). For example, at the site of Köpingsvik on Öland Island (Sweden) a single perforated sherd was placed near the pelvis of the deceased (Papmehl-Dufay 2006, 102). Similarly, pottery sherds were discovered together with skull and teeth fragments in a poorly preserved inhumation burial excavated at Korsnäs (eastern central Sweden) in 2009 (von Hackwitz 2009, 52–53). In fact, as miniature vessels have occasionally been placed even in Volosovo graves (Khramstova pers. comm.),[4] there seems to be a pattern in how pottery was used — and not used — within the burial traditions of the hunter-fisher-gatherer peoples of the late fourth and early third millennium BC European forest zone.

2 It must be noted, however, that bird figurines are more common in Volosovo settlement contexts, where they are predominantly discovered inside houses (Kashina and Kaverzneva 2021, 687).

3 The archaeologists of the Petrozavodsk State University (Russia) discovered yet another hunter-gatherer burial with v-perforated amber buttons during the summer of 2021 on the western shores of lake Onega, north-western Russia (Zhulnikov 2022).

4 Email between Anastasia Khramtsova and Marja Ahola, 9th September 2022.

Conclusions

When exploring "the eve of destruction" from the perspective of the fisher-hunter-gatherer societies of the northern and eastern Baltic Sea region, it seems evident that during the period spanning from 3500 to 3000/2500 BC all destruction is still far ahead. Indeed, even though the presence of specialised production workshops and long-distance gift-giving or trade networks testify to centralisation of resources, and consequently emerging social inequality (Tarasov and Nordqvist 2021), the burial record does not show evidence of, for example, increased violence. Moreover, even if the number of burials is low, it does not seem that this is indicative of population decline. On the contrary, when the graves, burials, and burial customs of fisher-hunter-gatherers from the northern and eastern Baltic Sea region are compared to those of contemporary societies to the east and west, it seems that a multiplicity of mortuary practices co-existed, and an inhumation burial was only one way to dispose of a dead body. In other words, it seems that these peoples continued to utilise the rich aquatic resources and trade and gift-giving networks existing in the region, while burial rituals mainly occurred in special places that had been in use for hundreds, or even thousands, of years. According to a recent paper by D. Legzdiņa and G. Zariņa (2023), these mortuary practices continued even into the second millennium BC.

Compared to the earlier part of the fourth millennium BC in this region, changes can, however, be seen for example in the artefact types circulating within fisher-hunter-gatherer groups. Interestingly, the v-perforated amber buttons, a novelty of the mid fourth millennium BC, are clearly present both in the long-distance trade or gift-giving networks and in the burial record, while Karelian type metatuff axes and adzes and asbestos are not encountered in graves. Accordingly, the amber items were likely not only valued goods but could also have played a significant role in the cosmological beliefs relating to death and burial. It must be noted, however, that amber pendants, rings and beads were already commonly used in early fourth millennium BC fisher-hunter-gatherer burials in the region (Ahola 2017; Zagorska 2001). Accordingly, even if the artefacts took the novel form of a v-perforated button, the tradition of using amber in burial rituals seems to continue ages-old traditions. Interestingly, the same seems to apply to the use of axes and adzes as burial gifts. Indeed, as only one burial (Nästinristi grave X) was accompanied by a stone adze, while a stone chisel was discovered from another (Tamula I grave IX), these artefacts were still not considered as suitable grave goods. This being said, it must be noted that the meaning behind these practices could nonetheless have changed over time.

When the fisher-hunter-gatherer burials of the northern and eastern Baltic Sea region are investigated in the wider context of Volosovo and PWC grave customs, it seems evident that very similar mortuary practices existed among the peoples of the European forest zone. Indeed, while the PWC culture burials and other deposits suggest common ground in cosmological beliefs regarding particular body parts, the Volosovo burials and northern and eastern Baltic burials seem to share the tradition of adorning the dead with amber. At the same time, the ways pottery and pottery sherds were used as part of the burial were apparently present among all these fisher-hunter-gatherer peoples. In this light, it seems reasonable to assume that the fisher-hunter-gatherer peoples of the European forest zone, whether dwelling in the western coastal area of Scandinavia, the big islands of the Baltic Sea, northern Fennoscandia, the eastern Baltic or further east in central Russia, understood the world in a very similar way. Indeed, all these peoples seem to mark certain places within the landscape with burials, while having a close relationship with animals such as birds, porpoises and seals. At the same time, inanimate objects, such as amber buttons, pottery vessels and axes, were used, circulated and discarded according to specific rules. In other words, despite the evidence of human movement and migration, we are likely not seeing movement of new ideas, beliefs and ritual practices, but rather glimpses of ages-old funerary practices that now materialise in the preferred artefact types and raw materials of the period. As these practices were largely shared by the forager communities of the European forest zone, it is reasonable to assume that they also acted as an important venue of negotiation and discourse for the fisher-hunter-gatherer peoples dwelling, moving, and migrating within this world. In fact, it is only with the arrival of the groups connected with the Corded Ware complex that we see a clear arrival of new beliefs and ritual practices (Ahola 2020). However, even then, the material remains of ritual practices in this region show evidence of religious syncretism to which both traditions contributed. Accordingly, it seems that the realm of ritual and belief acted as a crucial venue of interaction even between the locals and the newcomers.

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THE EVE OF DESTRUCTION?

This volume collects papers on the pre-Corded Ware horizon in central Europe and adjacent areas (i.e. from c. 3500 – 2800 BC). This phase is very patchily researched, partly also because certain kinds of evidence, notably domestic architecture and burials, are rare or absent in many regions. This has occasionally been interpreted as signs of a major crisis and population bottleneck, which in turn facilitated the migration of new populations from the steppe, bringing with them amongst others new economic regimes, ideologies and settlement patterns.

Research over the last few years has shown that this scenario needs to be nuanced. Although evidence remains scattered, a picture of regional diversity is emerging, with probably mobile but well-connected Late Neolithic societies undergoing social changes of their own, and instituting several key innovations long before the appearance of the Corded Ware. This volume offers a selection of such case studies, comprising amongst others an overview over the steppe background of new mortuary practices, contributions on settlement and changing networks in Switzerland, Poland and several regions of Germany, as well as discussions on the spread of pottery innovations and lithic material, the possible effect of droughts on Late Neolithic societies, new patterns of monumentality and figurative expression, the social role of battle axes, networks of influences visible in burial rites, and the possibility for "parallel societies" with different modes of life. An introductory chapter draws out central themes.

Together, these contributions show that the transition to the Corded Ware culture was a diverse and multi-facetted process, with many continuities across the transition.

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